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Note to the readers

The author and the International Potash Institute would greatly appreciate to get copies or references of publications not mentioned in this review as this would contribute to improve our information concerning the relationship between potassium and plant health. We thank in advance the readers for their collaboration.

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1. Summary and conclusions

Many of those who took part in the 12th Colloquium of the IPI, *"Fertiliser Use and Plant Health"*, held in Izmir/Turkey (1976) felt that there was a need for a really complete survey of the literature dealing with the effects of potassium on plant health. Fully realising the difficulties involved, IPI agreed to undertake this task and the results are presented here.

The beneficial effects of potassium on plant health had already been recognised by the end of the last century and the topic has received increasing attention in recent years. We found in the literature a total of 2449 indications concerning the relationship between potassium and plant health. These indications concern more than 400 diseases and pests. The desire to make the survey as complete as possible inevitably led to difficulty in evaluation since the data are extremely heterogenous. Experiments were not always laid down with the prime aim of investigating the relationship between fertilisation and plant health. Even when trials were directly related to the subject, trial techniques and conditions varied greatly and sometimes they were not clearly described in detail with regard to trial type (field, pot, nutrient solution, etc.), rates and type of fertiliser applied, soil K status, assessment and interpretation methods. Such variation explains why results are often contradictory and not comparable.

Potassium may affect the reaction of a plant to pest or disease by:

1. Direct effects on the pathogen numbers, development, multiplication, survival, vigour, length of life cycle.

2. Direct effects on attack severity on host: by effects on the internal metabolism of the plant affecting food supply for the pathogen; by modifying the microclimate through changes in habit, density of growth, etc.

3. Effects on establishment of the pathogen and spreading within the plant - through effects on plant structures (e.g. cell wall and cuticle thickness, tissues firmness) - through the functioning of the stomata.

4. Affecting the plant's ability to recover from pest or disease attack through the repair of damage or, more simply and most frequently, by a general

improvement in growth and yield which is, after all, the farmer's overriding concern. Clearly and apparently adverse effect of a nutrient in increasing pathogen number and vigour is of no practical consequence if such an effect is accompanied by a marked increase in crop yield.
The heterogenous nature of the available data and the complexity and variety of the ways in which potassium might be expected to modify the effects of disease make it difficult to draw general conclusions. Nevertheless, we have attempted to do so.

1.1. Main conclusions

a) Generally, potassium tends to improve plant health. The bibliographical data relating to all pests and diseases indicate a beneficial effect in 65% and a deleterious effect (increased diseases or pests) in 28% of cases (Table 1). Fungal and bacterial diseases were decreased in 7 cases out of ten, insects and mites in 6 cases out of ten, while nematodes and viruses were somewhat more often increased than decreased. Fungal diseases (63% of data) were more frequently investigated followed by insects and mites (19%).

Table 1. Effect of potassium on incidence of diseases and pests

Parasite group	Number - () % of indications			
	Total	Incidence decreased	Incidence unchanged	Incidence increased
Fungal diseases	1549	1080 (70)	112 (7)	357 (23)
Insects + mites	459	290 (63)	39 (9)	130 (28)
Nematodes	111	37 (33)	4 (4)	70 (63)
Viruses	186	76 (41)	14 (7)	96 (52)
Bacteria	144	99 (69)	14 (10)	31 (21)
Total	2449	1582 (65)	183 (7)	684 (28)

b) The potassium effect appears to be related to soil K status. In field trials on low K soils, potassium had a beneficial effect in 87% of cases; in trials on other soils of unspecified K status (most cases) or sufficient or high in K (a few cases), K had a beneficial effect in 66% of cases (Table 2).Similarly the average reduction in severity of fungal disease was four times greater on low K soils. This would be explained if the unspecified soils included a large proportion of satisfactory or high K soils, as may appear likely, on which K would be expected to have less effect.

Table 2. Potassium effect on soils low in K in field trials

K-status of the soil	% indications of a reduction - () No. data	Average reduction of fungal diseases in % - () No. data
Low	87 (173)	57 (74)
Unspecified, sufficient or high	66 (1090)	13 (498)

c) *Magnitude of the effect.* As shown in Figure 1, reductions in parasite development or damage ranging between 10-50% were observed in more than one third of cases and between 50-90% in 1 case out of 6. In 1 case out of ten, potassium increased parasite development or damage by less than 10%.

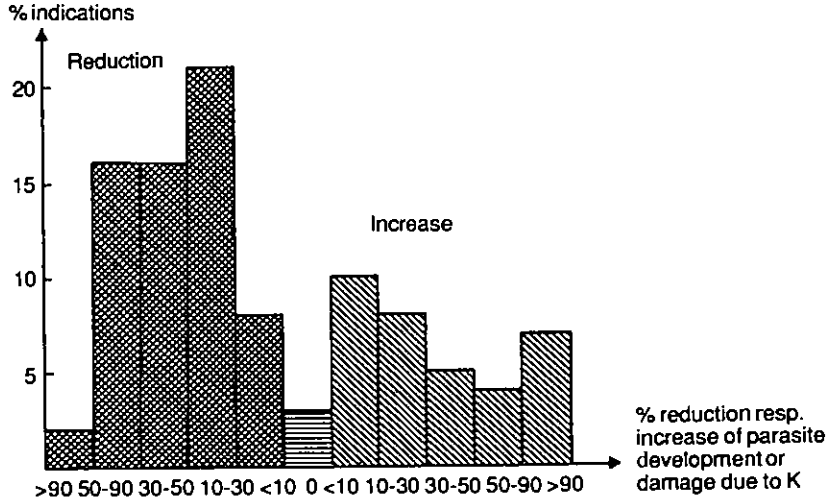

Fig. 1. Magnitude of the potassium effect

d) Effect of potassium carrier. KCl had a beneficial effect in 66% of the cases and K_2SO_4 (which was less frequently investigated) in 51% of the cases.

e) Effect of trial type. The beneficial effect of potassium was more frequently observed in field trials than in laboratory, pot and nutrient solution trials (Table 3).

Table 3. Trial type and potassium effect

Trial type	% of cases showing beneficial K-effect
Field trials	68 %
Laboratory, pot, nutrient solution solution trials etc.	58 %

f) The effect of potassium on the yield or growth of infected plants. In 439 cases where the effect of potassium on yield or growth was measured the magnitude varied according to the parasite group (Table 4). The greater part of the data relate to fungal diseases, where the increase was 42%. The large growth increases reported for viruses and nematodes are interesting since these pathogens were more often increased by potassium. This shows that adequate potassium nutrition helps plants to tolerate pathogen attacks better or better to recover from them.

Table 4. Potassium and average yield or growth increase of infested plants

Parasite group	Average increase in % - No. data	
	Yield	Growth
Fungal diseases	42 (320)	31 (43)
Insects + mites	36 (8)	18 (6)
Nematodes	19 (6)	85 (17)
Viruses	78 (2)	49 (28)
Bacteria	57 (6)	45 (3)

g) Mode of action of potassium. Potassium affects metabolism and in K deficiency, soluble compounds of low molecular weight accumulate, especially soluble N compounds and sugars because of increased activity of decomposing enzymes and reduced phosphorylation. This is frequently accompanied by better parasite development probably because such compounds constitute a particularly suitable diet for them. Adequate potassium nutrition increases the content of phenols which can also play a beneficial role in plant resistance. There is a lack of precise data on the host-parasite relationship. Potassium affects plant morphology, hardening the tissues with resulting improvement in resistance to disease penetration and insect feeding. Stomata are open for longer than necessary in potassium deficiency increasing the chances of disease penetration.

h) Nitrogen-potassium balance. All nutrients affect plant health but nitrogen and potassium are particularly important. Most authors agree that high nitrogen tends to decrease resistance and that high potassium has the opposite effect. The balance between these two nutrients is more important than their absolute rate of application since relative N excess or relative K deficiency tend to have much the same effect in reducing resistance. *Fuchs and Grossmann [1972]* who have published a very complete review on the effect of nutrition on resistance of cultivated plants wrote: "Besides N, K has the strongest influence on resistance and this almost always in the opposite direction so that the ability to resist, particularly fungal and bacterial diseases, depends upon the N:K ratio. Generally speaking, K has a predominating influence on resistance".

When the NxK interaction was investigated in the papers reviewed for the present publication, this interaction was almost always positive which means that potassium increases crop resistance more when plants receive increasing nitrogen rates than when they are given no nitrogen. In other words increasing N rates decrease crop resistance less when K fertilization is adequate. Thus, potassium reduces the detrimental effects of nitrogen on plant health.

1.2. Practical considerations

The use of fertilizers is one of a number of factors including climate, plant protection, varietal susceptibility, cultural techniques and soil conditions which may affect plant health.

Balance, particularly between nitrogen and potassium, meaning that relative excess or deficiency of either should be avoided, is of great importance so that the *level of K fertilizer should be adjusted to the level of nitrogen used.* Thus, adequate K fertilization can be considered a kind of insurance against the risk of disease, especially on soils which are not sufficiently provided with potassium. More, and more systematic, investigations are needed to improve our understanding of the relationships between fertilizer use and plant health. It is suggested that the following points should be observed in planning such investigations:

- potassium rates should be clearly defined and should include a control treatment without K or deficiency, sufficiency and a higher rate
- the intensity of attacks should always be measured (quantified)
- soil K status should be indicated
- rates of other nutrients (particularly N) should be clearly stated in quantitative terms
- the effect of K on yield or growth should always be measured
- it would be interesting to examine the differential effects of potassium on yield or growth of diseased and healthy plants
- the effect of potassium on plant metabolism and plant morphology (as they affect resistance and tolerance)

The realisation of such a programme requires the close collaboration of agronomists, plant pathologists, physiologists and biochemists.

2. Introduction

2.1. History

Potassium has been regarded as a major plant nutrient that plays a very important role in determining plant health for almost as long as fertilizers have been used. Its beneficial effects had already been recognised by the end of the last century. *Remy [1898]* in *Lowig [1935]* mentioned that barley was markedly more resistant to disease when well supplied with potassium. *Hecke [1898]* in *Fuchs and Grossmann [1972]* observed that potassium increased resistance of potato to *Phytophthora* and *Laurent [1899]* in *Hopfengart [1953]* found that potassium fertilizers made grapes more resistant to mildew. With the passage of time, the topic has invited more and more attention, especially so since about 1950 as indicated in Figure 2. Surprisingly, the rate of publication on this topic seems to have slowed down after 1980.

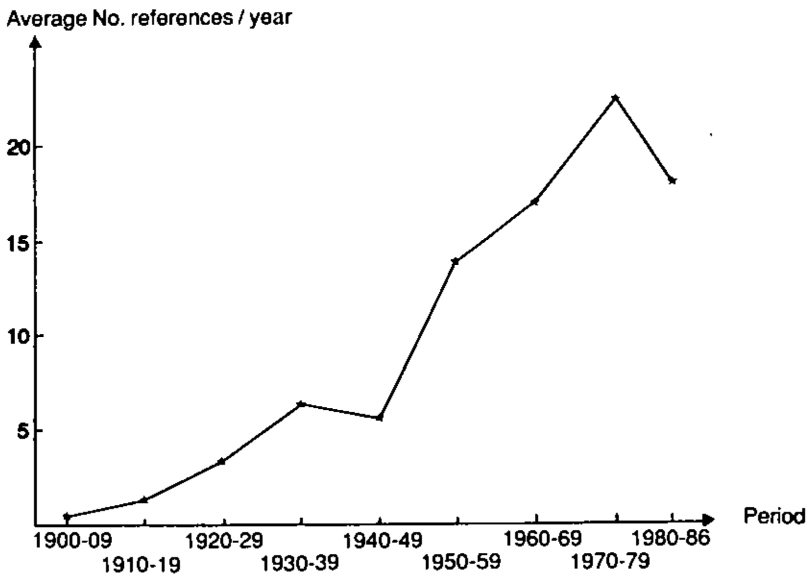

Fig. 2. Average number references/year over time

2.2. Reasons for IPI's survey

Recognising the great current interest in problems of the interaction between fertilizers and plant health, the *Scientific Board* of the *International Potash Institute (I.P.I.)* decided that the 12th Colloquium of the Institute should be devoted to this subject. The meeting was held in Turkey in 1976 under the title *"Fertilizer Use and Plant Health"*. It emerged in discussion that many delegates felt that there was a need for a complete survey of the many references to the effects of potassium on plant health wich are scattered in the literature and IPI undertook the task of producing such a review in regard to potassium. The results of this study of over 800 publications or references to papers are presented here (second revised and completed edition).

2.3. Earlier reviews

Several authors have already reviewed the subject *"Fertilizer Use and Plant Health"*. All are in general agreement that potassium usually increases the crop's resistance to diseases and pests, while the contrary is the case for nitrogen. The following quotations illustrate this general point.

- *Fuchs and Grossmann [1972]* who have published by far the most complete review wrote: "Beside N, K has the strongest influence on resistance and this almost always in the oposite direction so that the ability to resist, particularly fungal and bacterial diseases, depends upon the N:K ratio. Generally speaking, K has a predominating influence on resistance".

- *Mc New [1953]* wrote: "More plant diseases have been retarded by use of potash fertilizers than any other substance".
  He recommends that "Conspicuous soil deficiencies, particularly in potash, should be avoided. Every effort should be made to avoid surpluses of nitrogen that are not needed for steady and strong growth of the plant".

- *Krauss [1969]* wrote: "Potassium fertilization has an inhibitory effect on diseases, which significantly increases as potassium rates increase in comparison to nitrogen rates".

- *Trolldenier [1969]* concludes: "In general, K deficiency and N excess decrease resistance to diseases, whereas K excess and N deficiency increase it".

- *Leath and Ratcliffe [1974]* wrote: "There are more data to support than to refute the statement that high N increases and that high K reduces disease".

- *Chaboussou [1976]* concluded: "On the whole, one can say that nitrogen, or rather nitrogen excess, increases crop susceptibility to fungal diseases. Most authors agree that contrary to nitrogen, potassium provides the plants with a better resistance to diseases".

- *Huber and Arny [1985]* who made a very detailed review on the effect of potassium on plant diseases stated: "K is an important management tool in our arsenal against diseases" and "The nutritional balance is frequently as important as the level of a single nutrient".

2.4. Difficulties encountered in the literature review

In aiming to collect and summarize a maximum of data we have made our task more difficult than would have been the case had we been selective, but we felt that it was necessary to accept these difficulties and the limitations which they impose in order that the survey should be complete. Data available in the international literature are heterogenous in a number of respects:

- An important number of observations were made in trials which were not designed to investigate the effects of fertilizers on plant health. Such a data may merely amount to a remark that K appeared to stimulate or depress disease or pest attack without numerical data or detailed description of conditions.

- In trials actually designed to study effects on plant health, experimental technique varied greatly as did conditions. This is especially true as to:

  - type of experiment (field, pot, nutrient solution, etc.)
  - rates of fertilizer applied
  - type of fertilizer used
  - soil K status
  - variety used (susceptible, resistant)
  - methods of assessment and interpretation

- Sometimes the trial techniques and conditions are not defined in detail.

  For example, several authors fail to indicate the rates of potassium used or may describe them only as "high", "medium" or "low" without actually stating the levels. Similarly there is frequently little or no information on the K status of the soil. The assessment techniques used for diseases and pests may not be described.

- Over 400 diseases and pests have been investigated but there are usually only few data for each individual disease or pest. Thus, more than 250 fungal diseases are mentioned but sufficient data upon which to base general conclusions are available for only seven.

  In spite of these difficulties we have tried to summarize the data from more than 800 publications in such a way that clear conclusions may be drawn.

2.5. Observations on the concept of the study

We have tried to use as a standard in our summaries the effect on plant health of an optimum rate of potassium compared with nil or low rates. Thus, in a nutrient solution trial, for example, the potassium effect would be derived from comparison of parasite development in the basal solution with that in the solution deficient in potassium. In a few cases, the potassium effect compares plant performance on low K and adequate K soils.

All the results available are detailed in Appendix Tables 187 - 192 and the following notes explain the procedure adopted:

- The potassium effect has been described by the signs + (positive) 0 or - (negative) according as to whether parasite development or damage was respectively decreased, unchanged or increased.
- Evaluation of results is rendered difficult because standards of statistical significance adopted by the several authors vary and because many give no indication of significance. We have alloted to all apparent potassium effects the appropriate sign (+, 0 or -) even though such effects may be very small or of doubtful significance. This procedure has the virtue of simplicity but suffers from evident limitations.
- When results were quantified, we have indicated the effect as % decrease or increase in intensity.
- Trial type and type of potassium fertilizer used have been mentioned whenever they were indicated by authors.

- Other information on trial conditions and techniques is indicated under remarks.

- When in a given trial several different aspects of parasite development or damage were examined, (*e.g.* no. dead plants, no. disease spots, disease intensity, no. conidia, etc.), they have all been evaluated.
  However, when many successive assessments were made during a season, the average for the season was evaluated except when the results of the individual assessements were contradictory in which case each individual assessment is presented.

- Where the level of infestation is indicated, we have, with the exception of a very few cases, where the level was obviously extremely low, used results for all levels of infestation since, in practice, it is impossible to decide upon a level below which the infestation could be considered as being of no importance.

The information contained in the complete Appendix tables has been used in order to derive general tendencies for each major group of pests and diseases in chapters 3 - 7 which deal with fungus diseases, insects and mites, nematodes, viruses and bacteria. Each chapter is introduced by a summary table, following which we deal with a representative selection of quantitative results only, as to deal in detail with all the available information would be tedious and would involve much repetition. We have relied much upon tables and figures for the sake of brevity and to facilitate comprehension.

3. Effect of potassium on fungal diseases

3.1. Effect by crop or crop group

Taking all crops together (Table 5), potassium had a beneficial effect in seven cases out of ten. Disease is reduced by potassium in the majority of cases for all crop groups and for the most investigated crops (Table 5). Cereals, particularly rice, have been more investigated than other crops, results for this crop group comprising over 40 % of the total.

3.2. The most thoroughly investigated diseases

Of all the (1549) results reported 38 % refer to 7 diseases of cotton, maize, rice, wheat, barley, oats, rye and soybeans which have been more thoroughly investigated than the rest (Table 6). With the exception of rice blast, potassium more often reduced than increased all these diseases.

3.3. Cereals

3.3.1. Barley

The majority of indications concern 2 diseases, i.e. powdery mildew and common root rot which were more often decreased than increased by potassium (Table 7).

Common root rot *(Helminthosporium sativum)*

- In North Dakota *(Timm, Goos, Johnson, Sobolik and Stack ([1986*]) potassium applied as KCl significantly decreased common root rot incidence at the boot stage at 2 of 5 sites (Table 8). The application of K_2SO_4 markedly increased incidence of this disease at 1 site whereas it decreased it to a variable extent at the 4 other sites. According to the authors, Cl-induced disease repression may explain KCl response but the reason for this effect ist not known.
- In Canada, 30 kg K_2O/ha were applied to 5 barley varieties growing on a soil very low in available potassium (Piening [1982]). The average percentage of plants infected decreased from 91 % without potassium to 40 % with potassium (Table 9).

Table 5. Effect of potassium on fungal diseases of different crops or crop groups

Crop	No indications - () % of toal			
	Total	+	0	-
Cereals:				
- Barley	77	47	10	20
- Maize	160	126	10	24
- Rice	214	131	30	53
- Wheat	175	112	7	56
- Various cereals	42	33	7	2
Fibre crops:				
- Cotton	158	126	4	28
- Various fibre crops	18	17		1
Forage crops	92	81	3	8
Forest	48	31		17
Fruit crops	104	68	17	19
Oil crops:				
- Soybeans	106	79	2	25
- Various oil crops	44	34	7	3
Starch and sugar crops	63	36	3	24
Stimulants	19	12	2	5
Vegetables	170	107	4	59
Various crops	59	40	6	13
Total	1549	1080 (70)	112 (7)	357 (23)

Table 6. Effect of potassium on the 7 most investigated diseases

Crop	Disease	No. indications			
		Total	+	0	-
Wheat, barley	Powdery mildew	57	35	6	16
Wheat, barley, oats, rye	Various rusts	74	58	4	12
Maize	Stalk rot	113	92	5	16
Rice	Brown leaf spot	66	50	11	5
Rice	Rice blast	93	34	14	45
Cotton	Cotton wilt	142	116	2	28
Soybeans	Pod and stem blight	43	27	2	14

Table 7. Effect of potassium on diseases of barley

Disease	No. indications			
	Total	+	0	-
Brown rust of barley	1	1		
Common root rot	32	22	3	7
Dryland root rot	2	1	1	
Leaf stripe of barley	1	1		
Mildew	3	2	1	
Net-blotch of barley	2	1		1
Powdery mildew	31	17	5	9
Take-all	3			3
Yellow rust	1	1		
Disease unspecified	1	1		
Total	77	47	10	20

Table 8. Effect of K source and rate on common root rot incidence at the boot stage at 5 sites

kg K_2O/ha	Source	% infection Carrington	Fortuna	Minot	Powers Lake	Williston	Yield (t/ha) - Average of 5 sites
0		13	39	60	87	94	3.37
28	KCl	21	33	44	74	73	3.50
113	KCl	15	40	42	68	79	3.48
28	K_2SO_4	22	33	47	83	89	3.38
113	K_2SO_4	23	34	59	72	93	3.38

Table 9. Effect of potassium on the percentage of plants infected with common root rot

Variety	Without K	With K
Bonanza	74	16
Centennial	96	30
Conquest	86	35
Galt	100	35
Gateway	100	86
Average	91	40

- In a field trial, KCl fertilization significantly reduced common root rot severity on 2 varieties at 3 sites *(Goos, Johnson and Holmes [1987)]*.

Net blotch of barley *(Helminthosporium teres)*

Singh [1963] observed a slight disease decrease when K was omitted from the nutrient solution.

Powdery mildew *(Erysiphe graminis)*

- *Hopfengart [1953]* made pot trials with 4 barley varieties. KCl or K_2SO_4 at medium rates generally increased disease intensity whereas infection type observations showed that resistance was increased or unchanged by potassium. KCl delayed incubation and fructification whereas K_2SO_4 had no effect. The low K-rate in this trial (1/20 of medium K-rate) was probably too extreme to provide good growth conditions for the fungus and this could explain why the highest disease intensity was observed with medium K-rates. K-effect varied with plant age, thus young K-deficient plants were more susceptible than older plants, a medium K-rate increased the number of disease spots on old plants but markedly reduced it on young plants (Table 10).

Table 10. No. of disease spots per leaf

Sowing date	Variety Isaria			Variety Donaria		
	Low K	Medium K	High K	Low K	Medium K	High K
October 8	18	21	12	19	24	11
October 12	24	23	13	26	24	12
October 16	39	16	11	38	12	8

Take-all *(Gaeumannomyces graminis)*

According to the 3 year average results obtained from 1971 to 1973 in the Hoosfield Permanent Barley Experiment in the UK, potassium increased take-all incidence *(Slope and Broom [1974]*.

3.3.2. Maize

Potassium generally reduced stalk rot, Northern corn leaf blight, corn root rot and corn smut (Table 11). In the case of late wilt the number of positive and negative indications was the same.

Table 11. Effect of potassium on maize diseases

Disease	No. indications			
	Total	+	0	-
Charcoal rot	1	1		
Corn root rot	9	7	2	
Corn rust	1			1
Corn smut	8	8		
Late wilt	10	5		5
Northern corn leaf blight	15	10	3	2
Root rot	3	3		
Stalk rot	113	92	5	16
Total	160	126	10	24

Corn root rot

- In a field trial *(Martens and Arny [1967])* root necrosis was completely suppressed by K until end of September in the resistant variety W 22 whereas a smaller disease reduction due to K appeared only at end of September in the susceptible variety W 23. For the intermediate variety W 575, effect was intermediate and appeared only by September 10 (Table 12).
- Increasing K-concentration of the nutrient solution from 8 to 120 ppm resulted in a slight diminution of the root-rot index *(Thayer and Williams [1960])*.

Corn smut

In a long-term trial *(Mühle and Frauenstein [1969])*, K-effect varied according to year and manuring or liming. Potassium markedly reduced disease in 1963 whereas no notable reduction was observed in 1964 (Table 13).

Table 12. Effect of potassium on root necrosis

Treatment	Date	Variety		
		Resistant (W 22)	Susceptible (W 23)	Intermediate (W 575)
NP	17.8.	2	2	2
NPK		1	2	1
NP	27.8.	4	4	2
NPK		1	4	2
NP	10.9.	5	4	6
NPK		1	5	4
NP	24.9.	4	8	6
NPK		1	6	2

0 = no necrosis   10 = very severe necrosis

Table 13. Potassium and corn smut

Treatment					No. "Brandbeulen"				Yield (t/ha)	
					1963		1964			
Manure	Lime	N (kg/ha)	P	K	Cobs	Stalks	Cobs	Stalks	1963	1964
-	-	100	72	0	38	25	19	19	3.7	1.6
-	-	100	72	120	37	25	13	14	3.7	1.7
+	-	100	72	0	42	48	37	50	3.9	1.5
+	-	100	72	120	32	44	37	36	3.6	1.5
+	+	100	72	0	44	38	37	33	3.7	1.2
+	+	100	72	120	35	31	36	47	3.7	1.3
-	+	100	72	0	31	32	25	13	4.3	1.2
-	+	100	72	120	16	17	25	13	4.1	1.5
Average for plots without K					39	36	30	29	3.9	1.4
Average for plots with K					30	29	28	28	3.8	1.5

Northern corn leaf blight (*Helminthosporium turcicum*)

- In two field trials *(Bogyo [1955])*, disease incidence was significantly reduced by potassium (Table 14).
- In a nutrient solution trial *(Edwards [1941])*, infection index was lower at 20° C for variety Golden Glow and slightly higher for variety Funk's Yellow whereas it was unchanged for both varieties at 28° C (Table 15).
- In a field trial *(Hooker, Johnson, Shurtleff and Pardee [1963])*, potassium reduced disease intensity, reduction was more pronounced on plots receiving lime (Table 16).

Stalk rot

- In a field trial, potassium effect on stalk rot percentage on 6 different hybrids artificially inoculated was investigated *(Otto and Everett [1956])*. Potassium had no effect in III A x Wisc. W 23 which was very heavily stalk-rotted, whereas a very marked disease reduction was observed in the hybrids less severely affected (Figure 3).
- In a long-term trial, potassium fertilization had no effect on disease intensity *(Krüger, Grobler and DuPlooy [1965])*. The absence of potassium effect can probably be attributed to the high K-level of the soil.
- In K-fixing soils, a considerable reduction of stalk-rot was obtained with K-feritlization *(Siebold [1974])*. Maximum disease reduction and maximum yields were observed with K_2O-rates of 600 kg/ha (Figure 4).
- Similar results were obtained on 3 soils fixing K by *Burkart, Zscheichler and Diez [1976]*. Thus, the average stalk rot percentage was 46 % without K and 12 % with 600 kg K/ha.
- In a nutrient solution trial *(Thayer and Williams [1960])*, potassium slightly decreased disease index when combined with low N and slightly increased it when combined with high N (Table 17).
- On a potassium deficient soil in South Africa, potassium practically suppressed stalk rot incidence which was very strong in the control *(Farina, Channon and Phipson [1983])*:

kg K_2O/ha	% infection
0	100
180	< 1
240	< 1

Table 14. Effect of potassium on Northern corn leaf blight

Trial 1			Trial 2	
KCl (kg/ha)	Disease index	Yield (kg/plot)	Treatment	Disease index
0	3.9	3.16	NP	3.36
56	3.5	3.86	NPK	2.50
112	3.6	3.57		
168	3.1	3.40		

Table 15. Effect of potassium on infection index

Variety	Temperature	K-concentration (ppm)	
		0	250
Golden Glow	20°C	2.9	2.3
Golden Glow	28°C	3.0	3.0
Funk's Yellow	20°C	2.2	2.3
Funk's Yellow	28°C	0.7	0.7

Table 16. Leaf blight ratings of US 13-1 corn as influenced by various applications of K, N, limestone, and phosphate at Brownstown, Ill., in 1961

K	Lime	No phosphate		Rock phosphate		Superphosphate	
(kg/ha)		N (kg/ha)		N (kg/ha)		N (kg/ha)	
		0	90	0	90	0	90
0	yes	4.2*	4.0	4.2	4.2	4.8	4.2
	no	1.2	2.8	1.2	2.2	0.8	1.8
46.5	yes	1.8	2.8	1.2	2.8	3.2	2.8
	no	0.8	1.5	1.5	1.8	1.2	1.5
93.0	yes	1.5	2.0	1.0	2.2	1.5	2.2
	no	1.0	1.5	1.2	1.5	0.8	1.2

* The leaf blight ratings are the average of 2 observations and range from 0.5 (slight infection) to 5.0 (severe infection).

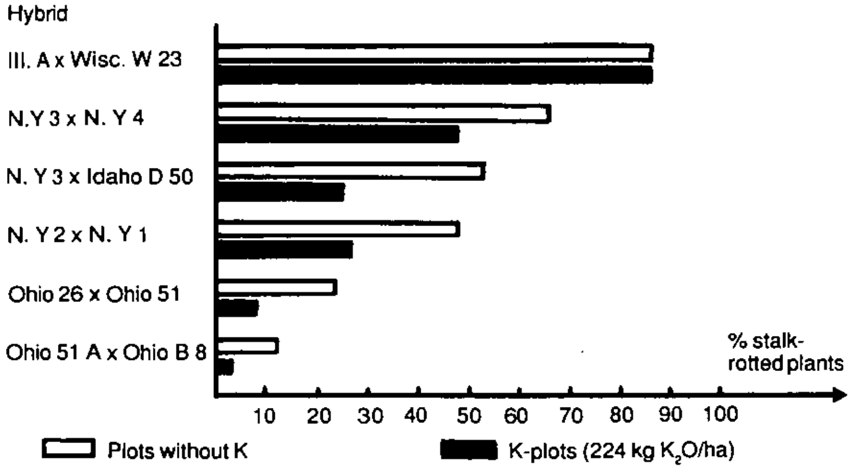

Fig. 3. Effect of potassium on percentage of stalk-rotted plants

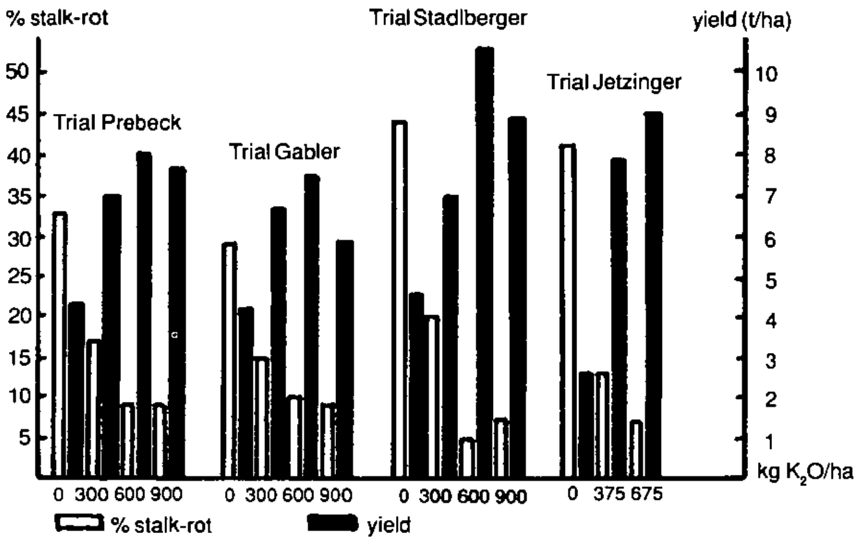

Fig. 4. Effect of potassium on stalk-rot and yield

Table 17. Potassium and stalk-rot rating

K-concentration, ppm	N-concentration, ppm		
	3	110	330
8	2.5	2.7	2.6
120	1.9	2.6	2.9
360	1.7	2.5	3.1

- *Abdel-Rahim, Shata, El-Fahl, El-Assiuty and Gouda [1984]* obtained variable results by applying potassium as K_2SO_4 in addition to various forms of nitrogen in a pot trial (Table 18).

Table 18. Effect of potassium on infection percentage in presence of 3 nitrogen sources

N source	Infection percentage (average of 3 evaluations) 1977		1978	
	Without K	With K	Without K	With K
Urea	50	42	48	65
Ammonium sulphate	50	45	72	73
Ammonium nitrate	42	47	60	53

3.3.3. Rice

Potassium in most cases decreases rice diseases with the exception of rice blast and dirty panicle disease (Table 19).

Brown leaf spot *(Helminthosporium oryzae)*

- *Okamoto [1958]* obtained a marked reduction of brown leaf spot with potassium at a rate of 75 kg K_2O/ha on a soil poor in K (Figure 5).

  He also found in an experiment on a soil low in K that potassium reduced the disease whether it was applied in the basal fertilizing or as a top dressing (Table 20).

Table 19. Effect of potassium on rice diseases

Disease	No. indications			
	Total	+	0	-
Brown leaf spot	66	50	11	5
Cercospora leaf spot	2	2		
Dirty panicle disease	5		3	2
Rice blast	93	34	14	45
Sclerotiniosis	3	3		
Sheath blight	7	6		1
Sheath rot	3	3		
Stem rot	34	32	2	
Helminthosporium spp.	1	1		
Total	214	131	30	53

Table 20. Effect of potassium and time of application on brown leaf spot

Basic fertilization	Top-dressing	% brown leaf spot
kg K_2O/ha	kg K_2O/ha	
0	0	12.5
0	37.5	4.5
56	0	3.5

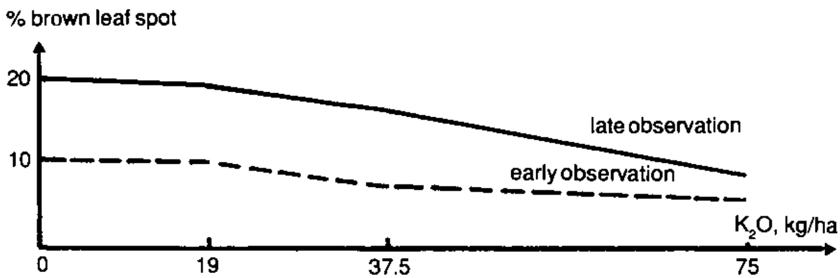

Fig. 5. Potassium and percentage of brown leaf spot on 3rd youngest mature leaf

- In a pot trial *(Abdel-Hak [1973])*, potassium reduced percentage of infection (Table 21).
- Size of disease spots was larger in K-deficient plants *(Ono [1953]) in Ono [1957])*.
- Number large spots on leaves and germination were increased when the nutrient solution was deficient in K *(Akai [1962])* Table 22).
- *Hiremath and Hedge [1975]* obtained a reduction of brown leaf spot incidence on grain by applying 24 kg K_2O/ha in addition to 60 kg N and 46 kg P_2O_5/ha:

kg K_2O/ha	Disease incidence on grains (%)
0	42.70
24	36.26

Table 21. Potassium and percentage of infection

K_2SO_4 (kg/ha)	Variety Sabeini	Variety Nahda
0	17	18
119	15	6
179	11	8
238	9	5

Table 22. Potassium and brown leaf spot development

Nutrient solution	No. large spots		% germination of
	1954	1960	conidia
Deficient in K	12.5	66.8	51.0
Normal K	10.1	39.7	37.7

Cercospora leaf spot

Potassium markedly reduced no. of disease spots per leaf and per leaf sheath *(Yoshida [1948] in Ono* [1958]) (Table 23).

Table 23. Potassium and number Cercospora leaf spots

Treatment	No. spots/leaf	No. spots/leaf sheath
NP	12	12
NPK	7	9

Rice blast

- *Okamoto [1958]* found that the disease was more severe on a high K soil and that K fertilizer stimulated development of the disease on a low K soil (Table 24).
- *Okamoto [1958]* also found a clear stimulating effect of potassium in a solution culture experiment (Table 25). Rice seedlings were first cultivated in soil and then in a nutrient solution. There were less spots on plants from the soil poor in K and receiving the solution without K. There were more spots on plants from the soil rich in K or from the soil low in K but fertilized with K and receiving the solution without K. There were also more spots on plants from the soil poor in K when they received the solution with K. Whereas spots on plants from the soil poor in K and receiving no K were of the dormant type, they were of the acute type on plants receiving K or on plants from the soil rich in K.
- *Okamoto [1958]* also found that the effect of potassium depended upon the stage of growth at which the disease first developed. When natural infection or inoculation was early potassium stimulated the disease but in late infection disease development was depressed by high potassium (Tables 26 and 27).
- *Mariani [1952]* found that application of KCl to a soil which had received no potassium for more than 10 years reduced blast attacks and panicle sterility and markedly increased the weight of panicles (Table 28).
- In pot trials, *Abdel-Hak [1973]* also obtained a reduction in infection severity due to potassium (Table 29).
- Sowing density *(Okamoto [1958])* can modify the effect of potassium which stimulated the disease more at higher sowing densities (Figure 6) in a pot trial with a low K soil.

Table 24. Potassium and rice blast development on 2 soils

K_2O (kg/ha)	Soil rich in K		Soil poor in K	
	Leaf blast index	% neck blast	Leaf blast index	% neck blast
0	5.2	14.2	0	-
19	5.2	14.5	0.7	4.9
37.5	5.1	14.3	1.0	6.2
75	5.1	16.0	2.0	20.0

Table 25. Effect of potassium on rice blast

Soil	Initial fertilizer		Culture solution	Number of spots per plant		Type of spot
	N kg/ha	K_2O kg/ha		I	II	
Niihari soil	47	0	No-K-solution	66	51	dormant type
(poor in K_2O)			NPK-solution	132	153	acute type
	47	56	No-K-solution	225	201	acute type
			NPK-solution	282	217	acute type
Mito soil	47	0	No-K-solution	375	408	acute type
(rich in K_2O)			NPK-solution	387	374	acute type

Table 26. Period of rice blast development in field and potassium effect

K_2O (kg/ha)	Disease index	
	Early development	Development later
0	0.4	2.5
19	1.1	2.1
37.5	2.0	1.2
75	2.4	1.1

Table 27. Period of rice blast artificial inoculation and potassium effect

Treatment (g/pot)		Disease index		
		Date of inoculation		
$(NH_4)_2SO_4$	K_2SO_4	Early	Intermediate	Late
3	0	2.5	2.5	2.2
3	3	4.0	2.3	1.5
6	0	4.0	3.2	3.2
6	3	7.0	3.5	2.1

Table 28. Potassium and rice blast development

	Plot without K	Plot with K
No. panicles with 0- 10 % sterility	0	484
No. panicles with 10- 25 % sterility	0	180
No. panicles with 25- 75 % sterility	46	132
No. panicles with 75-100 % sterility	834	76
Weight of 100 panicles at 18 % humidity	35	171

Table 29. Potassium and rice blast infection severity

K_2SO_4 (kg/ha)	Infection severity	
	Variety Sabeini	Variety Nahda
0	28	16
119	19	9
179	17	10
238	21	11

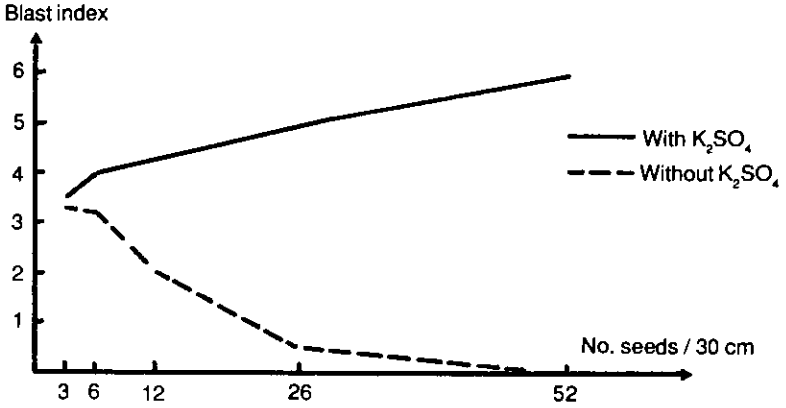

Fig. 6. Sowing density and effect of potassium on rice blast

- In pot trials carried out by *Kawamura and Ono [1948]* in *Ono [1958]*, germination and appressoria formation were depressed in water drops from plants receiving no potassium. Results were similar when conidia were put directly on the leaves (Table 30).

Table 30. Potassium and rice blast development (average of 3 trials)

Treatment	Germination (%)	Appressoria formation (%)
K_0	11	9
K_1	30	22
K_2	19	13

- In a pot trial with a soil deficient in K, *Okamoto [1968]* found that potassium application stimulated the disease as measured by number of lesions per leaf under various soil moisture conditions (Table 31).

Sclerotiniosis *(Leptosphaeria salvinii)*

Orsenigo [1956] obtained a disease reduction and less sterile spikes when the potassium content of the nutrient solution increased (Table 32).

Table 31. Potassium and no. rice blast lesions per leaf

K_2SO_4 (g/pot)	Soil state	No. lesions per leaf	
		1st evaluation	2nd evaluation
0	Semi-wet	4.0	3.0
3	Semi-wet	7.5	4.0
0	Wet	2.3	2.8
3	Wet	4.2	3.5
0	Submerged	1.4	1.8
3	Submerged	3.5	3.0

Table 32. Potassium and sclerotiniosis development

K-content (ppm)	Disease index	% sterile spikes
3	49	34
15	34	14
30	34	17

Sheath blight *(Thanatopherus cucumeris, Rhizoctonia solani)*

- In a field on a soil low in K in Java *(Ismunadji [1976])*, potassium reduced disease incidence and increased yield (Table 33).
- In a pot experiment carried out in India with rice plants artificially inoculated with *Rhizoctonia solani*, increasing rates of potassium markedly reduced disease incidence and strongly increased yield *(Kannaiyan and Prasad [1978a])* (Table 34).

Sheath rot *(Sarocladium oryzae)*

- In a field trial in India *(PRII [1986])*, increasing rates of potassium considerably decreased sheath rot incidence in presence of both 75 and 125 kg N/ha (Figure 7).

Table 33. Effect of potassium on sheath blight development on rice

Treatment (kg/ha)			Disease infestation (%)	Yield index
N	P	K		
120	60	0	68	100
120	60	60	55	125
120	60	120	48	142

Table 34. Potassium and sheath blight development

kg K_2O/ha	Disease index (%)	Grain yield (kg/pot)
0	81.1	10.85
49	75.9	10.92
99	65.3	12.50
148	61.3	13.70
198	54.7	15.45
247	49.4	16.32

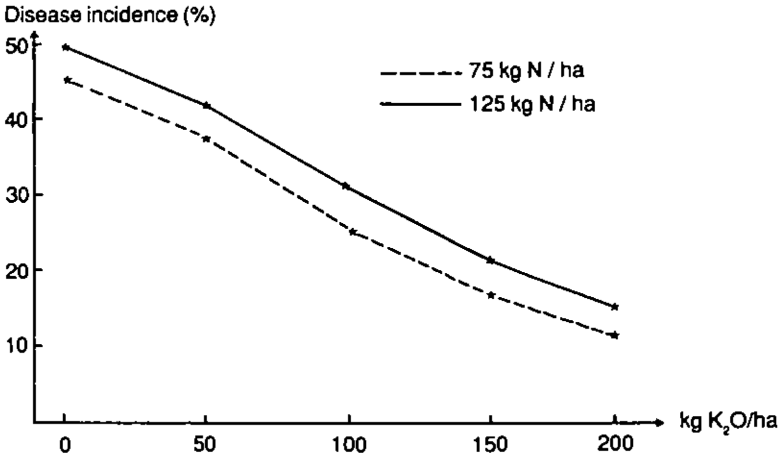

Fig. 7. Effect of potassium on sheath rot incidence

- The application of potassium as KCl or K_2SO_4 reduced disease incidence on artificially inoculated rice grown in pots *(Alagarsamy and Bhaskaran [1986])*. Thus, the sheath rot index (%) was 35.4 in the control, 21.0 with KCl and 25.8 with K_2SO_4.

Stem rot

- In presence of high N rates, potassium markedly reduced damage *(Yoshi, Koba and Watanabe [1949]* in *Ismunadji [1976])*.
- On a soil low in K in Indonesia, *Ismunadji and Partohardjono [1979]* obtained during 2 wet seasons an almost complete elimination of stem rot and a substantial yield increase by applying potassium in addition to 120 kg N and 60 kg P_2O_5/ha. The results for the 1976-1977 wet season are shown on Figure 8. 60 kg K_2O/ha were necessary for the full beneficial effect.
- *Goto and Fukatsu [1948]* in *Ono [1957]* obtained with potassium a marked diminution of damage, and a lower number of sclerotia on leaf sheath and stalk. A marked reduction of disease spots was observed only on stalks (Table 35).
- Soil moisture conditions affected the potassium effect in trials reported by *Ono [1950]* in *Ono [1957]*. Potassium had no effect on damage in a well-drained field whereas it decreased it on a semi-wet and on an ill-drained field (Figure 9).

Table 35. Fertilization and stem rot development

Treatment	% disease spots		% sclerotia formed		Damage
	Leaf sheath	Stalk	Leaf sheath	Stalk	degree
0	99	31	61	3.2	27
K	98	24	48	0.9	21
P	100	44	67	8.2	34
PK	94	27	45	3.0	22
NP	99	68	67	30.3	50
NPK	100	25	58	2.4	24

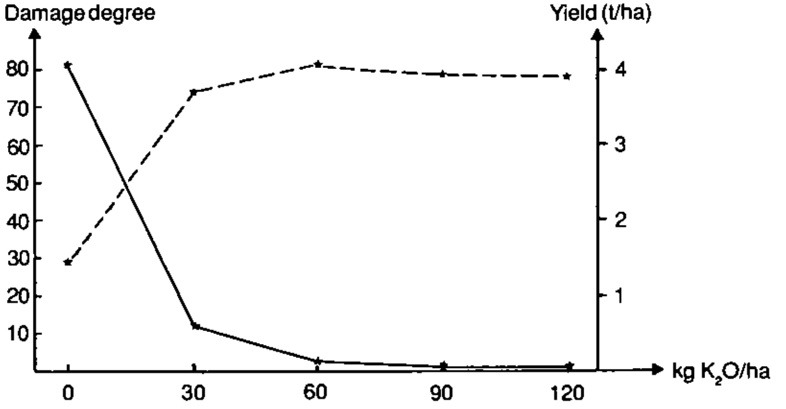

Fig. 8. Potassium and stem rot damage

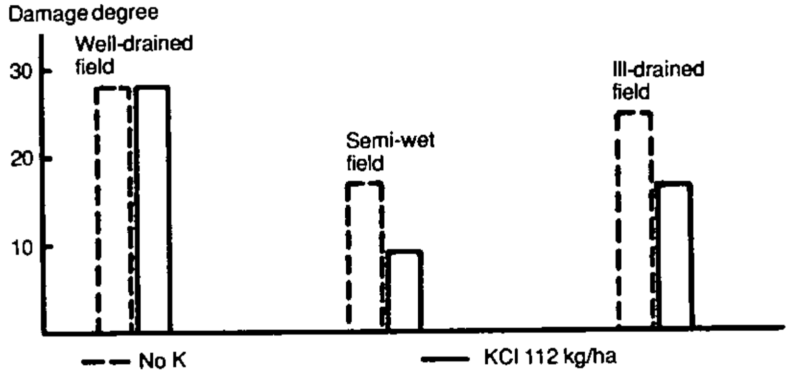

Fig. 9. Potassium and stem rot in fields with different moisture

- According to *Vaithilingam* and *Ragunathan [1977]* a significant reduction of disease incidence and percentage tillers infected was obtained with increasing rates of potassium in a field trial with 2 varieties (Table 36).

- *Subramanian* and *Balasubramanian [1977]* also obtained a marked reduction of stem rot incidence with increasing potassium rates in a field trial with 2 varieties.

- *Jain [1977]* mentions that potassium applied at transplanting almost eliminated stem rot on artificially inoculated rice grown in pots. The percentage of infection was 40.7 % without K and only 0.7 % with 120 ppm K (average for 2 years results). Potassium applied at later timings, *i.e.* at tillering or panicle initiation was somewhat less effective in reducing stem rot and the respective percentages of infection were 4.0 and 8.5.

Table 36. Effect of potassium on stem rot incidence

kg K_2O/ha	Variety Kannagi		Variety IR 20	
	Disease incidence (%)	Tillers infected (%)	Disease incidence (%)	Tillers infected (%)
0	43.4	81.7	30.5	67.9
22	33.4	71.5	24.6	59.6
45	24.9	71.9	21.3	50.3
67	17.7	59.6	17.8	43.9
90	8.0	37.1	11.0	36.3
112	19.7	40.8	6.3	24.2

3.3.4. Wheat

Potassium more often decreased than increased the various rusts, powdery mildew, glume blotch and take-all as shown on Table 37.
The effect of potassium on flag smut was variable while eyespot development was favoured by potassium.

Common root rot *(Helminthosporium sativum)*

Potassium had a variable effect on common root rot severity in field trials carried out in North Dakota *(Goos [1986])* (Table 38).

Eyespot *(Cercosporella herpotrichoides)*

- In a long-term field trial *(Glynne [1969])*, the average percentage of straws with severe eyespot lesions for 7 years from 1938-1944 was higher in the K-plots the year following the fallow and during the next 2-4 years following the fallow (Table 39).

- On fields where cereals were continuously grown, K increased eyespot attacks *(Stetter [1971])*.

Table 37. Effect of potassium on diseases of wheat

Disease	No. indications			
	Total	+	0	-
Brown foot rot of wheat	4	2		2
Brown rust of wheat	15	12	1	2
Bunt of wheat	2			2
Common root rot	6	2	3	1
Eyespot	16	1		15
Flag smut	12	5		7
Glume blotch	17	11	1	5
Leaf rust	7	4		3
Leafspot	2	2		
Mildew	3	3		
Powdery mildew	26	18	1	7
Rusts	15	15		
Speckled leaf blotch	3	2		1
Stem rust	12	7	1	4
Stripe rust	17	16		1
Take-all	14	10		4
Yellow rust	2	2		
Fusarium spp.	1			1
Linocarpon cariceti	1			1
Total	175	112	7	56

Table 38. Effect of potassium on common root rot severity

Crop	Site	Disease index *	
		Without K	With K
Hard red spring wheat	Stanley	2.1	1.7
Hard red spring wheat	Fortuna	1.6	1.6
Hard red spring wheat	Rawson	2.4	2.2
Hard red spring wheat	Minot	2.1	2.3
Durum wheat	Minot	2.1	2.1

* 1 = none, 4 = severe

Table 39. Effect of potassium on eyespot

Treatment	% straws with severe lesions Years after fallow	
	1	2-4
NP	22	41
NPK	33	55

Glume blotch *(Septoria nodorum)*

- On soils fixing K very strongly (Tables 40 and 41), high rates of potassium reduced disease incidence and numbers of spores in wheat *(Trolldenier [1973)*.
- In a field trial in West Germany, the application of 120 kg K_2O/ha on wheat with and without artificial inoculation had variable effects on pycnidia numbers on flag leaves and on pycnospora numbers on glumes and flag leaves *(Mielke and Finger [1977])* (Table 42).

Table 40. Potassium fertilization and glume blotch incidence, variety Kolibri

Kg K_2O/ha	Glume blotch %	Yield (t/ha)
0	49.7	4.11
300	49.5	4.46
600	42.3	7.20
900	37.7	5.10

Table 41. Potassium fertilization and numbers of spores, variety Diplomat

Kg K_2O/ha	No. spores	Yield (t/ha)
0	49.5	3.18
600	19.3	4.25
1800	25.6	4.80

Table 42. Effect of potassium on glume blotch

	Without artificial infection		With artificial infection	
	Without K	With K	Without K	With K
No. pycnidia on flag leaves-1974	43.4	36.3	174.5	203.3
No. pycnidia on flag leaves-1975	63.4	67.7	60.9	51.2
No. pycnospora on glumes-1974	280	134	870	772
No. pycnospora on glumes-1976	24	67	31	61
No. pycnospora on flag leaves-1974	1739	1156	2906	2260
No. pycnospora on flag leaves-1976	-	-	66	55

Leafspot *(Puccinia tritici-repentis + Septoria avenae)*

Potassium decreased disease severity in 2 field trials in USA *(Fixen, Buchenau, Gelderman, Schumacher, Gerwing, Cholik and Forber [1986])* (Table 43).

Table 43. Effect of potassium on leafspot percent severity

Treatment	Trial 84N			Trial 84S
	Flag leaf	2nd leaf	3rd leaf	
Check	19	53	94	77
KCl	13	43	90	52

Mildew

On a potassium fixing riverside soil *(Siebold [1980])*, the application of high rates of potassium reduced mildew incidence and considerably increased yield (Table 44).

Powdery mildew *(Erysiphe graminis)*

- In a long-term field trial at Rothamsted *(Glynne [1960])* disease incidence in wheat was markedly reduced on K-plots (Table 45).

Table 44. Effect of potassium on mildew incidence

kg K_2O/ha	Mildew index *	Yield (t/ha)
0	9	3.36
300	8	5.83
600	6	6.21

* 1 = absent, 9 = highest degree of infection

Table 45. Powdery mildew in winter wheat (Squarehaed's Master 13/4) on Broadbalk Field, July 2-9, 1958

Treatment	Mean percentage of leaf area covered with mildew			
	One year after fallow		Three years after fallow	
	Leaf 1	Leaf 2	Leaf 1	Leaf 2
Plots without potash	15.7	67.6	13.5	36.0
Plots with potash	6.1	22.6	2.3	5.5

- In pot experiments *(Lowig [1935])*, KCl and K_2SO_4 reduced disease incidence in 3 of the 4 wheat varieties tested.

- *Thier, Sammons, Grybauskas and Tommerlin [1986]* carried out a field study and a growth chamber study. In the field study, conducted with 2 varieties during 2 years, potassium slightly decreased disease severity and slightly increased yield (Table 46).

In the growth chamber study, potassium slightly decreased the mildew colony area and the number spores per mm^2 while it slightly increased the number spores per colony.

Rusts

There are not many indications of rust increase due to potassium.

- *Mashaal [1976]* in *Kiraly [1976]* showed that fewer pustules were produced in nutrient solutions rich in K.

- Delayed appearence of rust was observed on K-plots with seven wheat cultivars *(Pietschmann [1953])*.

- In India, *Singh [1978]* obtained a considerable reduction of rust incidence by applying 34 kg K_2O/ha. The infection percentage amounted to 78.4% without potassium and to only 29.1% with potassium.

Table 46. Effect of potassium on powdery mildew incidence

Treatment	Powdery mildew score 1)		Grain yield (t/ha)	
	1983	1984	1983	1984
Check	3.6	3.6	3.028	4.803
KCl	3.3	3.2	3.125	4.916

1) 0 = no disease, 9 = severe infection.

Speckled leaf blotch *(Septoria tritici)*

In pot trials, potassium decreased disease intensity on leaves and slightly increased picnidia formation *(Temiz [1976])*.

Take-all *(Gaeumannomyces graminis)*

- K-deficiency in the nutrient solution *(Garrett [1941])* increased the degree of visible infection. K-deficiency did not depress yield of uninoculated wheat whereas it did so with inoculated wheat, indicating that K-deficiency is likely to intensify the yield loss (Table 47).

- In fields under continuous cereals, potassium increased attacks *(Stetter [1971])*.

- *Taylor, Jackson, Powelson and Christensen [1983]* report a field trial in which the effect (not significant) of 45 kg K_2O/ha applied as KCl depended on the form on N used and on soil pH. At pH 6.0, potassium increased the infection percentage in presence of NH_4Cl and decreased it in presence of

$(NH_4)_2SO_4$ and $Ca(NO_3)_2$. At pH 6.2, potassium decreased the infection percentage in presence of NH_4Cl and $(NH_4)_2SO_4$ while it increased it in presence of $Ca(NO_3)_2$.

Table 47. Potassium and take-all

Treatment	% tillers with blackened stem bases	% tillers with majority of roots severely infected	Yield (average grain weight/plant in g)	
			Not inoculated	Inoculated
NP 1/3 K	39	79	8.22	6.51
NPK	20	66	8.31	8.07

Linocarpon cariceti

In a field trial with wheat, potassium increased disease intensity on plots receiving low or nil P-fertilizer and did not affect it on plots receiving medium P-fertilization *(Ponchet and Coppenet [1962])*.

3.3.5. Various cereals

Potassium reduced sugary disease of sorghum and rusts (Table 48).

Mildew

In 2 trials with oats on potassium fixing riverside soils (Figure 10), high rates of potassium markedly decreased mildew incidence and considerably increased yield (Siebold [1980]). In the Ergolding trial, yield was doubled by the application of 600 kg K_2O/ha.

Ragi blast *(Pyricularia setariae)*

In India, on a soil low in available potassium, a considerable reduction of disease incidence on finger millet was obtained by applying 45 kg K_2O/ha *(Muthuswamy, Thalamuthu and Narayanan [1985])*.

Septoria *(Septoria avenae)*

Fungus development was considerably increased with a low K-concentration in the nutrient solution *(Clark [1964])*.

Table 48. Effect of potassium on diseases of various cereals

Crop	Disease	No. indications			
		Total	+	0	-
Cereals unspecified	Brown rust	1	1		
Cereals unspecified	Powdery mildew	3	3		
Cereals unspecified	Rusts unspecified	3	3		
Finger millet	Ragi blast	1	1		
Oats	Crown rust of oats	2		1	1
Oats	Mildew	2	2		
Oats	Septoria	3	3		
Pearl millet	Downy mildew	1		1	
Pearl millet	Ergot	1	1		
Rye	Brown rust of rye	3	1	1	1
Rye	Rye ergot	1	1		
Sorghum	Rust	10	7	3	
Sorghum	Sugary disease of sorghum	11	10	1	
Total		42	33	7	2

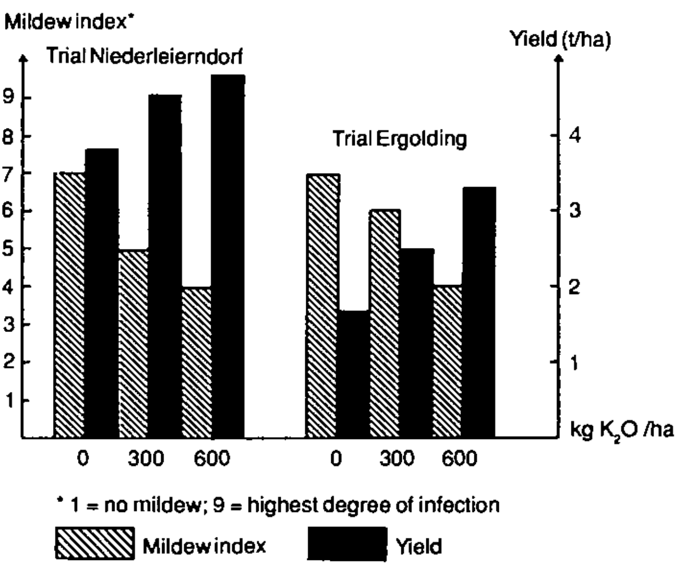

Fig. 10. Potassium effect on mildew incidence on oats

3.4. Fibre crops

3.4.1. Cotton

According to Table 49 potassium was generally beneficial, especially with cotton wilt.

Table 49. Effect of potassium on diseases of cotton

Disease	No. indications			
	Total	+	0	-
Cotton wilt	146	116	2	28
Damping-off	1	1		
Leaf blight	3	2	1	
Leaf spot	1	1		
Rhizoctonia seedling disease	1	1		
Verticillium wilt	6	5	1	
Total	158	126	4	28

Cotton wilt

- *Young, Janssen and Ware [1932]* obtained a marked reduction of wilt incidence in various field trials carried out in Arkansas, from 1929 to 1931 on soils which were generally poor in K. Yield increases due to potassium were substantial (Table 50).
- In a pot experiment reported by *Fahim, Youssef and El-Sharkawy [1971]* potassium reduced the percentage of wilted seedlings. Reduction depended on plant age and was much more marked when inoculation was carried out 36 days after planting than at 6 days after planting (Figure 11).
- *Sharoubeem, Naim and Habib [1967]* supplied cotton plants with nutrient solutions of various K-concentrations. The percentage of wilted plants was maximum at a K-concentration of 200 ppm it decreased at higher K-concentrations and wilt was almost entirely suppressed at 1000 ppm (Figure 12).

Table 50. Potassium and cotton wilt

Treatment	Average of several trials		No. trials
	% wilt	Yield (t/ha)	
Plots without K	26.0	6.29	3
Plots with K	12.3	9.64	
6-8- 0 fertilizer	25.1	7.83	8
6-8- 12 fertilizer	9.2	10.62	
No K	34.7	9.34	4
KCl 112 kg/ha	19.4	11.32	

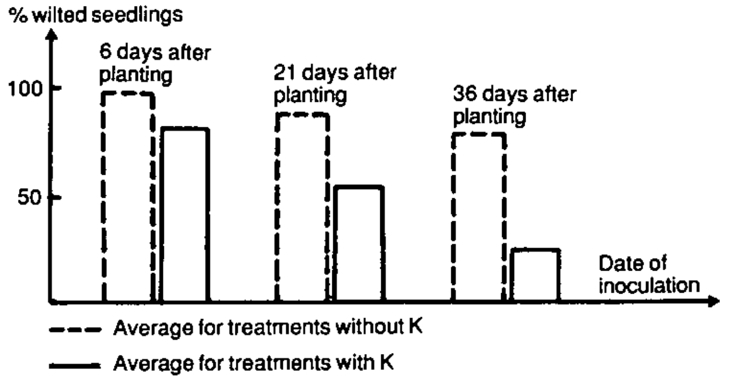

Fig. 11. Potassium and percentage wilted seedlings for different inoculation times

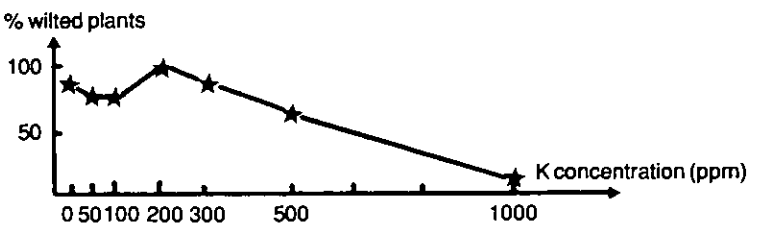

Fig. 12. K-concentration of the nutrient solution and percentage wilted plants

Leaf blight

- *Miller [1969]* reports a reduction of the percentage of infected plants in cotton with or without irrigation. Reduction was more pronounced with 100 kg/ha K than with 50 kg/ha (Table 51).

Table 51. Potassium and percentage plants infected with leaf blight

Treatment (kg/ha)			% infected plants, average of 5 ratings		2nd pick seed cotton (t/ha)	
N	P	K	Irrigation	No irrigation	Irrigation	No. irrigation
28	56	0	83	39	1.09	1.71
28	56	50	67	35	1.66	5.36
28	56	100	58	28	4.05	8.04
140	56	0	73	42	2.12	4.79
140	56	50	62	31	3.73	3.43
140	56	100	53	19	5.04	6.29

Rhizoctonia seedling disease of cotton

Ramasami and Shanmugam [1976] report that disease incidence was 94 % when plants received a nutrient solution deficient in potassium and only 64 % when they received a complete solution.

Verticillium wilt *(Verticillium dahliae)*

- In a field trial on a K-deficient soil, *Hafez, Stout and De Vay [1975]* report a marked reduction of wilt with potassium (Table 52).

- In an other field trial, on a soil with a K-level of 88-90 µgK/g, no reduction in wilt incidence was observed *(Hafez and Stout [1973]* in *Hafez, Stout and De Vay [1975])*.

Table 52. Potassium and Verticillium wilt

Treatment	% Verticillium wilt	Yield(t lint/ha)
Unfertilized check	27	4.93
KCl 270 kg/ha	7	7.98

- In a field trial in the USSR, the application of 100 kg K_2O/ha in addition to 220 kg N and 100 kg P_2O_5/ha reduced infection percentage from 23 to 17 % and increased yield from 3.5 to 4.0 t/ha *(Satlarov [1977])*.
- In California, *Thompson [1983]* obtained a considerable reduction of Verticillium wilt severity by applying potassium, the disease percentage being 27 % without K and 7 % with K.

3.4.2. Various fibre crops

The results available for this crop group show only disease reductions due to potassium with the exception of anthracnose on kenaf (Table 53).

Table 53. Effect of potassium on diseases of various fibre crops

Crop	Disease	No. indications			
		Total	+	0	-
Flax	Flax rust	2	2		
Flax	Wilt	2	2		
Jute	Jute anthracnose	4	4		
Jute	Jute stem rot	4	4		
Jute	Root rot	1	1		
Kenaf	Anthracnose	1			1
Sunnhemp	*Pythium butleri*	1	1		
Sunnhemp	*Rhizoctonia solani*	1	1		
Sunnhemp	*Rhizoctonia* sp.	1	1		
Sunnhemp	*Sclerotium rolfsii*	1	1		
Total		18	17		1

Jute stem rot *(Macrophomina phaseoli)*

Ji [1974] observed over 2 seasons a reduction of disease incidence due to potassium applied in addition to N and P (Table 54).

Table 54. Effect of potassium on jute stem rot incidence

Treatment (kg N, P_2O_5, K_2O/ha)	% infected plants 1972-73	1973-74
$N_{40}P_{40}$	23.6	18.0
$N_{40}P_{40}K_{40}$	7.9	17.0
$N_{40}P_{40}K_{80}$	6.2	16.7
$N_{40}P_{40}K_{160}$	3.6	8.8
$N_{80}P_{40}$	6.0	15.0
$N_{80}P_{40}K_{40}$	5.1	13.5
$N_{80}P_{40}K_{80}$	4.3	9.9
$N_{80}P_{40}K_{160}$	5.3	14.0

3.5. Forage crops

Potassium has predominantly beneficial effects on forage crops (Table 55).

3.5.1. Bermudagrass

Dollarspot

- In a field trial, both K_2SO_4 and KCl slightly reduced dollarspot incidence *(Pritchett and Horn [1966])* (Table 56).
- On a soil low in potassium, the application of this nutrient reduced susceptibility of 4 bermudagrass varieties to dollarspot *(Juska and Murray [1973])*.

Helminthosporium leaf spot *(Helminthosporium cynodontis)*

Juska and Murray [1973] report that on a soil low in potassium the application of 405 kg K_2O/ha reduced damage caused by Helminthosporium leaf spot on 4 bermudagrass varieties (Table 57).

Leafspot

In a field trial, potassium substantially decreased the number of spots per leaf *(Evans, Rouse and Gudauskas [1964])* (Table 58).

Table 55. Effect of potassium on diseases of forage crops

Crop	Disease	No. indications			
		Total	+	0	-
Bermudagrass	Dollar spot	6	6		
Bermudagrass	Helminthosporium leafspot	9	9		
Bermudagrass	Leafspot	12	12		
Clover	Leafspot	2	2		
Clover	Northern anthracnose	2	2		
Clover	Root rot	6	5	1	
Clover	*Ascochyta trifolii*	2	2		
Clover	*Erysiphe polygoni*	1	1		
Cocksfoot	Leaf fleck	1	1		
Cocksfoot	Leafspot	1	1		
Cocksfoot	Powdery mildew	2			2
Fescue	Leafspot	1	1		
Fescue	Powdery mildew	2			2
Fodder beet	Beet rust	1	1		
Grassland	*Epichloe*	1	1		
Lucerne	Leafspot	1	1		
Lucerne	Phytophthora root rot	3	2		1
Lucerne	Root rot	6	5	1	
Lucerne	Southern anthracnose	1	1		
Lucerne	Stemphylium leaf spot	1	1		
Lucerne	Verticillium wilt	2		1	1
Ryegrass	Leafspot	1	1		
Ryegrass	Snow mold	12	11		1
Timothy	Leafspot	5	5		
Timothy	Snow mold	9	8		1
Various	*Fusarium nivale*	1	1		
Various	*Helminthosporium*	1	1		
Total		92	81	3	8

Table 56. Potassium and dollarspot incidence

Treatment	Dollarspot rating
Check	6.8
KCl	7.3
K_2SO_4	8.0

Ratings: 1 = very heavy infestation; 9 = no dollarspot

Table 57. Effect of potassium on Helminthosporium leafspot

Variety	Year	Disease rating (10 = most resistant) Without K	With K
Tufcote	1971	6	8
Arizona common	1971	2	9
Arizona common	1972	4.8	9.5
Midiron	1972	8.5	8.8
Tufcote	1972	4.5	8.5

Table 58. Potassium and number of spots per leaf

kg K_2O/ha	No. spots per leaf
0	147.5
56	23.1
112	13.5

3.5.2. Lucerne

Root rot *(Fusarium spp.)*

- In a field trial reported by *Ubajdullaev [1970]* , fertilizer treatments were repeated for 3 consecutive years. In the 3rd year, a marked reduction of the percentage of attacked plants was observed with 300 kg K_2O/ha, the reduction was smaller with 150 kg K_2O/ha (Figure 13).

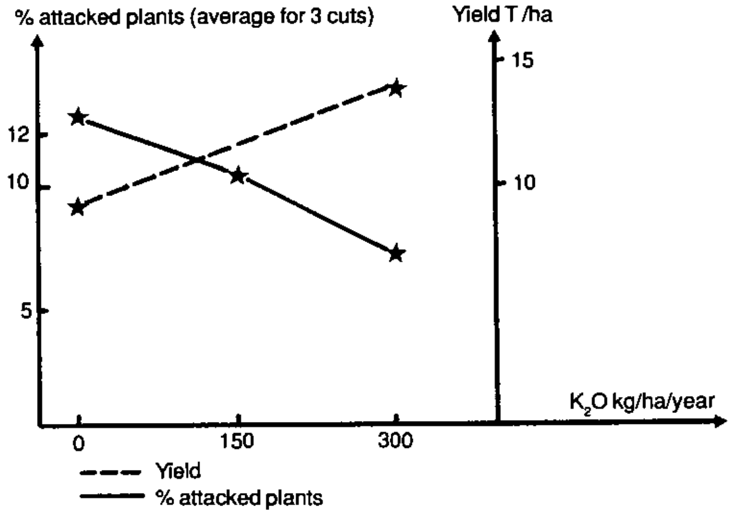

Fig. 13. Potassium and percentage plants with root rot

3.5.3. Ryegrass

Snow mold *(Fusarium nivale)*

In 3 pot trials reported by *Nyssinen [1970]* , potassium reduced number of dead plants and damage as estimated by colour. Mycelium formation was reduced in 2 trials (Table 59).

Table 59. Potassium and snow mold development

K (g/pot)	Damage estimated by colour	Mycelium formation	% dead plants	Plant weight (g/pot)
0	2.9	3.6	67	1.62
1.16	2.1	2.7	49	2.92

Ratings:
- Damage (0-4) 0 = no visible damage
- Mycelium formation (0-4) 0 = no fungus

3.5.4. Timothy

Leafspot *(Heterosporium phlei)*

In a field trial a very marked reduction of leafspot incidence was obtained in 1962 and 1963 *(Laughlin [1965])*. Disease was practically eliminated with K at 149 kg/ha. Applying K in autumn or spring did not affect the degree of reduction. Results for 1963 are given in Table 60.

Table 60. Potassium and leafspot development

Treatment (kg/ha)			Disease rating			
N	P	K	July 9		August 14	
			A	S	A	S
168	49	0	3.0	2.0	3.0	2.5
168	49	74	1.3	0.7	2.5	2.2
168	49	149	0.0	0.2	0.5	0.2
168	49	298	0.2	0.3	0.0	0.0

Ratings: 0 = none; 1 some; 2 = many; 3 = a great many
A = autumn application
B = spring application

Table 61. Effect of potassium on percent snow mold damage on timothy

Pathogen	Trial No.	K content of nutrient solution	
		1/4	Normal
Fusarium nivale	1 - Plants hardened	75.5	63.2
Fusarium nivale	2 - Plants hardened	85.3	79.5
Typhula ishikariensis	1 - Plants hardened	74.9	86.8
Typhula ishikariensis	2 - Plants hardened	97.0	95.1
Typhula ishikariensis	3 - Plants hardened	84.2	75.5
Typhula ishikariensis	3 - Plants not hardened	98.3	95.7
Sclerotinia borealis	2 - Plants not hardened	91.8	79.9

Snow mold *(Fusarium nivale, Typhula ishikariensis, Sclerotinia borealis)*

In 3 pot trials reported by *Arsvoll and Larsen [1977]*, snow mold damage on artificially inoculated phleum plants grown in sand was generally slightly decreased when these plants received a standard nutrient solution (Table 61).

3.6. Forest

Potassium more often decreased than increased diseases of forest trees, exceptions being walnut anthracnose on black walnut and root rot on pine (Table 62).

Table 62. Effect of potassium on diseases of forest trees

Tree	Disease	No. indications			
		Total	+	0	-
Beech	*Nectria ditissima*	2	1		1
Black walnut	Walnut anthracnose	6			6
Cupressus	*Coryneum cardinale*	1			1
Oak	Mildew	1	1		
Pine	Pine needle cast	4	4		
Pine	Pitch canker	6	4		2
Pine	Root rot	6	3		3
Pine	Snow blight	2	2		
Poplar	Leaf blotch	4	3		1
Poplar	Poplar leaf rust	9	7		2
Sugi	Needle mildew	1	1		
Trembling aspen	Hypoxylon canker	4	3		1
Tree unspecified	Snow blight	1	1		
Tree unspecified	*Botrytis* spp.	1	1		
Total		48	31		17

3.6.1. Black walnut

Walnut anthracnose *(Gnomonia leptostyla)*

According to results obtained over 2 years at 3 sites in USA, the average percentage of leaflets with lesions amounted to 33.7 % without potassium and to 36.8 % when potassium was applied *(Neely [1981])*.

3.6.2. Pine

Pine needle cast *(Lophodermium pinastri)*

In a pot experiment initiated in 1963, the number of defoliated seedlings was smaller in 1966 in the pots receiving K *(Chung and You [1970])* (Figure 14).

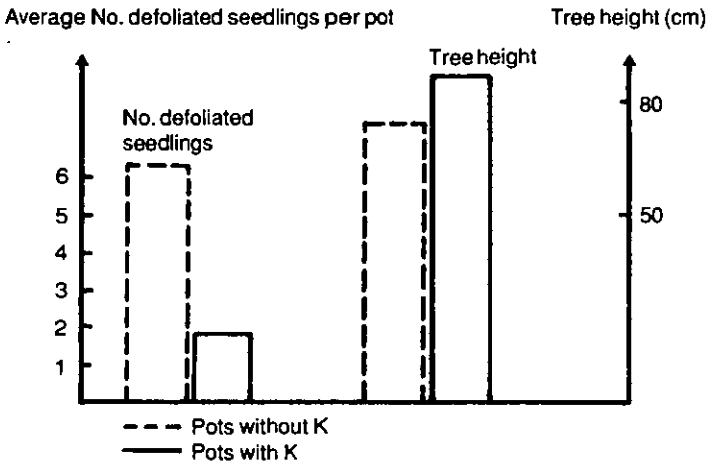

Fig. 14. Potassium and pine needle cast development

Pitch canker *(Fusarium moniliforme)*

According to *Fraedrich and Witcher [1982]*, potassium slightly reduced canker length on 2-year old slash pine and Virginia pine seedlings in the greenhouse whereas it increased it on 8 year old slash pines in the field (Table 63).

Table 63. Effect of potassium on cankers length (mm)

Treatment	Slash pine (Greenhouse)	Virginia pine (Greenhouse)	Slash pine (Field)
NP	50	55	65
NPK	47	53	76

3.6.3. Poplar

Leaf blotch *(Marssonina brunea)*

- Cuttings of *Populus euramericana* were cultivated in sand in the laboratory. The number of disease spots was increased on cuttings receiving a nutrient solution without K *(Garbaye and Pinon [1973])* (Table 64).
- *Donaubauer [1969]* in *Garbaye and Pinon [1973]* reports heavier attacks on K-plots.
- *Lahouste [1984]* working with artificially inoculated poplar seedlings grown in nutrient solution found that their sensitivity was reduced when they were adequately supplied with potassium. Thus, the number of disease spots/cm^2 leave was 25 when seedlings were grown in a nutrient solution deficient in potassium and only 8 when they were grown in a nutrient solution with an optimal K concentration.

Table 64. Potassium and leaf blotch development

Treatment	No. spots/square cm of leaf
NP	7.5
NPK	6.5

Poplar leaf rust *(Melampsora larici-populina)*

Suzuki [1973] reports trials carried out with different clones. Disease intensity on inoculated leaves was increased when the trees received a nutrient solution deficient in K, except in 1969 for clones *P.x japono-gigas* and *P. deltoides x*

P. nigra caudina. The decrease was more pronounced in the moderately and highly susceptible clones (Table 65).

Table 65. Potassium and poplar leaf rust development

Clone	Date		Infection coefficient on leaves	
			Solution deficient in K	Complete solution
Susceptible - *P.* x *japono-gigas*	Jan.	1969	7.0	8.4
Susceptible - *P.* x *japono-gigas*	Nov.	1970	10.9	4.4
Susceptible - *P. deltoides missouriensis*	June	1969	11.4	6.7
Susceptible - *P. deltoides* x *P. nigra caudina*	Nov.	1967	8.9	8.0
Susceptible - *P. deltoides* x *P. nigra caudina*	Oct.	1968	8.4	7.1
Susceptible - *P. deltoides* x *P. nigra caudina*	June	1969	6.1	7.8
Moderately resistant - P. x *canadensis* I-455	Nov.	1967	7.1	4.4
Moderately resistant - P. x *canadensis* I-455	Oct.	1968	9.2	3.2
Highly resistant - I-154	Oct.	1968	5.5	0.0

3.7. Fruit crops

Potassium generally reduced the 3 diseases which were the most investigated, *i.e.* brown rot of apricots, downy mildew of grapes and powdery mildew of grapes (Table 66).

3.7.1. Apples

Apple powdery mildew *(Podosphaera leucotricha)*

Schaffnit and Volk [1930] carried out pot trials. Potassium reduced disease intensity and length of the diseased portion of stems but it did not affect the interval between artificial inoculation and fructification. The first necroses appeared earlier in the pots receiving the higher K-rates (Table 67).

Table 66. Effect of potassium on fruit crops diseases

Crop	Disease	No. indications			
		Total	+	0	-
Apples	Apple powdery mildew	5	3	2	
Apples	Dry eye rot of apple	2	1		1
Apples	Gloesporium fruit rot	7			7
Apples	Mildew	1	1		
Apples	Scab	2	2		
Apples	*Cytosporina ludibunda*	1	1		
Apples	*Gloesporium* ssp.	2	2		
Apples	*Penicillium* ssp.	2		1	1
Apples	*Polystictus* sp. + *Stereum* sp.	1	1		
Apples	Disease unspecified	2	2		
Apricots	Brown rot of apricots	17	14	1	2
Avocado	Phytophthora root rot	2	1		1
Bananas	*Armillaria mellea*	1	1		
Bananas	Banana wilt	2	1	1	
Black currant	Currant anthracnose	3	2	1	
Chestnut	Ink disease	1	1		
Citrus	Mal secco	1			1
Gooseberry	Gooseberry mildew	7	4	2	1
Grapes	Downy mildew	18	12	4	2
Grapes	Grey mold	3	3		
Grapes	Mildew	1	1		
Grapes	Powdery mildew	9	8	1	
Peaches	Brown rot	2		2	
Peaches	Coryneum blight	4		1	3
Pears	*Polystictus* sp. + *Stereum* sp.	1	1		
Pistachio	Verticillium wilt	1	1		
Plums	Cytospora canker	1	1		
Red currant	Gooseberry mildew	5	4	1	
Total		104	68	17	19

Table 67. Potassium and apple powdery mildew development

K_2O (g/pot)	Trial 1927		Trial 1928		
	Disease index on leaves	Relative length of diseased stem part	Days between inoculation and fructification	Disease index	Appearance of first necroses
0	4	24	13	4	August 6
0.4	4	20	13	3-4	August 6
1.2	3-4	20	13	3	July 20-30
2	3	14	13	3	July 20

Gloesporium fruit rot *(Gloesporium album)*

The percentage gloesporium fruit rot on apples after 7 months of storage was 1.0 % when trees received no potassium and 1.6 % when they were given 140 kg K_2O/ha *(Sansavini and Montevecchi [1986])*.

3.7.2. Apricots

Brown rot *(Sclerotinia fructicola)*

Wade [1956] reports various field trials. A reduction of the percentage of brown rot was observed when 9.5 kg KCl/tree were applied. Incorporation around the trees or spraying did not improve the effect of potassium on brown rot (Table 68).

3.7.3. Bananas

Armillaria mellea

In Malawi, on a soil with a medium K content, *Spurling and Spurling [1975]* observed a very strong reduction in the percentage of dead plants when increasing rates of potassium were applied (Figure 15).

Table 68. Potassium and brown rot development

Treatment	% brown rot					
	Trial Rokeby			Trial Sandford		
	1951-52	52-53	53-54	52-53	53-54	54-55
Unfertilized check	40	48	22	50	25	32
9.5 kg KCl/tree	29	53	16	30	21	22
9.5 kg KCl/tree incorporated					18	24
1 spray with 1 % KCl	19			41		
4 sprays with 1 % CKl	26					
1 spray with 1 % K_2SO_4				51		
4 sprays with 1 % K_2SO_4				43	25	

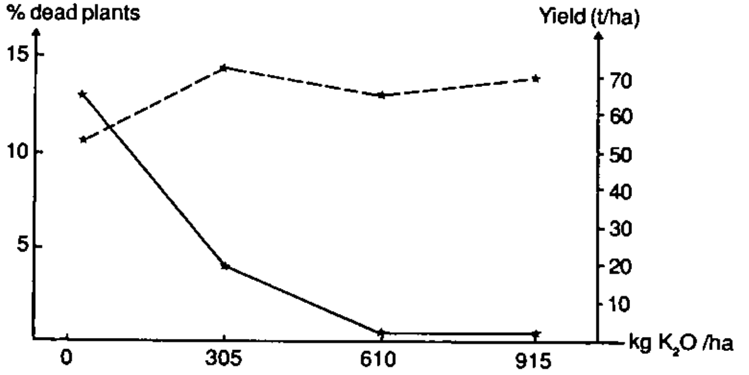

Fig. 15. Effect of potassium on banana plant death

3.7.4. Grapes

Downy mildew (*Plasmopara viticola*)

- *Schaffnit and Volk [1930]* made pot trials in 1926, 1927 and 1928. The rapidity of incubation was increased or unchanged whereas the percentage of successful inoculations was decreased by potassium. Potassium stimulated fungus development when inoculations were made early in the season and depressed it when they were made later. The fructification intensity was decreased by potassium in 1927 and 1928 but was unchanged in 1926.

- According to *Condei, Lepadata, Uglea and Glück [1980]*, the percentage of downy mildew on leaves was 7.5 % without potassium and 3.6 % when potassium was applied.

Grey mold *(Botrytis cinerea)*

A substantial reduction of grey mold due to potassium application is reported by *Condei, Lepadata, Uglea and Glück [1980])*. The percentage of diseased grapes was 28.4% in the control and it dropped to 9.0 % in the K treatment.

3.8. Oil crops

3.8.1. Soybeans

The effect of potassium was always or mostly beneficial in the case of phomopsis seed rot, pod and stem blight, stem and crown blight and anthracnose while the number of positive and negative indications is similar for purple seed stain (Table 69).

Table 69. Effect of potassium on soybean diseases

Disease	No. indications			
	Total	+	0	-
Anthracnose	5	5		
Brown stem rot	1	1		
Charcoal rot	1	1		
Phomopsis seed rot	25	25		
Pod and stem blight	43	27	2	14
Purple seed stain	19	10		9
Septoria brown spot	2	2		
Stem and crown blight	8	6		2
Diaporthe phaseolorum + *Phomopsis* sp.	2	2		
Total	106	79	2	25

Anthracnose (*Colletotrichum dematium*)

In Texas, on a soil low in K, the average anthracnose disease ratings for 3 years decreased significantly with increasing potassium rates *(Sij, Turner and Whitney [1985])*.

Phomopsis seed rot (*Phomopsis* sp.)

In a field trial with 4 soybean varieties in Ohio *(Jeffers, Schmitthenner and Kroetz [1982])*, the application of 60 kg K_2O/ha considerably reduced the moldy seed percentage and slightly decreased the phomopsis percentage (Table 70).

Table 70. Effect of potassium on phomopsis seed rot

	Without K	With K
Moldy seed due to Phomopsis (%)	12	4
Phomopsis (%)	54	50
Yield (t/ha)	1.5	2.4

Pod and stem blight of soybeans (*Diaporthae sojae, Diaporthe phaseolorum*)

- In a trial in cylinders filled with a soil low in K, potassium considerably reduced the percentage of diseased seeds for the 2 varieties investigated *(Crittenden and Svec [1974])* (Table 71).

Table 71. Potassium and pod and stem blight development

KCl or K_2SO_4	% diseased seeds		Yield (g/plant)	
(g/cylinder)	Var. Delmar	Var. Wayne	Var. Delmar	Var. Wayne
0	87	62	34	28
2	65	58	37	28
10	21	33	39	29
10 + 30 *	13	14	37	28

* as sidedress

- *Svec, Andrews and Crittenden [1976]* report results obtained over 2 years at 2 sites with 9 soybean varieties. The effect of potassium varied according to variety and site, but on the whole potassium tended to reduce the percentage of moldy seeds. The results for 1975 are shown in Table 72.
- According to *Camper and Lutz [1977]*, the application of 448 kg K_2O/ha on a soil low in potassium almost completely eliminated pod and stem blight during 2 years (Figure 16).

Table 72. Effect of potassium on percentage moldy seeds at 2 sites

Variety	Newark kg K_2O/ha			Georgetown kg K_2O/ha		
	0	56	223	0	56	223
FFR 444	14.2	9.4	9.6	31.2	18.4	24.6
Cutler 71	3.7	2.1	2.7	25.5	29.0	25.7
Kent	1.4	1.7	2.4	14.1	10.3	24.2
Wye	1.5	6.6	7.4	33.4	31.9	27.7
York	0.4	0	0.4	2.6	0.6	3.6
Essex	1.9	0.4	2.0	37.1	0.2	2.8
UD 67 - 18 KE - 32	1.7	0.4	0.2	1.0	2.2	1.7
UD 70 - 80 DE - 45	1.8	0.6	0.8	0.6	0.8	1.0
UD 70 - 80 DE - 37	9.5	3.1	1.2	0.2	0.4	1.5
Average	4.0	2.7	3.0	16.2	10.4	12.5

Purple seed stain *(Cercospora kikuchii)*

- In a trial carried out for 2 years with various soybean varieties on a soil medium in K, the effect of potassium was variable *(Svec, Andrews and Crittenden [1976])*. Table 73 contains the average results for both years.
- On a soil low in available K, *Camper and Lutz [1977]* obtained a marked reduction in the amount of purple stain by applying 448 kg K_2O/ha (Table 74).

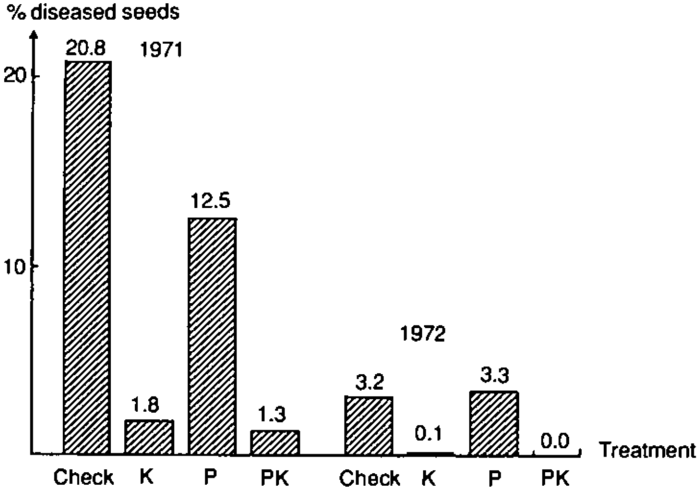

Fig. 16. Effect on potassium on pod and stem blight

Table 73. Average effect of potassium on purple stained seed percentage

Year	No. varieties	kg K_2O/ha		
		0	56	223
1974	5	4.4	3.1	3.6
1975	9	3.5	4.3	2.9

Table 74. Effect of potassium on purple stain

Treatment	% diseased seeds	
	1971	1972
Control	21.6	6.2
K	9.6	0.7
P	16.2	6.0
PK	8.4	0.8

3.8.2. Various oil crops

Table 75 shows that potassium more often decreased than increased leafspot on coconut and fusarium wilt on oil palm.

Table 75. Effect of potassium on diseases of various oil crops

Crop	Disease	No. indications			
		Total	+	0	-
Coconut	Coconut heart rot	2	2		
Coconut	Helminthosporium	1	1		
Coconut	Leaf spot	14	13		1
Coconut	Shoot rot	1	1		
Oil palm	Boyomi disease	1			1
Oil palm	Fusarium wilt	18	12	6	
Oil palm	Stem rot	1	1		
Peanut	*Fusarium* spp. + *Rhizoctonia solani*	2	2		
Rape	*Sclerotinia sclerotiorum*	1		1	
Sesame	Root rot	1			1
Sesame	Sesame blight	1	1		
Sunflower	*Sclerotinia sclerotiorum*	1	1		
Total		44	34	7	3

3.8.2.1. Coconut

Coconut heart rot

Mijailova [1971] observed in 1966 that the K-content of the soil was markedly lower where the trees were diseased.

Helminthosporium

The intensity of attacks was decreased by potassium applied as KCl in a trial in Ivory Coast *(Ollagnier, Ochs, Pomier and De Taffin [1983])*.

Leaf spot *(Drechslera incurvata, Pestalozzia palmarum)*

- In a pot trial with seedlings, potassium reduced disease intensity by 32 % *(Gallasch [1974])*.

- *Fagan [1985]* observed a reduction of sporulation due to K application in a pot experiment. In another pot experiment reported by the same author, potassium reduced disease severity on leaves while it tended to increase the number of primary spots per unit area. In this experiment, potassium reduced the size of lesions on leaves, the reduction being more important when nitrogen (16 g N/plant) was also applied (Figure 17).

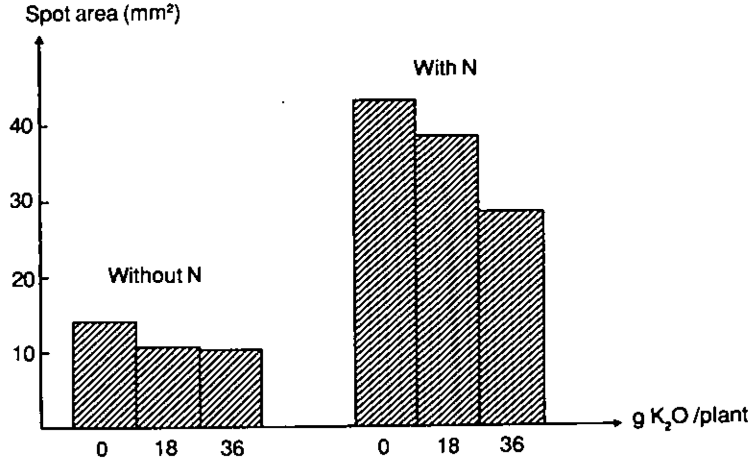

Fig. 17. Effect of nitrogen and potassium on spot area

- *Abad, Prudente and Magat [1978]* mention 2 trials which were carried out in the Philippines, *i.e.* one with 6 year old coconuts and the other with full bearing coconuts in which potassium very strongly reduced the number of leaf spots on leaflets. Results of the second experiment are presented in Table 76.

Table 76. Effect of potassium on leaf spots in full bearing coconuts

kg K_2O/tree/year	No. leaf spots per leaflet
0	198.0
0.50	16.6
1.00	12.4
1.50	11.1
2.00	14.1

3.8.2.2. Oil palm

Boyomi disease *(Fusarium bulbigenum* var. *tracheiphilum)*

In a field trial on a soil deficient in Mg, potassium slightly increased the percentage of diseased trees (from 17 to 23 %), this could be due to the Mg:K antagonism as Mg was the limiting factor *(Heim [1949]* in *Ollagnier [1976]).*

Fusarium wilt *(Fusarium oxysporum)*

- A longterm field trial has been carried out in Ivory Coast *(Ollagnier [1976]).* There were equal numbers of susceptible and resistant trees on each plot. A marked reduction of yield losses and a reduced disease progression appeared in the K-plots in 1971 and in subsequent years. The potassium effect only appeared 7 years after the initiation of the trial. The potassium effect was marked on both resistant and susceptible trees (Table 77).
- In a field trial initiated in 1948 in Benin *(Ollagnier [1976])* a marked reduction of the percentage of diseased trees was observed in the K-plots in 1964 (Figure 18).
- *Ollagnier [1976]* reports that in the nursery the K-content of the nutrient solution did not affect disease development after artificial inoculation.

Stem rot *(Fomes noxious)*

Navaratnam and Chee [1965] in *Thiagalingam [1977]* found that potassium was extremely effective in reducing attack whether applied alone or in combination with other nutrients (Table 78).

Table 77. Potassium and yield losses due to *Fusarium* wilt

Year	Treatment (kg KCl/tree)			
	K_0	K_1	K_2	K_3
1964	0.1	0.25	0.5	0.5
1965	0.2	0.5	0.75	1.0
1966	0.3	0.75	1.25	1.5
1967	0.4	1.0	1.5	2.0
1968	0.5	1.25	1.5	2.5
1969	0.5	1.25	1.5	3.0
1970-1972	0.5	1.25	1.5	3.0
1973-1975	0.75	4.5	1.5	3.0
	Yield losses (%)			
1971-1972	22	14	11	11
1972-1973	13	14	11	9
1973-1974	22	17	11	10
1974-1975	23	21	13	14

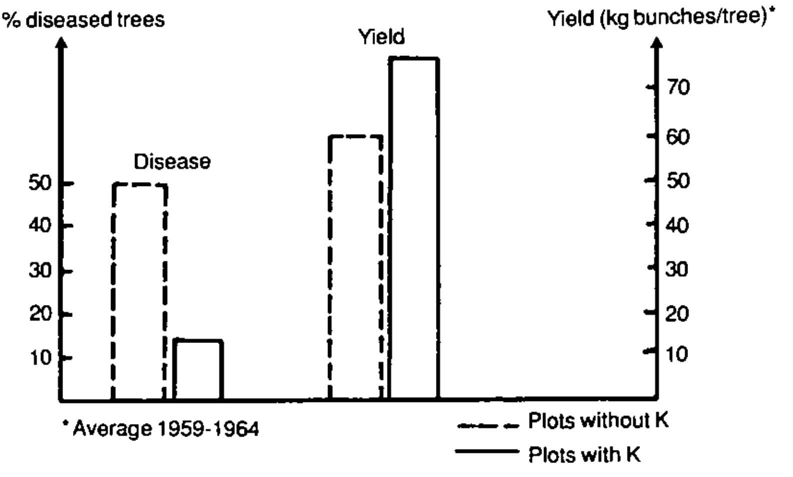

Fig. 18. Potassium and Fusarium wilt incidence

Table 78. Effect of various fertilizer treatments on stem rot disease

No. trees	Control	N	P	K	NP	NK	PK	NPK
Infected or dead	6	5	10	0	29	0	0	0
Suspect	11	8	14	1	21	0	0	0
Healthy	110	115	102	127	71	128	128	127
Missing	1	0	2	0	7	0	0	1
Total	128	128	128	128	128	128	128	128

3.8.2.3. Peanut

Fusarium spp. + *Rhizoctonia solani*

In 2 field trials in Egypt, K applied as K_2SO_4 reduced on average the percentage of infected pods by 54 % while it increased yield by 33 % *(El-Wakil, El-Deeb, Shalaby and Hilal [1984])*.

3.9. Starch and sugar crops

For all starch and sugar crops diseases taken together, positive effects of potassium are more numerous, however in the case of late blight of potato which was the most investigated disease there are more indications of an increase due to potassium (Table 79).

3.9.1. Beets

Root rot

On a soil poor in K, potassium considerably reduced the percentage of diseased plants and almost doubled the yield *(Trocmé and Lenoir [1956])* (Figure 19).

Table 79. Effect of potassium on diseases of starch and sugar crops

Crop	Disease	No. indications			
		Total	+	0	-
Beets	Beet rust	2	1		1
Beets	Cercospora	1	1		
Beets	Damping-off	4	4		
Beets	Root rot	1	1		
Beets	Rust	1	1		
Cassava	Anthracnose	3	3		
Cassava	Cercospora leaf spot	2	2		
Potato	Black scurf	4	3		1
Potato	Dry rot of potato	3	2		1
Potato	Early blight of potato	1	1		
Potato	Grey mould	1	1		
Potato	Late blight	30	7		21
Potato	Mildew	1	1		
Potato	Potato stem end rot	1	1		
Potato	Powdery scab	1	1		
Potato	Tuber blight	1		1	
Potato	*Phytophthora* spp.	2	2		
Sugarcane	Eyespot	2	2		
Sugarcane	Yellow spot disease	2	2		
Total		63	36	3	24

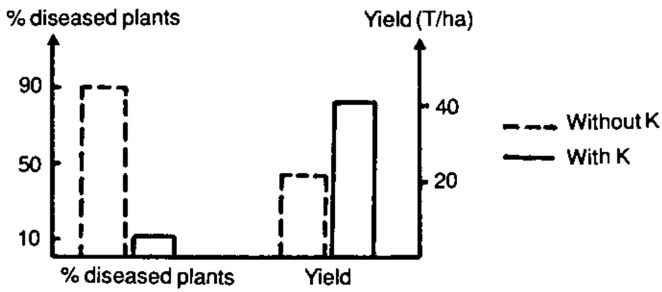

Fig. 19. Potassium and percentage of plants with root rot

3.9.2. Cassava

Cercospora leaf spot *(Cercospora henningsii)*

In India, a reduction of disease incidence due to potassium application was observed on 2 cassava varieties by *Muthuswamy, Sivaprakasam, Krishnamoorthy and Kandasamy [1977]*.

3.9.3. Potato

Dry rot of potato *(Fusarium coerulum)*
Potatoes were grown in 1972 on plots receiving the same fertilizer treatments since 1961 *(Langerfeld [1973])*. Potatoes were artificially inoculated during storage. Disease development was increased on tubers from plots receiving K (Table 80).

Table 80. Potassium and dry rot of potato

Treatment	Disease index
NP	2.62
NPK	3.78

Early blight of potato *(Alternaria solani)*

According to *Kumar, Gupta and Shah [1983]*, potassium markedly reduced disease incidence and increased yield (Table 81).

Table 81. Effect of potassium on incidence of early blight of potato

Treatment	Incidence (%)	Yield (t/ha)
NP	8.1	23.33
NPK	4.9	27.71

Late blight *(Phytophthora infestans)*

- Resistance of potato leaves was highest when K-concentration of the nutrient solution was 25 ppm, it decreased with an increase of the concentration to 150 ppm and increased again at 400 ppm *(Szczotka, Borys and Wojciechowski [1973])*. Effect was similar with both KCl and K_2SO_4.

- Potassium slightly increased spot formation on leaves and spore carrier development *(Weindlmayr [1965])*.
- In 15 trials carried out in Ireland, the average percentage of blighted tubers was 9.2 % without potassium and 9.5 % when 269 kg K_2O/ha were applied *(Herlihy and Carroll [1969])*. In these trials, the application of 269 kg K_2O/ha increased yield by 26 %.
- Potassium did not influence infection frequency but it increased development of lesions and intensity of sporulation *(Umaerus [1969]* in *Fuchs and Grossmann [1972])*.

Mildew

On a soil poor in K, disease incidence was reduced and yields were higher in the K-plots *(Kühn and Linser [1966])*.

Potato stem-end rot (*Fusarium* spp.)

In a long-term trial initiated in 1958, potatoes were cultivated in 1960/61. Without K, 10 % of tubers were diseased, with 280 kg/ha K this percentage decreased to 4 % *(Brewer [1962])*.

Powdery scab of potato *(Spongospora subterranea)*

In a long-term trial, powdery scab incidence was slightly reduced by potassium applied at 225 kg/ha *(Wenzl and Reichard [1974])* (Table 82).

Table 82. Potassium and powdery scab of potato

K_2O (kg/ha)	Disease index 1963
0	1.80
75	1.85
150	1.95
225	1.55

3.9.4. Sugarcane

Yellow spot disease *(Cercospora kopkei)*

In China, 60 kg K_2O/ha applied in addition to 240 kg N/ha resulted in a marked reduction of disease incidence *(Deyin [1983])* (Table 83).

Table 83. Effect of potassium on yellow spot disease

kg K_2O/ha	% affected plants	
	25. Aug. 1980	14. Sept. 1980
0	40.1	51.8
60	33.5	27.9

3.10. Stimulants

Beneficial effects of potassium on stimulants affected by fungal diseases are more numerous than the negative ones (Table 84).

3.10.1. Coffee

Brown spot *(Cercospora coffeicola)*

In a field trial in Cuba, potassium markedly reduced the degree of attack on leaves *(Isla, Rodriguez and Morales Gomez [1984])* (Table 85).

Rust *(Hemileia vastatrix)*

In a pot trial reported by *Figueiredo, Hiroce and Oliveira [1976]*, potassium decreased the number of leaves with pustules by 3 % and the number pustules per cm^2 of leaf by 6 % while it increased the number pustules per leaf by 7 %.

3.10.2. Tea

Anthracnose *(Gloesporium theae-sinensis)*

Kawai [1959] reported a marked reduction of the number of attacked leaves and thicker and harder leaves in the potassium plots (Table 86).

Table 84. Effect of potassium on stimulant crops diseases

Crop	Disease	No. indications			
		Total	+	0	-
Cacao	Blackpod	3	1		2
Cacao	Verticillium wilt	1		1	
Coffee	Brown spot	2	1	1	
Coffee	Leaf rust	1	1		
Coffee	Rust	3	2		1
Tea	Anthracnose	2	2		
Tea	*Colletotrichum camelliae*	1	1		
Tea	*Pestalozzia theae*	1	1		
Tea	Disease unspecified	1	1		
Tobacco	Brown spot	1	1		
Tobacco	Powdery mildew of tobacco	2			2
Tobacco	*Phytophthora* sp.	1	1		
Total		19	12	2	5

Table 85. Effect of potassium on brown spot

Treatment	Disease index on various plant parts		
	Base	Middle	Top
NP	7.1	2.1	0
NPK	1.2	1.1	0

Table 86. Potassium and anthracnose development

Treatment	No. leaves attacked (average of 6 samplings)	Thickness of leaves (mm)	Hardness of leaves (g)
NP	22	0.22	15
NPK	4	0.25	19
N	17	0.22	12
NK	3	0.25	20

3.11. Vegetables

Potassium almost always reduced muskmelon wilt and it also reduced fusarium yellows on celery in a large proportion of the cases while it always stimulated downy mildew on cabbage (Table 87).

Table 87. Effect of potassium on vegetable diseases

Crop	Disease	No. indications			
		Total	+	0	-
Beans	Anthracnose	7	5		2
Beans	Brown rust	2	1		1
Beans	Chocolate spot	1	1		
Beans	*Botrytis* spp.	1	1		
Broad beans	Chocolate spot	4	4		
Cabbage	Cabbage clubroot	5			5
Cabbage	Cabbage yellows	6	5		1
Cabbage	Downy mildew	14			14
Cabbage	Grey mold	1	1		
Cantaloupe	Fusarium wilt of cantaloupe	1	1		
Carrots	*Sclerotinia*	1	1		
Cauliflower	Downy mildew	1	1		
Celery	Fusarium yellows	36	22	1	13
Cowpea	Damping-off	3	2		1
Eggplant	Verticillium wilt	2	2		
Lentil	*Rhizoctonia solani*	2	1		1
Lentil	*Sclerotium rolfsii*	2	1	1	
Lettuce	Botrytis rot	1		1	
Muskmelon	Downy mildew	3			3
Muskmelon	Muskmelon wilt	22	20		2
Mustard	Cabbage clubroot	1			1
Onions	Basal rot	4	3		1
Onions	White rot	12	7		5
Onions	Disease unspecified	1	1		

Table 87 (continued)

Crop	Disease	No. indications			
		Total	+	0	-
Peas	Anthracnose	1	1		
Peas	Aphanomyces root rot	6	6		
Peas	*Botrytis* spp.	1	1		
Pigeon pea	Phytophthora blight	2	2		
Pumpkin	*Sclerotinia sclerotiorum*	1	1		
Radish	Verticillium wilt	1	1		
Squash	Foot rot	1	1		
Tomato	Alternaria leaf spot	3	3		
Tomato	Fusarium wilt of tomato	8	3		5
Tomato	Leaf blight	1			1
Tomato	Leaf mold of tomato	1	1		
Tomato	Stem rot	1	1		
Tomato	Verticillium wilt	2	1	1	
Tomato	*Botrytis cinerea*	7	5		2
Turnip	Cabbage clubroot	1			1
Total		170	107	4	59

3.11.1. Cabbage

Cabbage yellows *(Fusarium oxysporum)*

Walker and Hooker [1945] report results of 6 experiments with nutrient solutions. With the susceptible cabbage varieties, disease development was reduced by potassium at a temperature of 19° and 25° except for the evaluations after 32 days. With the resistant cabbage variety, disease development was increased by potassium (Table 88).

3.11.2. Celery

Fusarium yellows *(Fusarium oxysporum)*

The effect of potassium applied in addition to ammoniacal- and nitrate-nitrogen has been investigated in various greenhouse and field trials carried out with artificially inoculated celery in Louisiana *(Schneider [1985])*. In this study, the use of NH_4-N resulted in more severe disease than did NO_3-N and the application of KCl resulted in larger reductions of disease when it was combined with NO_3-N than with NH_4-N. The results of 3 greenhouse trials are shown in Table 89.

Table 88. Potassium and cabbage yellows development

Experiment number	1	2	3	4		5		6	
Type of host	Susc.	Susc.	Susc.	Susc.		Susc.		Type B Res.	
Temperature	19°C	19°C	19°C	25°C		25°C		25°C	
Nutrient concentration	0.1 H	2 H	2 H	1 H		1 H		1 H	
Duration (days)	35	36	42	15	32	15	32	32	
Nutrient solution	Disease indices							Average index	
K-deficient	87	61	83	93	100	71	98	31	71
Basal	75	40	53	67	100	62	94	41	56

Table 89. Effect of N and K form on disease severity

	Disease severity *		
Treatment	Trial 1	Trial 2	Trial 3
$(NH_4)_2SO_4$	5.6	5.4	5.9
$(NH_4)_2SO_4$+KCl	5.0	5.4	5.5
$(NH_4)_2SO_4 + K_2SO_4$	6.8	6.8	6.1
NH_4NO_3	5.1	5.5	5.0
NH_4NO_3 + KCl	4.6	5.0	4.8
$NH_4NO_3 + K_2SO_4$	6.0	5.6	5.3
NH_4Cl	5.6	5.5	6.3
NH_4Cl + KCl	5.4	5.1	5.9
$NH_4Cl + K_2SO_4$	6.1	5.6	6.0
$Ca(NO_3)_2$	3.6	3.1	3.4
$Ca(NO_3)_2$ + KCl	2.1	2.0	2.1
$Ca(NO_3)_2 + K_2SO_4$	3.8	3.9	5.2

* 1 = healthy; 7 = wilted or dead

In a field trial the percentage of disease was 16.2 % with $Ca(NO_3)_2$ alone and 7.5 % or 16.3 % when 448 kg K were added as KCl or K_2SO_4. In an other field trial the percentage disease was 52.5 % with $Ca(NO_3)_2$ and only 16.2 % with $Ca(NO_3)_2$ + KCl, K being applied at the rate of 291 kg K/ha.

3.11.3. Muskmelon

Muskmelon wilt *(Fusarium oxysporum)*

In pot trials with sterilized and unsterilized soil *(Ramasamy and Prasad [1974])*, a gradual decrease of wilt incidence, number of propagules and population of *Fusarium* spp. and *Fusarium oxysporum f. melonis* were observed with increasing potassium rates. Maximum decrease was generally obtained with 60 kg/ha K_2O. With the exception of wilt percentage in unsterile soil, no further decrease was obtained with higher K-rates (Figure 20 and Table 90).

3.11.4. Onions

Basal rot *(Fusarium oxysporum)*

According to *Ashour, Elewa, Ali and Dabash [1980]*, potassium markedly reduced bulb infection at harvest and after 2 months storage in a pot trial carried out over 2 years (Table 91).

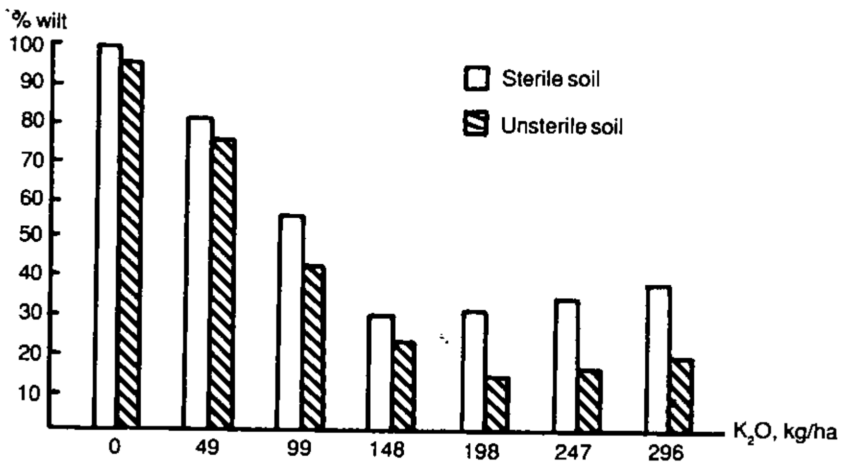

Fig. 20. Potassium and wilt incidence

Table 90. Potassium and Fusarium populations and propagules in hypocotyl

K_2O (kg/ha)	Population per kg soil after 25 days						Propagules per kg hypocotyl after 25 days	
	Unsterile soil				Sterile soil			
	Rhizosphere		Non-rhizosphere					
	Fusarium spp.	*F. o.f. melonis*	*Fusarium* spp.	*F. o.f. melonis*	Rhizo-sphere	Non-rhizo-sphere	Sterile soil	Unsterile soil
0	115	56	95	29	63	38	89	83
49	105	42	99	25	58	32	82	81
99	92	31	87	23	55	33	42	36
148	80	21	62	15	32	35	20	15
198	82	25	67	17	27	29	22	17
247	89	27	65	16	30	27	21	15
296	92	30	72	19	35	35	25	19

Table 91. Effect of potassium on bulb infection (%)

Treatment	At harvest		After 2 months storage	
	1973	1974	1973	1974
N_1P_1	16	10	26	36
N_1P_1K	12	8	19	14
N_2P_2	13	22	32	31
N_2P_2K	8	9	13	15

White rot *(Sclerotium cepivorum)*

Several trials are reported by *Ashtana [1945]*. Two field trials were carried out in 1931 and 1932 on an infected soil. Results varied according to infection intensity. In 1931, potassium increased the percentage of healthy plants when onions were inoculated and had no marked influence on this percentage when onions were not inoculated. In 1932, infections were more severe and potassium slightly decreased the percentage of healthy plants, whether or not the onions were inoculated (Table 92).

Soil type also influenced the potassium effect. Potassium increased the percentage of healthy plants for inoculated onions on a dry light soil whereas it decreased it on a wet peaty soil (Table 93).

In a laboratory trial, fungus penetration was reduced in onion bulbs from K-plots (Table 94).

Table 92. Potassium and white rot development in 2 different years

Treatment	Artificial inoculation	% healthy plants after ...days - trial 40 (1931)	63 (1931)	40 (1932)	63 (1932)
NP	Yes	38	13	17	15
NPK	Yes	65	65	16	9
NP	No	72	71	25	17
NPK	No	68	68	18	14

Table 93. Potassium and white rot development on 2 different soil types

Treatment	Artificial inoculation	% healthy plants Dry light soil	Wet peaty soil
NP	Yes	24	42
NPK	Yes	35	20
NP	No	43	70
NPK	No	45	66

Table 94. Potassium and white rot penetration in bulbs

Treatment	Rotted area (cm)
NP	1.2
NPK	0.8

3.11.5. Peas

Aphanomyces root rot *(Aphanomyces euteiches)*

In the greenhouse, *Wade [1955]* observed a reduced disease intensity and more plants free of symptoms with potassium in a soil with normal moisture or waterlogged for one week and then with normal moisture. The soil used was low in K (Table 95).

Table 95. Potassium and Aphanomyces root rot on 2 soils with different moisture

Soil moisture	Fertilizer	Disease rating	% plants free of symptoms	Weight of tops (g	Weight of roots (g)
Normal	0	1.95	2	5.1	2.0
	K	1.18	14	6.5	2.9
Waterlogged 1 week,	0	2.90	0	3.2	0.6
then normal	K	2.03	2	4.8	1.3

3.11.6. Pigeon peas

Phytophthora blight of pigeon pea *(Phytophthora drechsleri)*

In India, *Pal and Grewal [1976]* report that potassium decreased the percentage of plants killed in a 2 year field trial (Table 96).

Table 96. Effect of potassium on the percentage of plants killed

kg K_2O/ha	1970	1971
0	63.5	44.9
25	58.0	39.4
50	51.6	33.1

3.11.7. Tomato

Alternaria leaf spot *(Alternaria solani)*

- *Kiraly [1976]* reports a reduction of the size of necrotic spots on leaves when the K-concentration of the nutrient solution increases (Table 97).
- *Bedi and Dhiman [1983]* found that potassium decreased the velocity of incubation and disease incidence.

Table 97. Potassium and diameter of *Alternaria* leaf spot lesions

K-concentration (ppm)	Diameter of lesions (μm)
8	2000
78	2170
237.5	1380
400	1028

Fusarium wilt

When a nutrient solution was sprayed after inoculation, increasing K-content stimulated disease development whereas K-content had no effect when the nutrient solution was sprayed before inoculation *(Foster and Walker [1947])* (Table 98).

Table 98. Indices of the development of *Fusarium* wilt in tomato plants sprayed with potassium chloride before and after inoculation

Molar concentration	Disease indices *	
	Sprayed before inoculation	Sprayed after inoculation
0	62.0	47.5
0.12	67.0	48.5
0.24	62.5	62.5
0.36	64.0	64.0
0.48	62.5	74.0

* Calculated from a scale in which 0 represents no symptoms and 100 represents severe wilt. Each figure is the average for 160 plants.

3.12. Various crops

3.12.1. Hops

Verticillium spp.

The percentage infected plants decreased when the N:K ratio of the nutrient solution given to hops decreased. With the decrease of the N:K ratio, the percentage of plants with wilt symptoms first markedly decreased and increased again at lower N:K ratios *(Maier [1971])* (Figure 21).

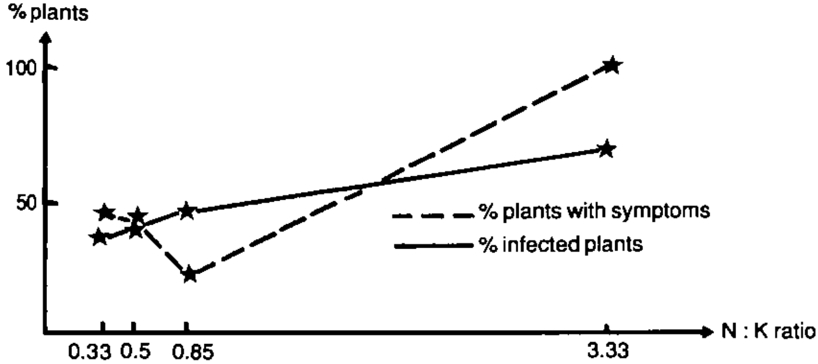

Fig. 21. N:K ratio and *Verticillium* spp.

3.12.2. Peppers

Fruit rot *(Alternaria solani + Colletotrichum capsici)*

In a field trial conducted in India, potassium decreased disease intensity *(Sivaprakasam, Subramanian and Pillayarsamy [1976])*.

3.12.3. Turfgrasses

Red thred disease *(Corticium fuciforme)*

In a field trial continued for 2 years with perennial ryegrass, the application of 163 kg K_2O/ha tended to reduce disease in 1980 and it reduced it significantly in 1981 *(Cahill, Murray, O'Neill and Dernoeden [1983])* (Table 100).

Tables 99. Effect of potassium on diseases of various crops

Crop	Disease	No. indications			
		Total	+	0	-
Antirrhinum	Antirrhinum wilt	1	1		
Carnations	Fusarium wilt of carnations	1	1		
Carnations	*Fusarium* sp.	1	1		
Chrysanthemum	Phoma root rot	7	1	2	4
Gladiolus	Dry rot	4	4		
Gladiolus	Fusarium basal rot	1			1
Gladiolus	Fusarium yellows	1	1		
Hops	*Verticillium* spp.	2	2		
Lion's mouth	Verticillium wilt	1	1		
Mint	Mint rust	1	1		
Peppers	*Alternaria solani* + *Colletotrichum capsici*	1	1		
Philodendron	Phytophthora leaf spot	1	1		
Roses	Mildew	1	1		
Roses	Powdery mildew	4		4	
Strawberry	Leaf spot	7	6		1
Strawberry	Strawberry fruit rot	1	1		
Turfgrasses	Brown patch	1			1
Turfgrasses	Dollar spot	4	1		3
Turfgrasses	Helminthosporium red leaf spot	1	1		
Turfgrasses	Ophiobolus patch	2	2		
Turfgrasses	Red thred disease	8	7		1
Turfgrasses	Rhizoctonia brown patch	1	1		
Turfgrasses	Snow mold	3	1		2
Turfgrasses	Stripe smut	2	2		
Turfgrasses	*Helminthosporium poae*	1	1		
Turfgrasses	*Helminthosporium* spp.	1	1		
Total		59	40	6	13

Table 100. Effect of potassium on red thred disease

kg K_2O/ha	Disease rating *	
	1980	1981
0	7.4	5.8
163	7.5	6.2
325	7.5	6.0

* 1 = 99 - 100 % of leaves diseased; 9 = 0 - 1 % of leaves diseased

4. Effect of potassium on insects and mites

There are more than twice as many indications of a depressing effect on insects and mites than indications of a stimulating effect (Table 101).

4.1. Effect of potassium in different pest groups

According to Table 101, most indications (89%) concern 6 pest groups which are in order of importance aphids, Lepidoptera, mites, planthoppers, Coleoptera and scales. There is no indication of stimulation due to potassium for scales. Aphids are depressed almost 3 times more frequently than stimulated. The beneficial effect of potassium largely predominates in the case of planthoppers and Coleoptera while for Lepidoptera and mites, numbers of indications of a depression or stimulation are similar.

Table 101. Effect of potassium on insects and mites

Pest group	No. indications - ( ) % of total			
	Total	+	0	-
Thysanoptera (Thrips)	8	5	1	2
Heteroptera (Bugs)	6	5		1
Homoptera - Aphids	175	115	19	41
Homoptera - Leafhoppers	12	10	2	
Homoptera - Mealybugs	4	3		1
Homoptera - Planthoppers	35	29	2	4
Homoptera - Scales	17	16	1	
Homoptera - White flies	2			2
Lepidoptera	83	41	5	37
Coleoptera	34	23	1	10
Hymenoptera	5	3	1	1
Diptera	14	9	1	4
Mites	64	31	6	27
Total	459	290 (63)	39 (9)	130 (28)

4.2. Thysanoptera *(Thrips)*

Baliothrips biformis

In a field trial with rice in India, *Subramanian and Balasubramanian [1976]* observed a considerable reduction of the thrips population with increasing potassium rates (Figure 22).

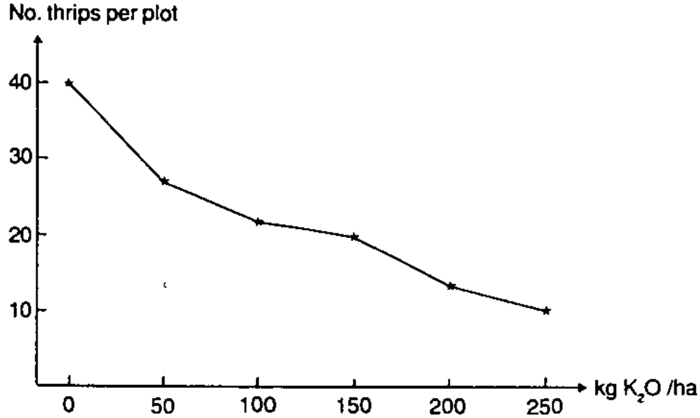

Fig. 22. Effect of potassium on *Baliothrips biformis*

Chloethrips oryzae

In a field trial with rice, potassium reduced the thrips populations *(Vaithilingam and Balasubramaniam [1976])*.

Frankliniella fusca

According to *Semtner [1984]*, the application of potassium increased the number of thrips on flue cured and dark fired tobacco.

4.3. Heteroptera (Bugs)

Blissus leucopterus

Pritchett and Horn [1966] report that in a field trial with turfgrasses damage decreased slightly with increasing KCl-rates.

Table 102. Effect of potassium on Thysanoptera

Name	No. indications			
	Total	+	0	-
Baliothrips biformis	1	1		
Chloethrips oryzae	2	2		
Frankliniella fusca	2			2
Thrips lini	1	1		
Thrips sp.	2	1	1	
Total	8	5	1	2

Table 103. Effect of potassium on Heteroptera

Name	No. indications			
	Total	+	0	-
Blissus leucopterus	3	2		1
Helopeltis theivora	1	1		
Species not mentioned	2	2		
Total	6	5		1

4.4. Homoptera

4.4.1. Aphids

According to Table 104, the most investigated aphid, *Myzus persicae* is depressed almost 7 times more frequently than increased.

Acyrthosiphon pisum

- In 5 pot trials carried out by *El-Tigani [1962]* with broad beans and peas, potassium decreased the number of larvae per plant in 2 trials whereas it markedly increased it in 1 trial (Table 105).

Table 104. Effect of potassium on aphids

Name	No. indications			
	Total	+	0	-
Acyrthosiphon pisum	14	9	1	4
Aphis craccivora	1			1
Aphis fabae	4	2		2
Aphis gossypii	2	1	1	
Aphis pomi	3	1	1	1
Aphis rhamni	1	1		
Brachycolus noxius	1			1
Brevicoryne brassicae	5	5		
Doralis rhamni	1			1
Eriosoma lanigerum	10	8	1	1
Lipaphis erysimi	2			2
Macrosiphum euphorbiae	10	5		5
Myzus persicae	64	55	1	8
Rhopalosiphum fitchi	1	1		
Rhopalosiphum padi	4	3		1
Schizaphis graminum	18	7	2	9
Therioaphis maculata	5	3		2
Toxoptera graminum	3	1		2
Species not mentioned	26	13	12	1
Total	175	115	19	41

Table 105. Potassium and *Acyrthosiphon pisum*

Crop	Trial	No. larvae per plant	
		NP 1/4 K	NPK
Broad beans	I	188	205
Broad beans	II	258	252
Peas	I	202	119
Peas	II	248	299
Peas	III	238	192

- *Taylor, Apple and Berger [1952]* report 2 field trials carried out in 1950 and 1951, respectively. The number of aphids per plant in the open was decreased by potassium in both years, whereas in cages the number was decreased in 1950 and increased in 1951 (Table 106).

Table 106. Potassium and *Acyrthosiphon pisum*

Treatment	No. aphids per plant			
	Trial 1950		Trial 1951	
	Outside cages	In cages	Outside cages	In cages
NP	3.8	1035	84	10 400
NPK	2.4	890	61	11 900

- A nutrient solution trial with peas is reported by *Barker and Tauber [1951]*. When female aphids were put on 3 week old plants, potassium slightly decreased the female fecundity but it increased the interval between introduction of the aphids and plant death due to aphid injury. When female aphids were put on 4 weeks old plants, potassium increased the female fecundity and almost doubled the time to appearance of plant death (Table 107).

Table 107. Potassium and *Acyrthosiphon pisum*

Plants age at infestation	Treatment	Average progeny per female	Days to appearance of plant death
3 weeks	NPK low	73	20
3 weeks	NPK	69	29
4 weeks	NPK low	31	14
4 weeks	NPK	43	28

Aphis fabae

- Already in 1906, *Seelhorst* in *El-Tigani [1962]* observed that aphids developed much less on beans fertilized with potassium.

- Potassium considerably decreased number of larvae per plant in a pot trial with beet and very slightly increased it in a pot trial with broad beans *(El-Tigani [1962])* (Figure 23).

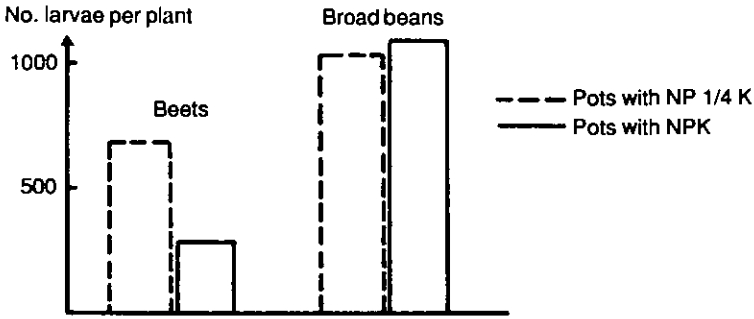

Fig. 23. Potassium and *Aphis fabae*

Brevicoryne brassicae

In a pot trial with cabbage, potassium considerably reduced the number of larvae per plant *(El-Tigani 1962)* (Figure 24).

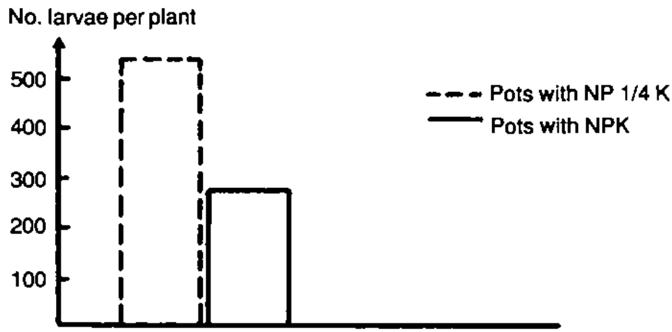

Fig. 24. Potassium and *Brevicoryne brassicae*

Doralis rhamni

In a field trial with potatoes, number of larvae was slightly higher in the potassium plots *(Völk, Bode and Hauschild [1952])* (Table 108).

Table 108. Potassium and *Doralis rhamni*

Plots	No. larvae from July 1.- 29.
Without K	76
With K	81

Eriosoma lanigerum

Reduced multiplication of *Eriosoma* on apples was reported by *Scheller [1932]* in *El-Tigani [1962]* and on red currant by *Trummer [1940]* in *El-Tigani [1962]*.

Lipaphis erysimi

In a pot trial with mustard, K did not affect appreciably the development period and reproduction rate of the mustard aphid *(Kundu and Pant [1967])*.

Macrosiphum euphorbiae

- In 2 trials with nutrient solutions and potatoes, potassium slightly increased the number of nymphs per adult in one trial and slightly increased the number of aphids per plant in the other trial *(Taylor, Apple and Berger [1952])* (Table 109).

Table 109. Potassium and *Macrosiphum euphorbiae*

Treatment (ppm)			Trial I	Trial II
N	P	K	No. nymphs per adult	No. aphids per plant
134	165	8	10.0	232
134	165	208	11.6	266

- In 2 field trials, the aphid population on 20 leaves in cages was slightly decreased by potassium in 1950 and increased in 1951. Number of aphids on ten feet rows was practically unaffected by potassium in 1951 *(Taylor, Apple and Berger [1952])* (Figure 25).

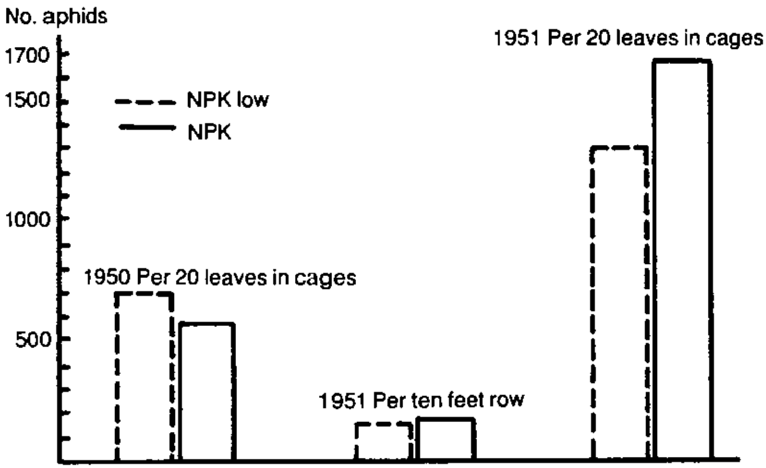

Fig. 25. Potassium and number of *Macrosiphum euphorbiae*

Myzus persicae

- In a long-term field trial with potatoes, a reduction of aphid numbers was observed in 1938 and 1951 *(Klapp [1951])* (Figure 26).

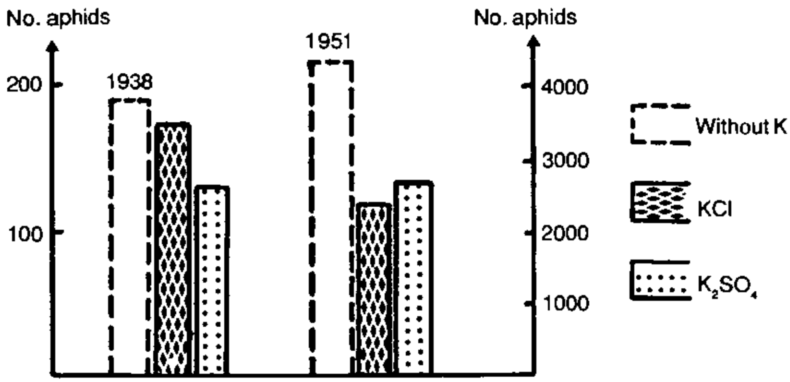

Fig. 26. Potassium and number of *Myzus persicae*

- In 2 pot trials with potatoes reported by *Wünscher [1952]*, the number aphids on plants was markedly decreased in both trials by K_2SO_4 and in one trial by KCl (Figure 27).

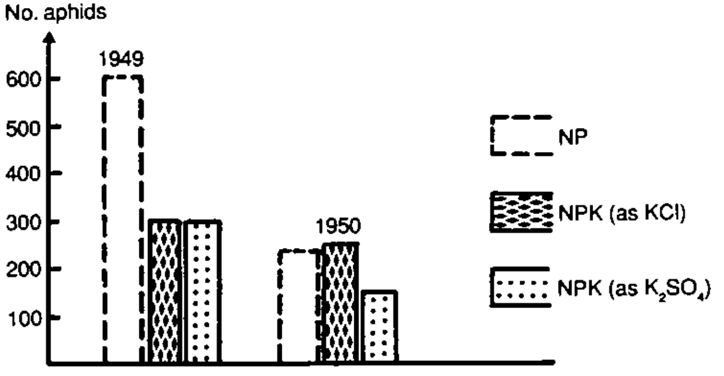

Fig 27. Potassium and number of *Myzus persicae*

- *El-Tigani [1962]* observed many fewer larvae on plants in pots receiving the full K-rate (Table 110).

- In a pot trial in the greenhouse, potassium increased aphid fecundity and lengthened adult and nymphal life whereas the effect was opposite in the insectary *(Wooldridge and Harrison [1968])* (Table 111).

- *Michel [1963]* reports that fecundity of aphids in Petri dishes was reduced when they received tobacco leaves cultivated in a nutrient solution deficient in potassium (Table 112).

Table 110. Potassium and number of *Myzus persicae* larvae

Treatment	No. larvae/plant
NP 1/4 K	36
NPK	17

Table 111. Potassium and development of *Myzus persicae*

Treatment (kg/ha)			Trial	Length in days of		No. youngs/
N	P_2O_5	K_2O		Adult life	Nymphal life	female
222	222	0	Greenhouse	7	5	17
222	222	445	Greenhouse	15	9	44
222	222	0	Insectary	15	8	38
222	222	445	Insectary	12	6	36

Table 112. Potassium and fecundity of *Myzus persicae*

Treatment	No. descendants per generation
NPK low	8.0
NPK	39.8

- Aphids in Petri dishes preferred potato leaves grown in nutrient solution deficient in potassium *(Völk, Bode and Hauschild [1952])* (Figure 28).

- In greenhouse trials, the application of potassium reduced reproduction and life span of aphids on 16 chrysanthemum varieties *(Markkula, Roukka and Tiittanen [1969])*.

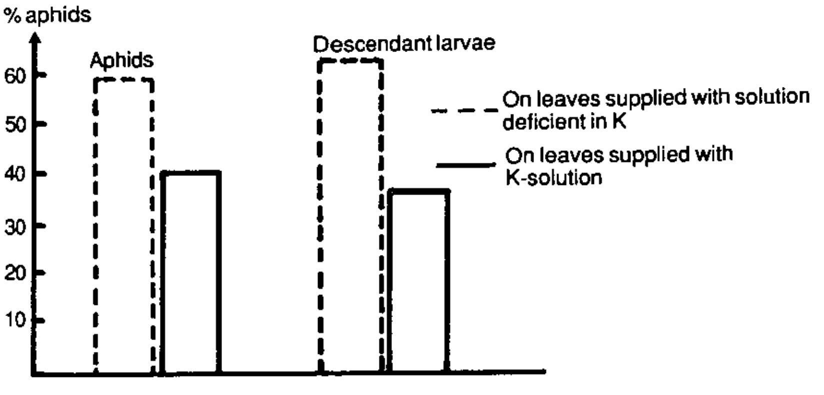

Fig. 28. Preference of *Myzus persicae* for leaves supplied with different nutrient solutions

Rhopalosiphum padi

In 3 of 4 pot trials with maize, oats and wheat reported by *El-Tigani [1962]* potassium markedly decreased the number of larvae per plant (Figure 29).

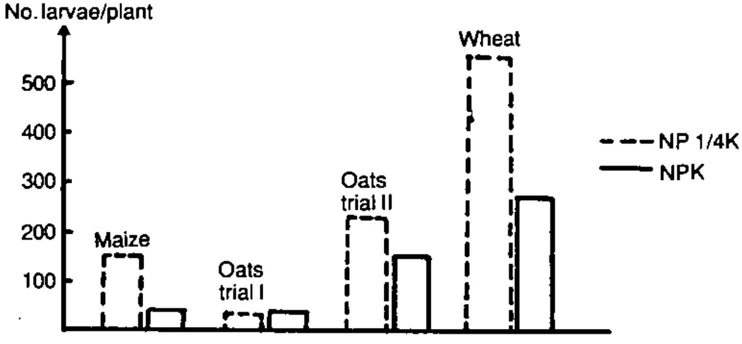

Fig. 29. Potassium and number larvae of *Rhopalosiphum padi*

Therioaphis maculata

More aphids were observed on resistant lucerne clones C-84 and C-902 when they were supplied a K-deficient nutrition solution but on the resistant clone Caliverde, the K-content of the nutrient solution did not affect aphid numbers *(Mc Murtry [1962]* in *Leath and Ratcliffe [1974])* (Figure 30).

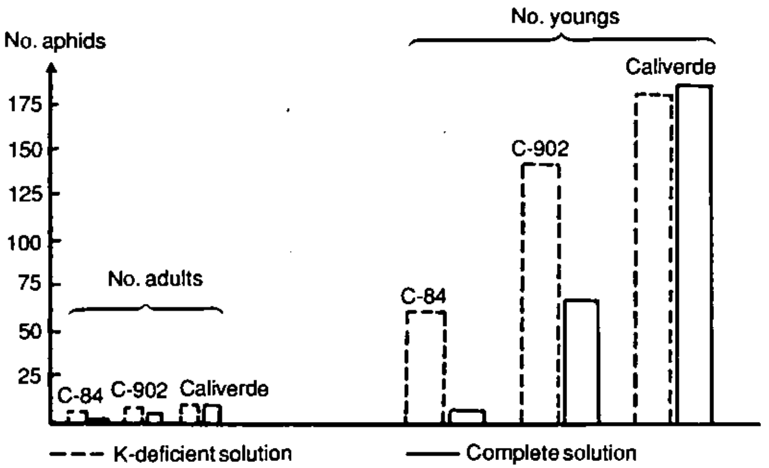

Fig. 30. Potassium and number of *Therioaphis maculata*

Toxoptera graminum

Daniels [1957] obtained a slight increase in number of aphids in 2 pot trials with wheat in the greenhouse (Table 113).

Table 113. Potassium and number *Toxoptera graminum* on wheat

Treatment (kg/ha)			No. greenbugs/2 plants	
N	P_2O_5	K_2O	Trial 1956	Trial 1957
67	67	0	180	313
67	67	67	193	366

4.4.2 Leafhoppers, mealybugs, planthoppers, white flies

In this group of insects the effect of potassium was 6 times more frequently beneficial than negative (Table 114).

Nephotettix virescens* and *Zygina maculifrons

- In a field trial with rice, potassium significantly reduced incidence of *Nephotettix virescens* and *Zygina maculifrons* in varieties Kannagi and IR 20 *(Vaithilingam and Balasubramanian [1976 a]).*

- *Subramanian and Balasubramanian [1976]* report that the number of *Nephotettix virescens* on rice decreased from 2.64 per plot without potassium to 1.72 and 1.44 when 100 and 200 kg K_2O/ha were applied.

Phenacoccus manihoti

In a pot trial with cassava, the application of potassium at 180 kg K_2O/ha decreased the number eggs per female by 9% on variety TMS 30572 while it increased it by 14% on variety TMS 30001 *(Lema and Mahunga [1983]).*

Nilaparvata lugens

- In laboratory, insect feeding was reduced on rice plants fertilized with potassium and in a field trial, potassium significantly reduced insect incidence in rice varieties Kannagi and IR 20 *(Vaithilingam and Balasubramanian [1976 a]).*

Table 114. Effect of potassium on leafhoppers, mealybugs, planthoppers and white flies

Family	Name	No. indications			
		Total	+	0	-
Leafhoppers	*Empoasca devastans*	2		2	
Leafhoppers	*Empoasca fabae*	1	1		
Leafhoppers	*Nephotettix virescens*	3	3		
Leafhoppers	*Zygina maculifrons*	2	2		
Leafhoppers	Green leafhopper	2	2		
Leafhoppers	Species not mentioned	2	2		
Mealybugs	*Phenacoccus manihoti*	2	1		1
Mealybugs	*Planococcus citri*	1	1		
Mealybugs	*Pseudococcus comstocki*	1	1		
Planthoppers	*Nilaparvata lugens*	13	12		1
Planthoppers	*Pyrilla pusana*	4	2		2
Planthoppers	*Pyrilla* spp.	2	1		1
Planthoppers	*Saccharosydne saccharivora*	2		2	
Planthoppers	Brown planthopper	14	14		
White flies	*Bemisia tabaci*	2			2
Total		53	42	4	7

- According to *Subramanian and Balasubramanian [1976]*, the application of 100 kg K_2O/ha reduced by 15% the number of brown planthoppers per hill in a field trial with rice.

- *Ittyavirah, Vasudevan Nair and Thomas [1979]*, observed 800 brown planthoppers per m2 when rice received no potassium and only 302 when 135 kg K_2O/ha were applied.

Saccharosydne saccharivora

In 2 pots trials with young and ratoon cane respectively, the average daily egg production of females was not affected by potassium *(Metcalf [1970])*.

Bemisia tabaci

In a field trial with squash, number of eggs was practically unaffected by potassium whereas number of nymphs was slightly increased *(El-Bebeidi and Goubar [1971])* (Table 115).

Table 115. Potassium and development of *Bemisia tabaci*

Plots	No. eggs/cm^2	No. nymphs/square inch	Yield (kg/plot)
Without K	1.45	0.52	8.47
With K	1.47	0.59	7.38

4.4.3. Scales

There is no indication of scale increase due to potassium (Table 116).

Table 116. Effect of potassium on scales

	No. indications			
	Total	+	0	-
Eulecanium corni	2	2		
Eulecanium rufulum	4	3	1	
Lepidosaphes beckii	4	4		
Melanaspis glomerata	1	1		
Parlatoria ziziphi	2	2		
Saissetia oleae	4	4		
Total	17	16	1	

Eulecanium corni

In a field trial with Robinia, potassium almost completely eliminated scales and markedly reduced the number of dead trees *(Brüning and Uebel [1971])* (Table 117).

Table 117. Potassium and *Eulecanium corni*

Treatment	No. insects/10cm section of stem	No. dead trees per 1000 m^2	Average tree height (m)	Tree growth (m^3/1000 m^2)
PCa	9.09	286	3.08	0.41
PKCa	0.26	164	3.84	0.70

Eulecanium rufulum

- In a food preference test in Petri dishes, larvae chose less frequently oak leaves from potassium-plots *(Brüning and Uebel [1971])* (Figure 31).

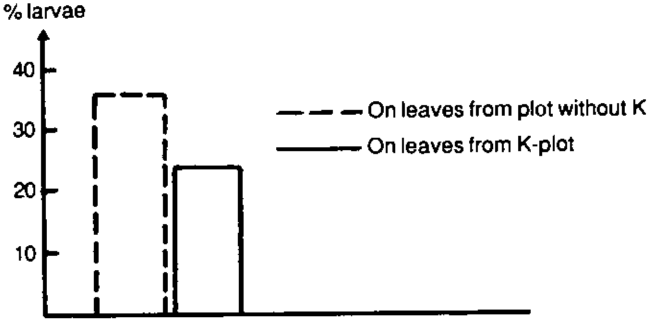

Fig. 31. Food preference of *Eulecanium rufulum*

- In a field trial *(Brüning and Uebel [1971])*, larvae were put in early spring on twigs of oak trees receiving various fertilizer treatments. In the year of artificial infestation, there was practically no difference between the treatments but the number of insects of the second generation which developed in the following year was considerably reduced by potassium. The author suggests that the absence of fertilizer effect in the first spring could be due to the fact that the upward flowing sap in spring is concentrated enough to mask the shortages of particular constituents which became apparent at a later stage of development (Figure 32).
- In a field trial with natural infestation, potassium considerably decreased the number of insects *(Brüning and Uebel [1971])* (Figure 33).

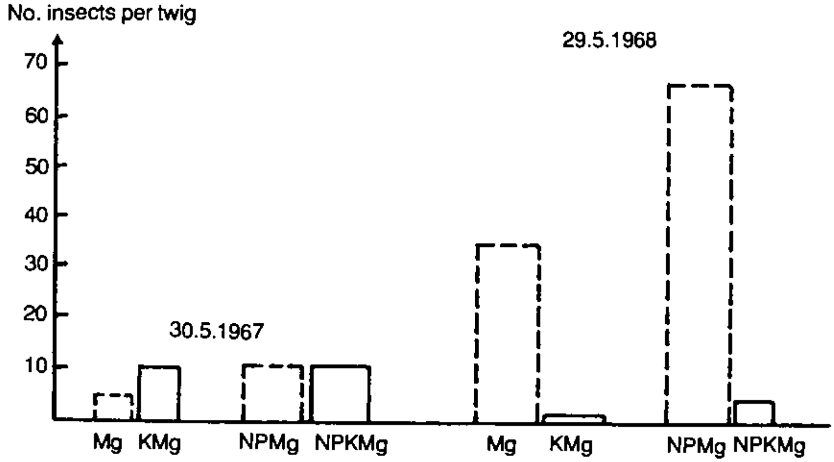

Fig. 32. Potassium and *Eulecanium rufulum*

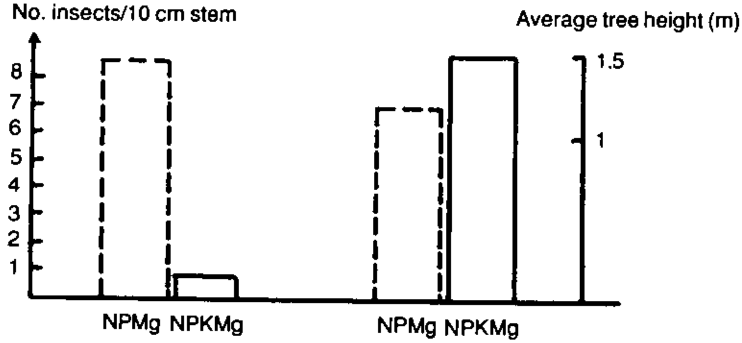

Fig. 33. Potassium and *Eulecanium rufulum*

Lepidosaphes beckii

In a field trial with citrus *(Chaboussou [1974] and [1976])*, the number of scales on leaves, twigs and fruits was considerably reduced by potassium (Figure 34).

Melanaspis glomerata

In a field trial with sugarcane, the percentage of infested nodes dropped from 24.5% in the control to 18.0% with 168 kg K_2O/ha and to only 6.5% with 336 kg K_2O/ha *(Raghunath [1983])*.

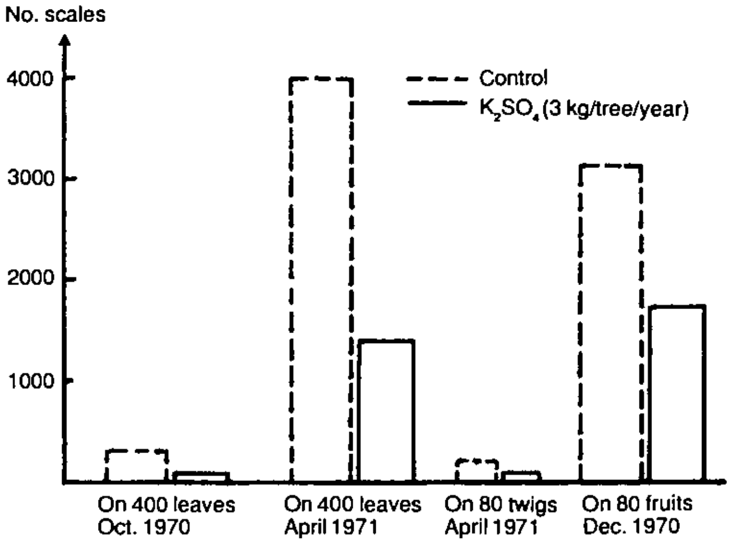

Fig. 34. Potassium and *Lepidosaphes beckii* populations

Parlatoria ziziphi

In a field trial with citrus, numbers of scales on leaves and twigs were very low in the potassium-plots *(Chaboussou [1976])* (Table 118).

Table 118. Potassium and *Parlatoria ziziphi*

Treatment	No. scales	
	On 400 leaves	On 80 twigs
Control	132	104
K_2SO_4 (3kg/tree/year)	54	20

Saissetia oleae

In a field trial with citrus, number of scales on leaves, fruits and twigs were markedly reduced in the potassium-plots in 1970 and 1971 *(Chaboussou [1974])* (Figure 35).

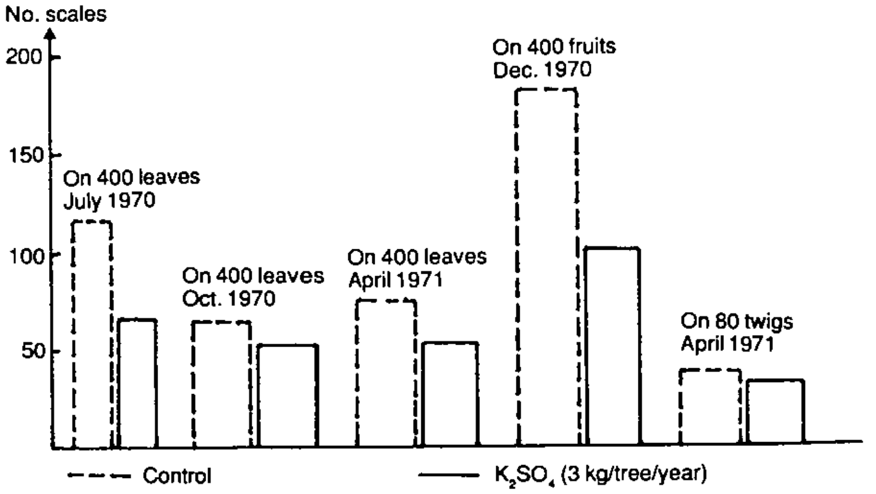

Fig. 35. Potassium and *Saissetia oleae*

4.5. Lepidoptera

Chilo suppressalis

In a greenhouse trial, potassium reduced percentage surviving larvae and larval body weight. In 2 nutrient solution trials, potassium did not markedly affect surviving larvae and slightly increased larval body weight in one trial *(Hirano and Ishi [1961])* (Table 120).

Table 119. Effect of potassium on Lepidoptera

Name	No. indications			
	Total	+	0	-
Chilo auricilus	1		1	
Chilo infuscatellus	3	3		
Chilo sacchariphagus	2	1		1
Chilo suppressalis	6	3	1	2
Choristoneura occidentalis	6	5		1
Cnaphalocrocis medinalis	5	5		
Dioryctria splendidella	1			1
Heliothis armigera	1	1		
Heliothis zea	3	1		2

Table 119 (continued)

Name	No. indications			
	Total	+	0	-
Leucinodes orbonalis	1	1		
Lymantria dispar	1	1		
Lymantria monacha	1			1
Manduca sexta	4			4
Pieris brassicae	3		1	2
Pyrausta nubilalis	4	1		3
Rhyacionia buoliana	5	3		2
Rhyacionia spp.	2	2		
Spodoptera frugiperda	14	5	1	8
Spodoptera litura	1	1		
Tryporyza incertulas	12	3		9
Cotton leaf roller	1	1		
Leaf roller	2	2		
Stem borer	2	2		
Top borer	2		1	1
Total	83	41	5	37

Table 120. Potassium and development of *Chilo suppressalis*

Trial	Potassium level	% surviving larvae	Average body weight (g)
Greenhouse	Zero	37	51.38
Greenhouse	Low	31	54.06
Greenhouse	High	32	47.71
Nutrient solution I	Low	53	52.31
Nutrient solution I	High	60	57.55
Nutrient solution II	Low	95	53.58
Nutrient solution II	High	89	53.76

Choristoneura occidentalis

Schmidt and Follin [1983] report trials carried out with larch at 2 sites. Potassium decreased the percentage of fascicles injured and the percent lateral shoots damaged at both sites (Table 121). It also decreased the percentage of damaged terminal shoots at Rice Ridge while it increased it at Lower Cottonwood.

Table 121. Potassium and damage by *Choristoneura occidentalis*

Treatment	% fascicles injured		% lateral shoots damaged		% terminal shoots damaged	
	Site 1 *	Site 2	Site 1	Site 2	Site 1	Site 2
NP	25	28	65	56	53	87
NPK	20	21	58	54	60	67

*1: Lower Cottonwood, 2: Rice Ridge

Cnaphalocrocis medinalis

- In a field trial with 2 rice varieties, increasing rates of potassium markedly decreased the percentage of damaged leaves *(Vaithilingam, Balasubramanian and Baskaran [1982])* (Table 122).
- *Subramanian and Balasubramanian [1976]* also obtained a reduction of damage with increasing rates of potassium.

Table 122. Effect of potassium on damage by *Cnaphalocrocis medinalis*

kg K_2O/ha	Percentage of leaves with damage	
	Variety Kannagi	Variety IR 20
0	28.5	31.9
50	26.9	26.4
100	18.2	27.3
150	21.1	22.0
200	13.7	14.7
250	10.8	18.7

Dioryctria splendidella

In a field trial with pine trees, more trees were attacked in the potassium-plots *(Guinaudeau [1969])* (Figure 36).

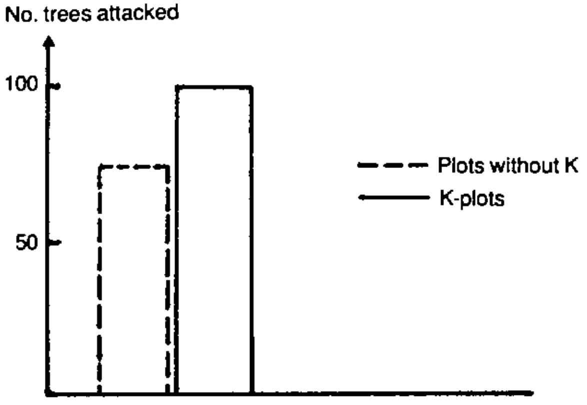

Fig. 36. Potassium and *Dioryctria splendidella*

Heliothis armigera

According to *Rangarajan, Mahadevan, Ganapathy and Mahalingam [1984]*, the percentage of damage to sunflower capitulum decreased from 77.8% in the control to 67.6% with an application of 80 kg K_2O/ha.

Heliothis zea

Excised foliage from maize receiving various fertilizer treatments was force-fed to larvae, damage on foliage was slightly more pronounced in the potassium plots, larval weight was increased and life length was very slightly shortened *(Wisemann, Leuck and Mc Millan [1973 a])* (Table 123).

Table 123. Potassium and *Heliothis zea*

K_2O (kg/ha)	Damage rating	Life length (days)	Larval weight (mg)
0	3.1	8.4	5.1
101	3.3	8.1	6.2

Damage ratings: 1 = 10 % foliage damaged; 2-10 = 20-100 % foliage damaged.

Leucinodes orbonalis

On eggplants, the percentage of borer affected fruits was 7.38 when 0 and 6.33% when 50 kg K_2O/ha were applied *(Sinha, Chakraborty, Dasgupta and Dhua [1976])*.

Lymantria dispar

Mortality of larvae was higher on spruce fertilized with potassium *(Merker [1958])* (Table 124).

Table 124. Potassium and mortality of *Lymantria dispar* larvae

Treatment	Mortality of larvae
0	30 %
K	53 %

Lymantria monacha

When larvae fed on trees fertilized with potassium, their mortality was reduced *(Merker [1958])* (Table 125).

Table 125. Potassium and mortality of *Lymantria monacha* larvae

Treatment	Mortality of larvae
0	43 %
K	32 %

Manduca sexta

Semtmer, Rasnake and Terrill [1980] report that on 4 tobacco varieties, the average number of insects per 20 plants (total of 4 observations during the season) was 2.8, 4.1 and 4.8 when 0, 202 and 405 kg K_2O/ha were applied.

Pieris brassicae

When turnip was supplied with a nutrient solution deficient in potassium, larval weight was reduced and duration of larval period was longer whereas the number dead larvae was unchanged *(Allen and Selman [1957])*.

Pyrausta nubilalis

In a nutrient solution trial with maize, potassium did not markedly affect the percentage of surviving larvae but it slightly increased the rapidity of larval growth. In a field trial with maize potassium increased the number of borers per plant but did not affect the rate of larval growth *(Taylor, Apple and Berger [1952])* (Table 126).

Table 126. Potassium and development of *Pyrausta nubilalis*

Trial	Treatment	% surviving larvae	Average instar
Nutrient solution	NPK low	78	4.4
	NPK	76	4.9
		No. borers/plant	
Field	NPK low	1.6	4.5
	NPK	1.9	4.6

Rhyacionia buoliana

- In a trial with pines on a soil poor in K, there were less larvae in the potassium-plots *(Nef [1967])* (Figure 37).
- In a long-term field trial with pine, fertilizers were applied in 1957 and the two subsequent years. The percentage of attacked shoot-tips was slightly increased by potassium in 1960 but was practically unchanged in 1963 and 1964 *(Schindler and Baule [1964])* (Figure 38).

  It is interesting to note that marked differences between fertilized and unfertilized plots appeared only 6 years after fertilizers were first applied. The authors suggest using higher P and K rates i.e. 600 and 540 kg/ha of P_2O_5 and K_2O respectively and applying fertilizer earlier i.e. before planting.

Fig. 37. Potassium and number of *Rhyacionia buoliana* larvae

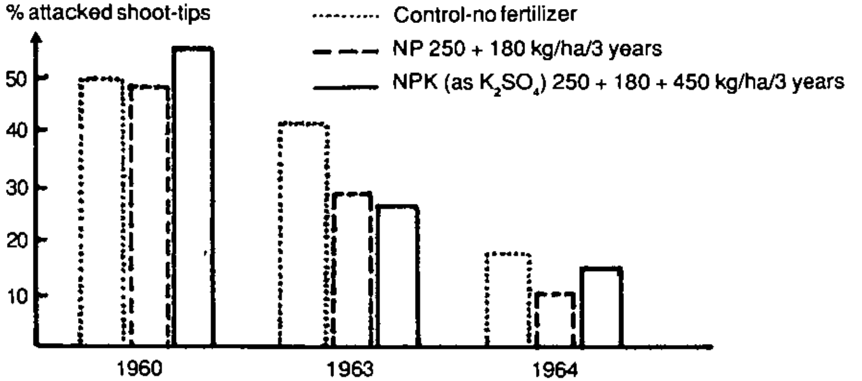

Fig. 38. Potassium and percentage shoot-tips attacked by *Rhyacionia buoliana*

Rhyacionia spp.

In two field trials on soils poor in K, potassium reduced the percentage trees attacked *(Pritchett and Smith [1972])* (Figure 39).

Spodoptera litura

The number larvae per 5 plants amounted to 1.76 on sunflower receiving no potassium and to 1.33 when 80 kg K_2O/ha were applied *(Rangarajan, Mahadevan, Ganapathy and Mahalingam [1974])*.

Tryporyza incertulas

- In a field trial with rice, *John and Thomas [1980]* obtained the following reduction of the white earheads percentage by applying increasing potassium rates (kg K_2O/ha):

K_0	: 7.58%
K_{90}	: 6.48%
K_{180}	: 5.18%

Cotton leaf roller

In India, the application of 90 kg K_2O/ha reduced the cotton leaf roller incidence by 29% *(Muthuvel, Kandasamy, Subbian and Kaliappa [1982]).*

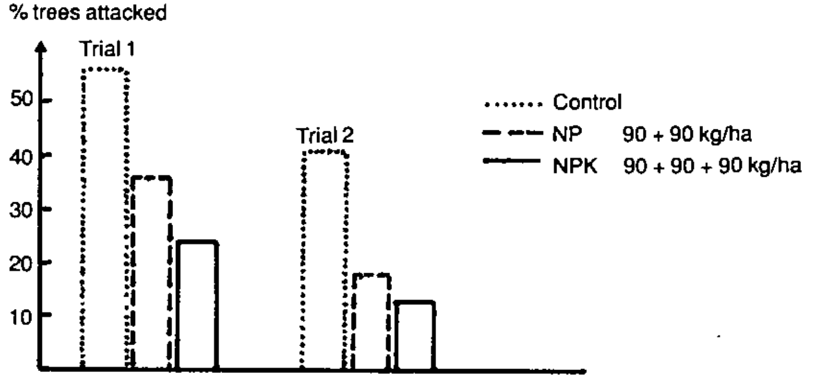

Fig. 39. Potassium and percentage trees attacked by *Rhyacionia* spp.

4.6. Coleoptera

Brachyrhinus sulcatus

Root weevils fed with strawberry leaves from potassium plots had reduced fecundity in 1960 but very slightly increased fecundity was observed in 1961 and 1962 *(Cram [1965])* (Figure 40).

Cylas formicarius

In a field trial with 4 sweet potato varieties *(Das and Behera [1985])*, the percentage of infested tubers was lower when potassium was applied (Table 128).

Table 127. Effect of potassium on Coleoptera

Name	No. indications			
	Total	+	0	-
Brachyrhinus sulcatus	3	1		2
Cylas formicarius	5	5		
Diabrotica spp.	1	1		
Epitrix hirtipennis	4			4
Lema melanopus	1	1		
Lema sp.	1	1		
Lissorhoptrus brevirostris	4	4		
Phaedon cochleariae	1			1
Pempheres offinis	4	4		
Pissodes strobu	2			2
Sciopithes obscurus	1	1		
Scolytus rugolosus	1	1		
Sitona lineatus	1		1	
Sitophilus oryzae	1			1
Cotton stem weevil	1	1		
Flea beetles	1	1		
Wireworms	2	2		
Total	34	23	1	10

Table 128. Effect of potassium on tubers infestation

kg K_2O/ha	% infested tubers *	Tuber yield (t/ha)*
0	16.1	15.54
50	13.4	21.63
100	13.1	25.90
150	13.2	26.07

* Average for 4 varieties

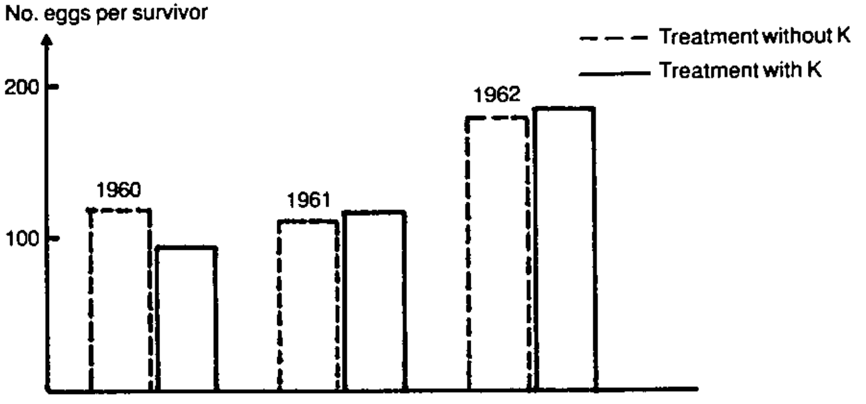

Fig. 40. Potassium and fecundity of *Brachyrhinus sulcatus*

Epitrix hirtipennis

On 4 tobacco cultivars, the average number of insects per plant (total of 4 observations during the season) was 1.87 without potassium and 2.74 when tobacco received 202 kg K_2O/ha *(Semtner, Rasnake and Terrill [1980])*.

Lissorhoptrus brevirostris

In Cuba, a reduction of the number of insects on rice was observed due to the application of 60 kg K_2O/ha *(Meneses and Elizalde [1980])*. This potassium fertilization also reduced by 18% the leaf area destroyed by adults.

Cotton stem weevil

According to *Muthuvel, Kandasamy, Subbian and Kaliappa [1982]*, potassium at the rate of 90 kg K_2O/ha reduced weevil incidence by 17%.

4.7. Hymenoptera

Diprion pini

In the laboratory, mortality of larvae on twigs fertilized with potassium was unchanged in 1962 whereas it was higher in 1963 *(Nef [1966]* in *Merker [1969])*.

Table 129. Effect of potassium on Hymenoptera

Name	No. indications			
	Total	+	0	-
Cephus cinctus	2	2		
Diprion pini	2	1	1	
Pristiphora abietina	1			1
Total	5	3	1	1

Pristiphora abietina

Mortality of larvae was decreased on spruce fertilized with potassium *(Merker [1958])* (Table 130).

Table 130. Potassium and mortality of *Pristiphora abietina* larvae

Treatment	Mortality of larvae
0	58 %
K	30 %

4.8. Diptera

Hydrellia sasakii

- *Subramanian and Balasubramanian [1976]* found a marked reduction of damage on rice with increasing potassium rates:

kg K_2O/ha	% damage
0	11.74
50	10.03
100	7.62
150	7.76
200	6.97
250	5.90

- *Saroja and Naju [1981]* report that the percentage of damaged tillers was 14.1% when potassium was applied at the locally recommended rate i.e. 60 kg K_2O/ha and 13.9% without potassium.

Table 131. Effect of potassium on Diptera

Name	No. indications			
	Total	+	0	-
Chlorops taeniopus	1	1		
Hydrellia sasakii	2	1		1
Oscinella frit	2	1	1	
Pachydiplosis oryzae	5	2		3
Phorbia coarctata	1	1		
Tipula sp.	1	1		
Whorl maggot	2	2		
Total	14	9	1	4

Oscinella frit

In a field trial with oats, number of eggs deposited in plots receiving abundant potassium fertilization was only one third of that found in the control plots *(Trolldenier [1969])*.

Phorbia coarctata

Wheat plots receiving no potassium fertilizer suffered badly from wheat bulb fly attacks *(Johnson, Lofty and Cross [1969]* in *Jones [1976])*.

4.9. Acarina (Mites)

Aceria sheldoni

Sternlicht, Regev and Goldenberg [1975] have conducted several nutrient solution trials. In a trial with citrus seedlings kept in plastic bottles, seedlings receiving the standard solution had slightly fewer mites than those in the K-free solution. In 4 trials with citrus seedlings kept in polyvinyl tubes, seedlings in the K-free solution had significantly more mites than those given the standard solution. In a trial with lemon seedlings, the following numbers of mites per seedling were observed:

K-free solution	:	12.3
Standard solution	:	10.3

Table 132. Effect of potassium on mites

Name	No. indications			
	Total	+	0	-
Aceria sheldoni	6	6		
Brevipalpus sp.	1	1		
Bryobia praetiosa	4	2		2
Mononychellus sp.	1	1		
Mononychellus tanajoa	2		1	1
Panonychus ulmi	3	1		2
Tetranychus atlanticus	4	4		
Tetranychus bimaculatus	1			1
Tetranychus spp.	3		1	2
Tetranychus telarius	17	7	2	8
Tetranychus urticae	20	7	2	11
Species not mentioned	2	2		
Total	64	31	6	27

Brevipalpus sp.

In a field trial with citrus, foliar sprays with KNO3 markedly reduced numbers of *Brevipalpus sp.* on fruits *(Chaboussou [1976])* (Figure 41).

Tetranychus bimaculatus

- *Rodriguez [1951]* reports slightly increased progeny of *Tetranychus bimaculatus* females with increasing K-concentration of the nutrient solution (Figure 42).

Tetranychus telarius

- In a nutrient solution trial with beans, potassium slightly decreased progeny of OP-susceptible mites and increased it for OP-resistant mites *(Henneberry [1962])* (Figure 43).

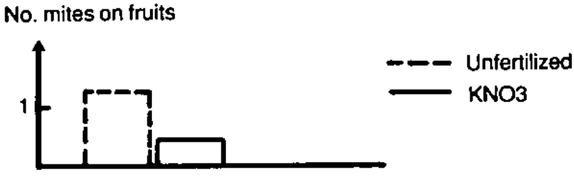

Fig. 41. Potassium and number of mites

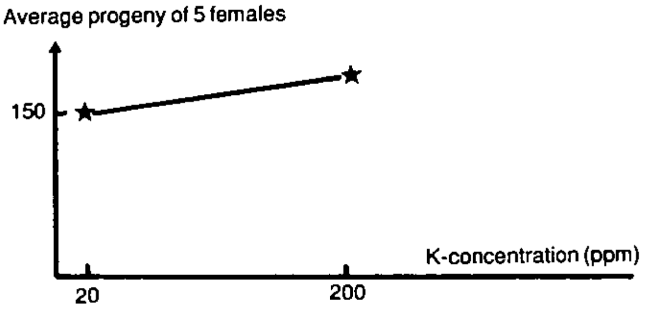

Fig. 42. Potassium and number of *Tetranychus bimaculatus*

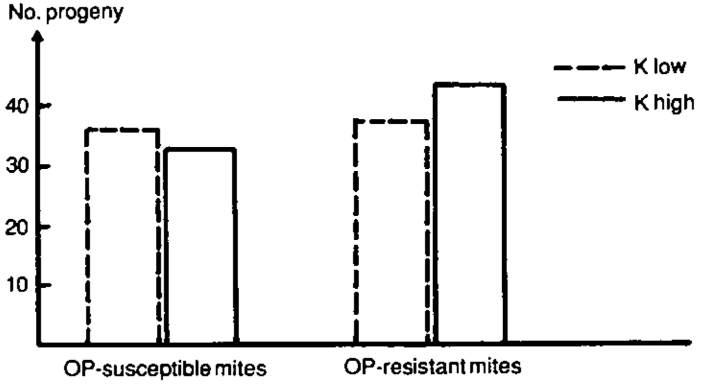

Fig. 43. Potassium and progeny of *Tetranychus telarius*

- In a greenhouse trial with 10 chrysanthemum varieties, potassium reduced the number progeny per female on 5 varieties and increased it on 5 varieties *(Markkula, Roukka and Tiittanen [1969])*.

Tetranychus urticae

- *Fritsche [1961]* reports a higher rate of multiplication of mites on beans deficient in potassium.
- When mites were fed with grape foliage sprayed with KNO_3, they had reduced fecundity *(Chaboussou [1972])* (Table 133).
- In a long-term trial, potassium increased the number mites on raspberries by 183% in [1972] and by 33% in 1973 *(Badowska-Czubik, Suski and Mercik [1977])*.
- *Schreiner [1984]* observed a much lower fecundity of females on leaves of grapes receiving a nutrient solution deficient in K.

Table 133. Potassium and fecundity of *Tetranychus urticae*

Treatment	Fecundity reduction (compared to control)
Spray with 0,5 % KNO_3	26 %
Spray with 1 % KNO_3	44 %
Spray with 2 % KNO_3	34 %

5. Effect of potassium on nematodes

There are more indications of stimulation than of depression of nematodes (Table 134). In spite of this direct effect on nematodes, potassium seems to improve markedly tolerance of infested plants since it generally considerably increases their growth. Thus, the average growth increase due to potassium, which was measured in 17 cases, amounted to 85% (see Chapter 10).

Table 134. Effect of potassium on nematodes

Name	No. indications			
	Total	+	0	-
Aphelencoides oryzae	2	1		1
Aphelencoides spp.	1		1	
Heterodera avenae	1	1		
Heterodera glycines	4			4
Heterodera schachtii	7	6		1
Meloidogyne exigua	3	2	1	
Meloidogyne hapla	1			1
Meloidogyne incognita	53	9		44
Meloidogyne javanica	7	3	1	3
Meloidogyne sp.	3	1		2
Meloidogyne spp.	1	1		
Pratylenchus penetrans	7	4	1	2
Rotylenchus reniformis	14	6		8
Tylenchorhynchus latus	1			1
Tylenchorhynchus sp.	1			1
Tylenchulus semipenetrans	2			2
Xiphinema americanum	3	3		
Total	111	37(33)	4(4)	70 (63)

- The stimulation of nematodes' development might be attributed to the larger size of the root system due to potassium. *Ritter [1976]* mentions investigations showing that at high inoculum rates, nematodes develop more and quicker on plants well supplied with nutrients.

- When instead of the total number nematodes per root one considers the nematode density in roots (*e.g.* number nematodes per g of root), the increase due to potassium is usually much less pronounced or even not apparent.

Heterodera glycines

On soybean grown in pots, potassium applied as KCl or K_2SO_4 increased the number cysts in soil and on plants *(Luedders, Shannon and Baldwin [1979])*.

Heterodera schachtii

- In a pot trial with sugarbeet cultivated in sand, number larvae 2 weeks after inoculation and number cysts 6 weeks after inoculation were higher when sugarbeet received a nutrient solution without potassium *(Curtis [1964])* (Figure 44).
- In an other pot trial with sugar beet, fertilizers were supplied in solid form. Potassium increased the number of larvae, but decreased the number of adult cysts *(Curtis [1964])* (Table 135).
- In the laboratory, filtrate from plants grown without K stimulated hatching of cysts compared with filtrate from control plants *(Curtis [1964])*.

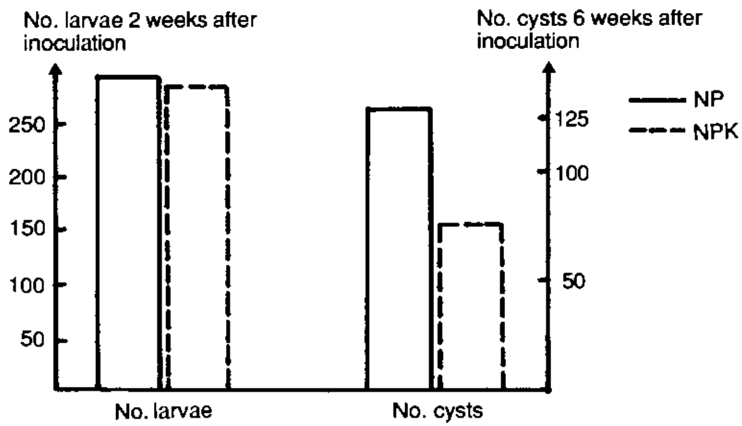

Fig. 44. Potassium and *Heterodera schachtii*

Table 135. Potassium and *Heterodera schachtii*

Treatment	No. larvae	No. adult cysts
Check	5	154
KCl 0.5 g/pot	28	48

Meloidogyne hapla

In a trial with cucumbers, the total number of nematodes in roots increased at increasing K-concentrations of the nutrient solution *(Marks and Sayre [1964])* (Figure 45).

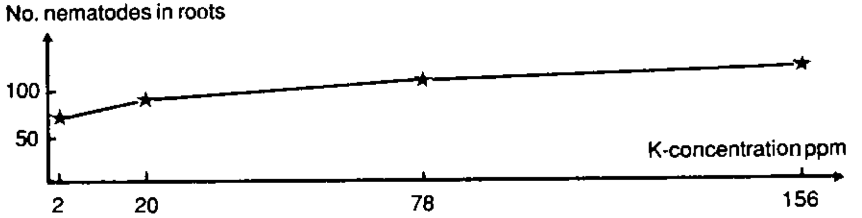

Fig. 45. Potassium and *Meloidogyne hapla*

Meloidogyne incognita

Oteifa [1952] and *[1953]* showed in pot trials with beans that potassium favours the rapidity of nematode development but also helps to compensate to some extent the negative influence of nematodes on growth (Figure 46).

- In a nutrient solution trial with cucumbers, potassium increased the number of nematodes in roots and the rapidity of nematode development expressed by the number of mature egglaying females *(Marks and Sayre [1964])* (Table 136).

- In a nutrient solution trial with eggplant, potassium increased the root-knot index and the dry weight of eggplant *(Haque, Khan and Saxena [1974])* (Table 137).

Table 136. Potassium and *Meloidogyne incognita*

K-concentration (ppm)	No. mature egg-laying females	Total number nematodes in roots
2	4.5	259
20	8.5	296
78	65.8	387
156	98.0	423

Table 137. Potassium and *Meloidogyne incognita*

Nutrient solution	No. larvae inoculated per plant	Root-knot index	Dry weight (g/plant)
Deficient in K	0	-	2.38
Medium K	0	-	8.67
Deficient in K	5	0.5	2.23
Medium K	5	0.9	8.42
Deficient in K	50	1.2	2.64
Medium K	50	1.7	8.63
Deficient in K	500	2.5	3.88
Medium K	500	3.1	10.44
Deficient in K	5000	3.4	2.01
Medium K	5000	3.7	6.84

- The results are different if one considers the number nematodes in the whole roots or per g root. Thus *Oteifa and Elgindi [1976]* report that in a nutrient solution trial with cotton numbers of eggmasses per root were 3 times higher at high potassium concentration whereas they were slightly lower per g of root. This is due to the improved growth with potassium (Figure 47).

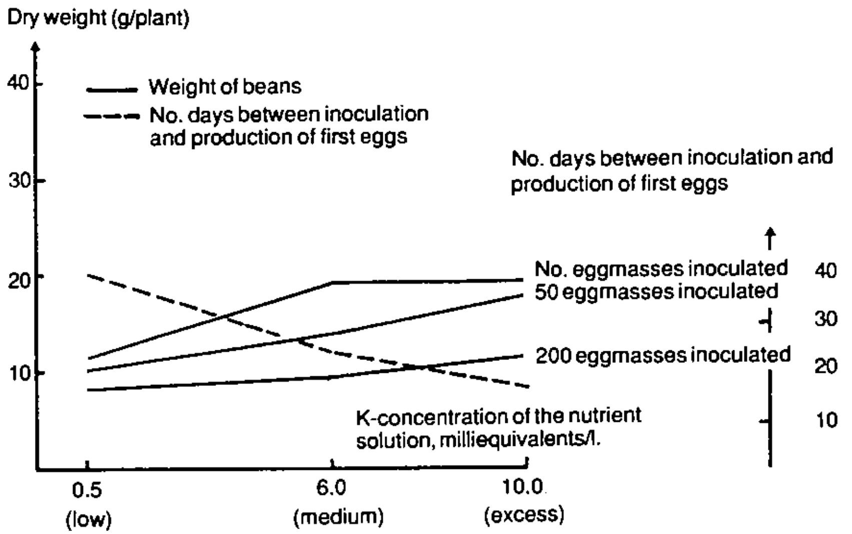

Fig. 46. Potassium and *Meloidogyne incognita*

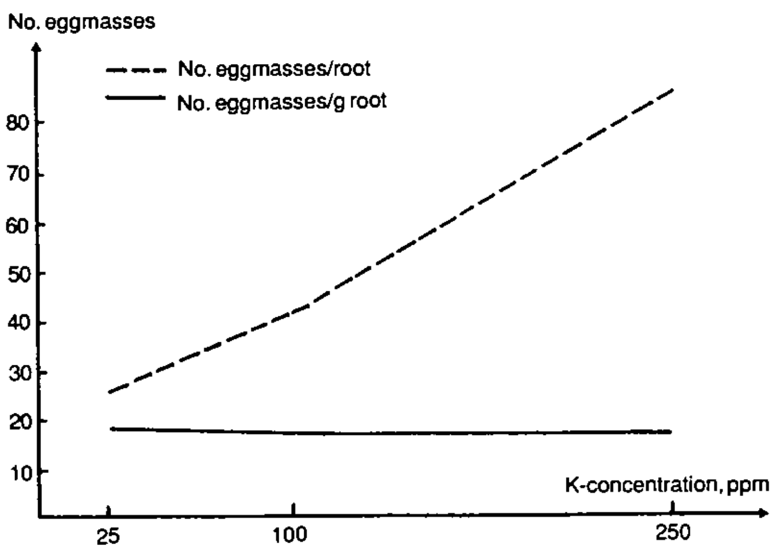

Fig. 47. Potassium and number of *Meloidogyne incognita* per root and per g of root

- In an other nutrient solution trial with beans, the relative increase in females and eggmasses numbers due to potassium was much less pronounced, when expressed per g of root than per plant *(Oteifa [1951])*. Root-gall index was slightly decreased by potassium when 50 eggmasses were inoculated and slightly increased when 200 eggmasses were inoculated (Table 138).

Table 138. Potassium and *Meloidogyne incognita*

K-level	No. eggmasses inoculated	No. females		No. eggmasses		Mean root-gall index	Mean root weight (g)
		per g root	per plant	per g root	per plant		
Low	50	117	1084	20	200	3.2	9.2
Medium	50	126	4079	54	1665	2.7	32.5
High	50	158	3330	108	2281	3.0	21.2
Low	200	246	3675	83	1229	3.8	15.0
Medium	200	346	8034	196	4564	4.0	23.1
High	200	361	7668	186	3964	4.0	21.1

- *Ismail and Saxena [1980]* compared the effect of 0 and 156 ppm K in the nutrient solution in presence of 10, 100 and 1000 females inoculated in a trial with castor. When 1000 females were inoculated potassium increased nematodes population by 38%, root growth by 47% and shoot growth by 50%.
- According to *Jaehn, Monteiro, Lordello, Barbim and Demétrio [1983]* working with coffee grown in pots, potassium increased the velocity of nematodes development, the number nematodes per plant, the number eggs per ootheca and the number eggs per plant.

- *De Guiran and Villemin [1980]* report that the number eggs per female amounted to 1198 when tomato plants received a nutrient solution deficient in K and to 1536 when they were given a complete nutrient solution.

Meloidogyne javanica

- In a nutrient solution trial with cucumber, potassium scarcely affected total number of nematodes in roots whereas it increased the rapidity of nematode development expressed by the number of mature egg-laying females *(Marks and Sayre [1974])* (Figure 48).

- In a nutrient solution trial with tomato, nematodes grew faster in plants deficient in K *(Bird [1960])* (Figure 49).

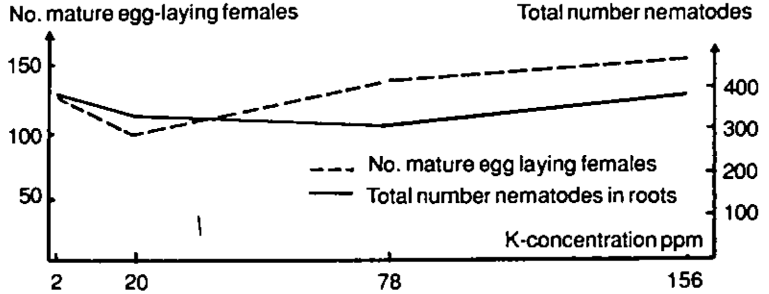

Fig. 48. Potassium and *Meloidogyne javanica*

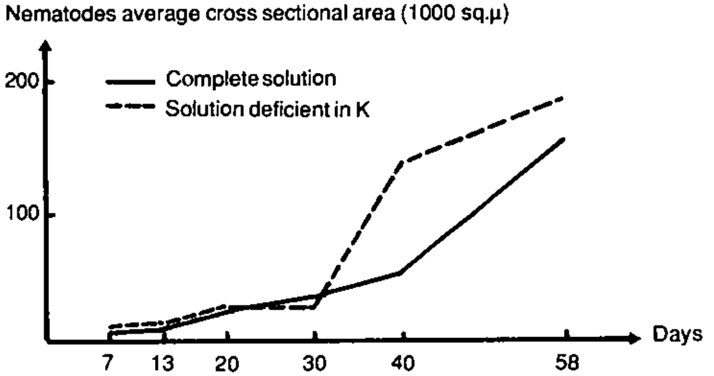

Fig. 49. Potassium and *Meloidogyne javanica*

- *Spiegel, Cohn, Kafkafi and Sulami [1982]* who conducted 2 experiments with tomato came to the conclusion that "while the degree of infection did not increase significantly with increased potassium, it seems that tolerance to nematode parasitism by the infected plant did".

Pratylenchus penetrans

- *Willis [1973]* reports that nematode reproduction in alfalfa was not affected by potassium fertilization.

- In a pot experiment with red clover reported by *Willis [1976]*, increasing rates of potassium had a variable effect on the number of nematodes while they markedly improved yield and root growth (Table 139).

Table 139. Effect of potassium on *Pratylenchus penetrans*

µg K_2O/g soil	No. nematodes per pot	Yield (g/pot) Forage	Taproots	Rootlets
0	645 000	24.9	1.1	1.7
50	719 800	31.6	1.6	2.8
100	608 900	32.8	1.4	3.4
200	781 200	33.9	2.1	3.4

Rotylenchus reniformis

- *Oteifa and Elgindi [1976]* report that in a nutrient solution trial with cotton, potassium increased numbers hatched, penetration and eggmasses per root whereas it decreased number of eggmasses per g of root (Figure 50).

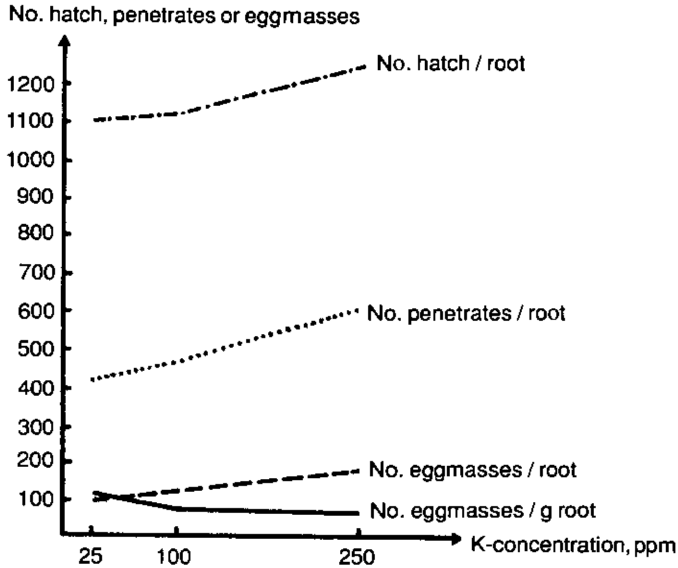

Fig. 50. Potassium and *Rotylenchus reniformis*

- In a pot trial carried out in Cuba *(Rodriguez Fuentes and Perdomo [1981])* potassium reduced nematode numbers in roots and soil in the case of garlic and pepper while the opposite was observed with tomato (Table 140).

Table 140. Effect of potassium on *Rotylenchus reniformis*

Crop	No. nematodes/5 roots		No. nematodes/10g soil	
	Without K	With K	Without K	With K
Garlic	11	0	4.6	0.4
Pepper	2	0	2.5	0.8
Tomato	10.8	59.6	23.5	47.0

- According to *Badra and Yousif [1979]*, potassium increased total nematode population by 51% and plant weight by 69% in a pot trial with cowpeas.

6. Effect of potassium on viruses

There are more indications of stimulation than of depression of viruses due to potassium (Table 141). In spite of this, potassium seems to have a beneficial effect on tolerance of infested plants since in average it increased their growth more i.e. by 49% (28 indications) than virus development *i.e.* by 38% (108 indications) (see also Chapter 10). In many cases, the best virus development occurs at the potassium level giving the best plant growth. Most indications concern 2 virus groups *i.e.* leafroll and mosaic. There are slightly more indications of stimulation than of depression for mosaics and various viruses while the difference is more pronounced for leafroll.

Table 141. Effect of potassium on different viruses groups

Viruses group	No. indications - ( ) % of total			
	Total	+	0	-
Leafroll	61	21	2	38
Mosaic viruses	58	26	8	24
Various viruses	67	29	4	34
Total	186	76(41)	14(7)	96(52)

6.1. Leafroll viruses

In spite of the fact that aphids are generally less numerous with potassium, virus development appears often to be stimulated in potassium plots. *Klapp [1951]* explained this as follows: K-deficient potatoes usually die 4 to 6 weeks earlier than those well supplied with K, thus virus migration towards the tubers is interrupted very early. Krüger [1951] came to similar conclusions.

- In a long-term field trial, descendants of potatoes fertilized with potassium were more frequently infected by leafroll *(Krüger [1951])* (Table 142).

Table 142. Potassium and leafroll

Plots	% descendants with leafroll						
	Eye cutting test			Göttingen		Ebstorf	
	1946	1947	1948	1948	1949	1948	1949
Without K	22	21	19	32	17	31	18
With K	60	52	44	45	29	51	34

- *Wünscher [1952]* reports that descendants of potatoes receiving potassium in a field trial had a lower leafroll percentage except in the eye cutting test when KCl was used (Table 143).
- *Völk, Bode and Hauschild [1952]* report that in a field trial, descendants of potatoes from the potassium-plots had a higher percentage of tubers with leafroll (Figure 51).
- In the field trials reported by *Reichard [1964]* descendants of potatoes fertilized with potassium were more infested with virus in 2 trials, whereas infection percentage was practically unchanged in 1 trial (Table 144).
- *Münster [1964]* reports that in field trials, the percentage of descendants with heavy viroses was generally lower for potatoes of the potassium-plots (Table 145).
- On a soil rich in available potassium, intense rolling was observed on NP plots while no symptoms of leafroll occurred on NPK plots *(Quelhas dos Santos [1979])*.

Table 143. Potassium and leafroll

Treatment	% descendants with leafroll		
	Eye cutting test	Field	
		Variety Mittelfrüh	Variety Ackersegen
NP	18.4	12	14
NPK (as KCl)	18.4	10	4
NPK (as K_2SO_4)	10.0	11	4

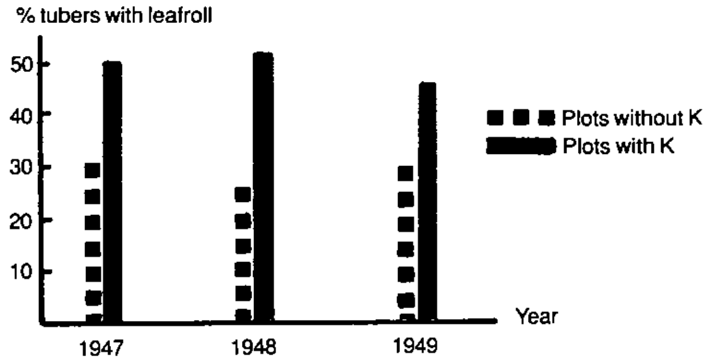

Fig. 51. Potassium and leafroll

Table 144. Potassium and leafroll

K_2O (kg/ha)	% descendants with leafroll					
	Trial Fuchsenbigl		Trial Rottenhaus		Trial Stift. Swettl.	
	1959	1960	1959	1960	1959	1960
0	2.4	5.1	3.0	5.2	2.7	4.5
150	3.1	6.2	2.9	5.3	3.2	6.7

Table 145. Potassium and leafroll

Treatment	% descendants with heavy viroses		
	Trial Ependes	Trial Payerne	Trial Senarclens
Check	3.0	10.7	6.8
KCl in autumn	2.7	3.8	3.3
KCl in spring	2.0	2.2	2.7
K_2SO_4 in spring	4.6	4.5	4.0

6.2. Mosaic viruses

Table 146. Effect of potassium on mosaic viruses

Name	No. indications			
	Total	+	0	-
Cauliflower mosaic	2	1	1	
Cucumber mosaic	1	1		
Maize dwarf mosaic	1			1
Maize mosaic	1	1		
Peppers mosaic	6	6		
Spot mosaic of tomato	6		2	4
Sunnhemp mosaic virus	2	1		1
Tobacco mosaic virus	27	9	3	15
Tomato mosaic virus	2	1		1
Tomato stripe	1	1		
Watermelon mosaic virus	1		1	
Wheat streak mosaic	1		1	
Mosaic unspecified	7	5		2
Total	58	26	8	24

Cauliflower mosaic

Potassium had no inflence on virus symptoms *(Broadbent and Trinsley [1953]* in *Fuchs and Grossmann [1972]).*

Cucumber mosaic

Infection of *Chenopodium amaranticolor* was reduced with increasing potassium rates *(Foster [1967]* in *Fuchs and Grossmann [1972]).*

Maize mosaic

Potassium deficiency increased the virus severity on sorghum *(Raychaudhuri, Iyer and Seth [1966]* in *Leath and Ratcliffe [1974]).*

Peppers mosaic

In 3 field trials carried out in India with peppers, increasing rates of potassium applied as KCl markedly decreased the mosaic incidence (Figure 52) *(Narasinham and Alagianagalingam [1986])*.

Spot mosaic of tomato

In 2 pot trials with tomato, potassium increased the rapidity of incubation and the number of successful inoculations, whereas they were not affected in a pot trial with tobacco *(Volk [1931])* (Table 147).

Sunnhemp mosaic virus

- Potassium deficiency favoured virus dissemination in *Crotalaria juncea* *(Sastry and Vasudeva [1963]* in *Fuchs and Grossmann [1972])*.
- In a nutrient solution trial with artificially infected cowpea seedlings, potassium increased virus concentration in the seedlings *(Chant, Gbaja and Kang [1984])*.

Tobacco mosaic virus

- In a nutrient solution trial with tobacco maximum growth and maximum virus concentration (measured by the average number of lesions caused on *Nicotiana* leaves by inoculum from tobacco) were observed at the same K-level, *e.g.* 704 ppm K *(Weathers and Pound [1974])* (Figure 53).

Table 147. Potassium and spot mosaic of tomato

K-rate	Tomato				Tobacco	
	Rapidity of incubation (days)		No. successful inoculations		Rapidity of incubation (days)	No.successful inoculations
	1st trial	2nd trial	1st trial	2nd trial		
0	12-13	16	8	11	9	11
Low	12	14	10	12	9	12
Medium	12	14	12	12	9	11

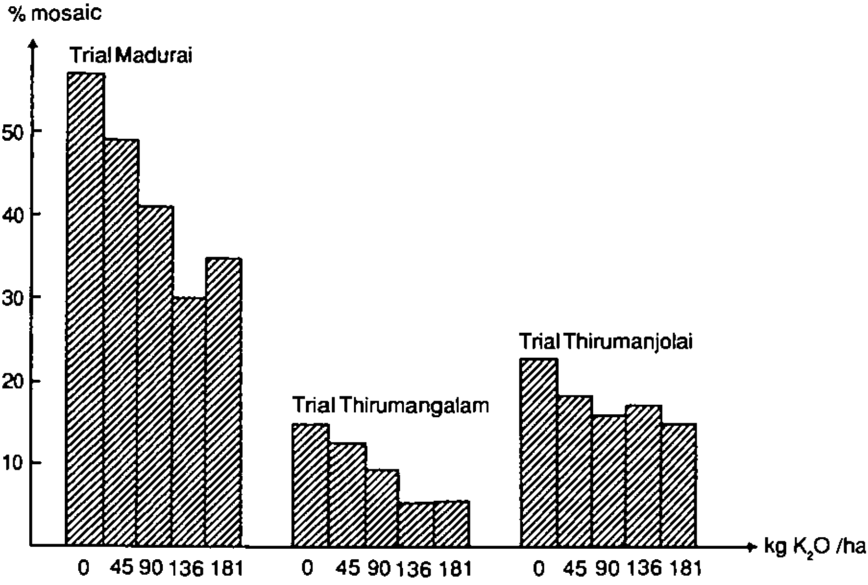

Fig. 52. Potassium and peppers mosaic

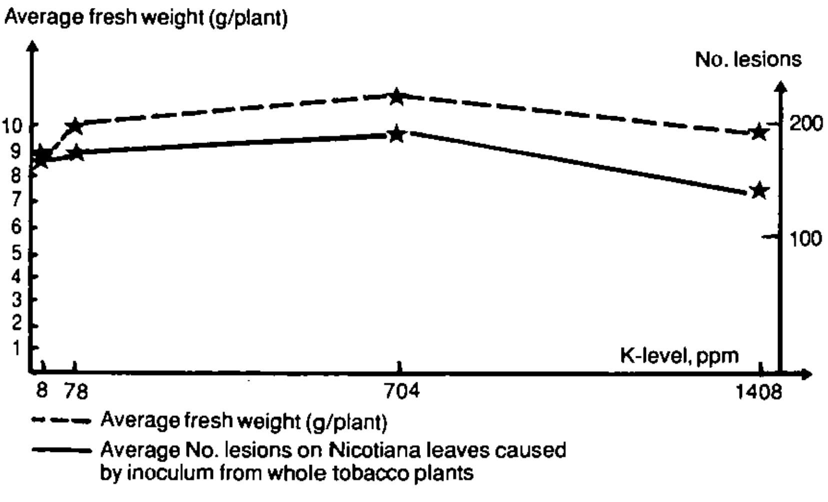

Fig. 53. Potassium and tobacco mosaic virus

- In 3 pot trials with tomato, there was no consistent effect of potassium on virus development (measured by the number of necrotic spots caused on *Nicotiana* leaves by inoculum from tomato) *(Rebowska [1965])* (Table 148).

Table 148. Potassium and tobacco mosaic virus

Trial	K_2O (mg/pot)	No. necrotic spots on *Nicotiana*	Dry matter (g/pot)
5 - 1960	0	50.6	1.33
	250	96.5	3.00
	500	119.8	2.13
7 - 1961	0	62.0	0.70
	250	48.0	3.06
	500	44.0	2.55
8 - 1961	0	49.0	1.97
	250	237.0	4.64
	500	78.7	4.45
Average	0	65.0	1.33
	250	127.2	3.57
	500	80.8	3.04

Tomato mosaic virus

Chant and Gbaja [1985] conducted a nutrient solution trial with tomato plants with and without inoculation with *Fusarium oxysporum*. Potassium increased the virus concentration in leaves by 119% in absence of *Fusarium oxysporum* whereas it decreased it by 21% in presence of the fungus.

Tomato stripe

In a long-term field trial, percentage of affected tomato plants was increased by potassium *(Ainsworth [1923]* in *Spencer [1935])* (Table 149).

Table 149. Potassium and tomato stripe

Treatment	% affected plants
NP	5.0
NPK	23.3

Wheat streak mosaic

Potassium did not affect virus content of wheat *(Haubold [1958]* in *Fuchs and Grossmann [1972])*.

Mosaic unspecified

According to *Balasubramanian and Subbiah [1981]*, increasing potassium rates reduced the percentage of infected peppers plants:

kg K_2O/ha	% infected plants
O	9.8
35	8.3
70	6.6
105	5.3

6.3. Various viruses

Beet yellows

Potassium diminished virus symptoms on beet *(Heiling [1953]* in *Fuchs and Grossmann [1972])*.

Beta virus 4

In pot trials with beet, symptoms of virus infection appeared earlier and were more pronounced with potassium deficiency *(Warcholowa [1970])*.

Cucumber virus 1

In two nutrient solution trials, potassium increased both virus concentration in spinach and spinach growth *(Cheo, Pound and Weathers [1952])*. Virus concentration was estimated by number of lesions caused on cowpea leaves by spinach inoculum (Table 151).

Table 150. Effect of potassium on various viruses

Name	No. indications			
	Total	+	0	-
Beet yellows	1	1		
Beta virus 4	2	2		
Cucumber virus I	2			2
Potato virus X	4	3	1	
Potato virus Y	29	14	1	14
Potato virus Y^N	2	2		
Pseudonetnecrose	2	2		
Rice stripe disease	2	2		
Streak of tomato	3		1	2
Tomato bushy stunt virus	2	1		1
Tomato spotted wilt	1			1
Turnip virus No. 1	6		1	5
Viruses unspecified	11	2		9
Total	67	29	4	34

Table 151. Potassium and cucumber virus I

K-concentration (ppm)	Trial 1		Trial 2	
	No. lesions	Spinach dry weight (g)	No. lesions	Spinach dry weight (g)
8	39	0.15	52	0.24
430	112	0.36	290	0.47

Potato virus Y

- In 4 pot trials with potato increasing potassium content of the nutrient solution slightly decreased the number infected plants *(Bawden and Kassanis [1950 a])* (Table 152).
- In 7 pot trials, fertilizers were given as nutrient solution (3 trials) or in solid form (4 trials). Potassium slightly decreased the number of infected plants *(Bawden and Kassanis [1950 a])* (Table 153).

Table 152. Potassium and potato virus Y

K-content of the nutrient solution	Average of 4 trials	
	No. infected plants	Fresh weight of plants (g)
0	79	25.0
Medium	75	38.6
High	69	45.0

Table 153. Potassium and potato virus Y

Trial	Treatment	No. infected plants plants	Weight of plants (g)
		Average of 3 trials	
Nutrient solution	NP	92	26.6
	NPK medium	82	33.5
	NPK high	90	34.7
		Average of 4 trials	
Solid fertilizers	Without K	5.9	69
	With K	5.6	84

Potato virus Y^N

In field trials, potatoes were artificially inoculated. Potassium had practically no effect on the percentage infected tubers *(Schepers and Van Beemster [1976])* (Table 154).

Rice stripe disease

In a field trial, potassium slightly decreased the percentage damaged hills *(Kim and Park [1973])* (Table 155).

Tomato bushy stunt virus

According to *Chant and Gbaja [1985]*, potassium decreased virus concentration in tomato leaves by 3% when the plants were inoculated with *Fusarium oxysporum* and increased it by 7% in absence of inoculation.

Table 154. Potassium and potato virus Y^N

Treatment	% infected tubers	
	Inoculation 27.6.1961	Inoculation 14.6.1962
Low K	19	37
High K	18	35

Table 155. Potassium and rice stripe disease

Treatment	% damaged hills	Yield (t/ha)
Check	2.00	4.63
KCl 16.7 kg/ha at transplanting	1.55	4.98

Tomato spotted wilt

Klinkowski and Uschdraweit [1952] in *Fuchs and Grossmann [1972]* report that potassium favoured the formation of necroses.

Turnip virus no. 1

- *Dufrenoy [1955]* reports that the virus biosynthesis was not affected by the K-concentration of the nutrient solution.
- In nutrient solution trials, virus concentration in the sap of *Nicotiana glutinosa* and *N.multivalis* was higher at the K-level giving optimal plant growth than at a low K-level *(Pound and Weathers [1953])*.

7. Effect of potassium on bacteria

Indications of a depressing effect of potassium on bacteria are more than 3 times more frequent than indications of a stimulating effect. Most indications concern bacteria of the *Pseudomonas* and *Xanthomonas* groups which are also clearly reduced by potassium (Table 156).

Table 156. Effect of potassium on bacteria

Bacteria group	No. indications - ( ) % of total			
	Total	+	0	-
Pseudomonas	39	29	2	8
Xanthomonas	49	37	6	6
Various bacteria	56	33	6	17
Total	144	99(69)	14(10)	31(21)

7.1. Pseudomonas group

Table 157. Effect of potassium on *Pseudomonas* bacteria

Name	No. indications			
	Total	+	0	-
Pseudomonas angulata	4	4		
Pseudomonas lachrymans	5	4	1	
Pseudomonas phaseolicola	2			2
Pseudomonas solanacearum	10	4		6
Pseudomonas syringae	8	8		
Pseudomonas tabaci	10	9	1	
Total	39	29	2	8

Pseudomonas solanacearum

- *Gallegly and Walker [1949]* report nutrient solution trials carried out in various seasons with tomato. Disease index was higher on plants receiving a nutrient solution low in K in the midwinter trial, whereas it was lower in the summer and autumn trials (Figure 54).

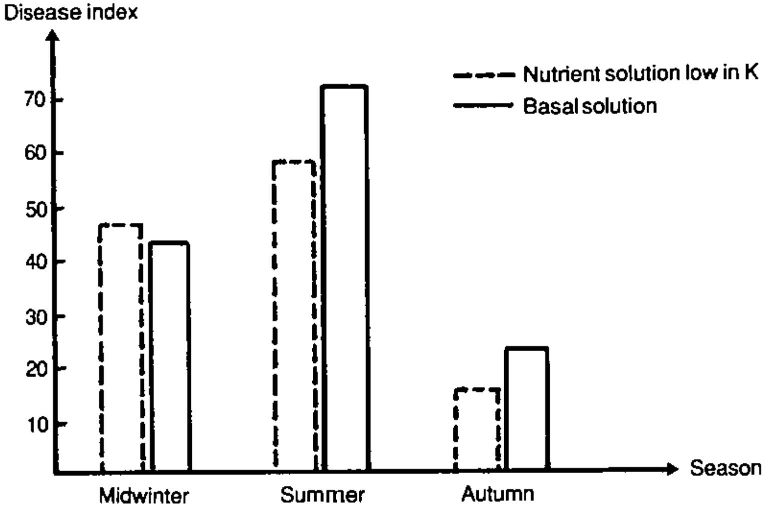

Fig. 54. Potassium and *Pseudomonas solanacearum*

- Feeding tomato plants with a nutrient solution low in K slightly reduced the disease index in 12 hour days but increased it in 18 hour days at normal light intensity (Table 158) *(Gallegly and Walker [1949])*. Reducing the light in 18 hour days reversed the effect. In normal light disease index was increased at 24° and 32°C, but the increase was less at 32°C.

- In 2 pot trials reported by *Mahmoud, Taha, Abdel-Hafez, Mickail and Farag [1976]*, potassium slightly increased disease severity.

Table 158. Potassium and *Pseudomonas solanacearum*

Nutrient solution	Disease index				
	Normal light 12-hr day	18-hr day	Low light 18-hr day	Normal light 24°C	32°C
Low in K	39	37	24	36	66
Basal	43	29	28	26	62
High in K	36	33	38	34	63

Pseudomonas syringae

- In 6 nutrient solution trials with Lima beans, potassium decreased disease incidence *(Thaung and Walker [1957])* (Figure 55).
- In a field trial with maize on a soil low in K, potassium eliminated disease *(Karlen, Arny and Walsh [1973])* (Table 159).

Table 159. Potassium and *Pseudomonas syringae*

Treatment (kg/ha)		Disease index
N	K_2O	
0	0	2.2
80	0	2.1
160	0	2.0
0	80	0.0
80	80	0.1
160	80	0.1
0	160	0.0
80	160	0.0
160	160	0.0

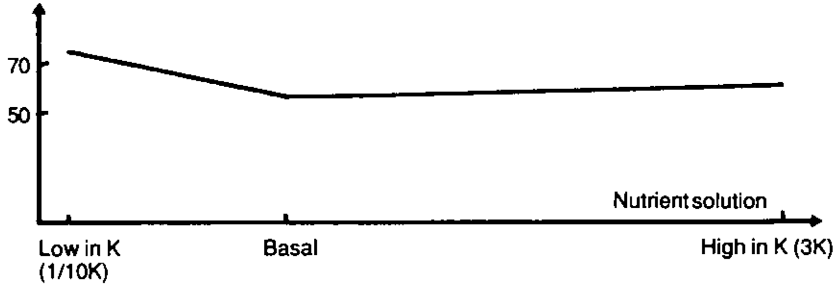

Fig. 55. Potassium and *Pseudomonas syringae*

7.2. Xanthomonas group

Table 160. Effect of potassium on *Xanthomonas* bacteria

Name	No. indications			
	Total	+	0	-
Xanthomonas axonoperis	1	1		
Xanthomonas campestris	12	8	4	
Xanthomonas malvacearum	1	1		
Xanthomonas manihotis	4	4		
Xanthomonas oryzae	14	12	2	
Xanthomonas pelargonii	1	1		
Xanthomonas phaseoli	4			4
Xanthomonas pruni	2	2		
Xanthomonas sp.	6	4		2
Xanthomonas spp.	2	2		
Xanthomonas vesicatoria	2	2		
Total	49	37	6	6

Xanthomonas axonoperis

In a field trial with Imperial grass on a soil with a medium K-level, potassium considerably reduced percentage dead plants and more than doubled yield *(Castaño, Lotero, Thurston and Crowder [1965])* (Figure 56).

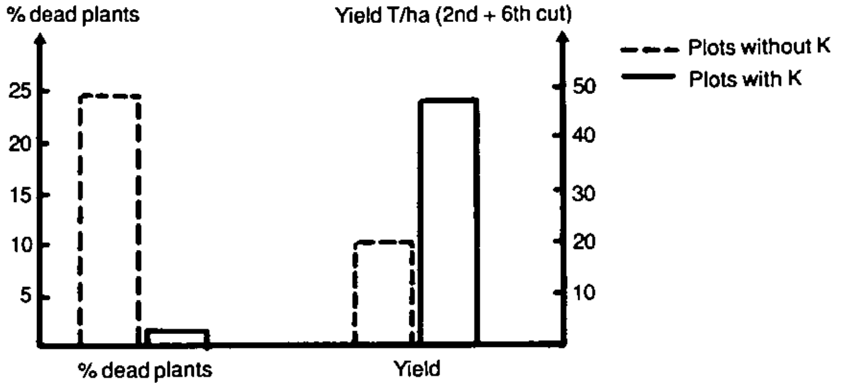

Fig. 56. Potassium and *Xanthomonas axonoperis*

Xanthomonas campestris

- *Walker and Gallegly [1951]* report than in 4 nutrient solution trials potassium did not significantly influence disease development.

- *Mohanty, Reddy and Sridhar [1983]* conducted a nutrient solution trial with 3 rice varieties differing in their susceptibility to *Xanthomonas campestris i.e.* Taichung Native 1 (susceptible), IR 8 (intermediate) and Malagkit Sung Song (tolerant). Increasing potassium rates decreased lesion length in all varieties, the effect being more important in the intermediate variety (Table 161).

Table 161. Effect of potassium on *Xanthomonas campestris* on rice

K content of nutrient solution (mg K/l)	Lesion length (mm) Taichung Native 1	IR 8	Malagkit Sung Song
3	83.3	65.3	20.5
20	77.0	55.5	14.8
40	68.5	49.8	11.3
80	66.3	43.5	8.0
120	65.5	35.3	6.3
160	65.5	30.3	4.8

- In a pot trial carried out with cabbage in Ecuador, the application of 0.64 g K_2O/pot reduced the percentage of infection by 21 % and lesion size by 8 % *(Iza and Orellana [1986])*.

- According to *Ikotun and Ogunbiyi [1984]* potassium reduced the number of leaf spots by 50 % on 2 cassava varieties grown in pots.

Xanthomonas manihotis

- In a field trial with a tolerant and a susceptible cassava variety, the largest reduction of infection and the highest yield were observed with the application of 90 kg K_2O/ha *(Adeniji and Obigbesan [1978])* (Table 162). The reduction of infection due to potassium was more important in the tolerant variety.

Table 162. Effect of potassium on *Xanthomonas manihotis*

kg K_2O/ha	Tolerant variety		Susceptible variety	
	% infection	Yield (kg/plant)	% infection	Yield (kg/plant)
0	56.2	2.73	74.4	1.64
60	44.4	2.78	70.5	1.66
90	39.8	3.13	63.5	2.07
120	50.6	2.55	72.2	1.96

- In Nigeria, on a soil low in K, potassium fertilization reduced disease incidence and considerably increased yield *(Odurukwe and Arene [1980])* (Figure 57).

Xanthomonas oryzae

- In a field trial with rice, a potassium top-dressing reduced the percentage infected leaves at harvest *(Padhi and Misra [1972])*. As this trial was carried out during the rainy season on a sandy-loam soil, some of the initial K might have leached down resulting in a reduced supply of this nutrient (Table 163).

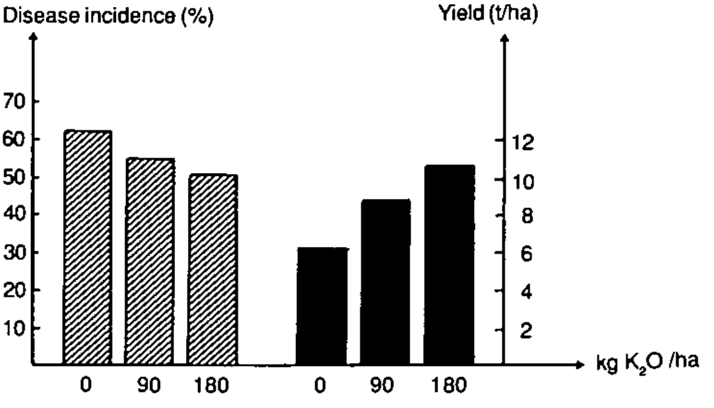

Fig. 57. Potassium and *Xanthomonas manihotis*

Table 163. Potassium and *Xanthomonas oryzae*

Basic treatment (kg/ha)			% leaves infected at harvest	
N	P_2O_5	K_2O	No top-dressing	Top-dressing with K_2O (20 kg/ha)
0	60	60	38	27
40	60	60	46	35
80	60	60	63	49
120	60	60	77	61
160	60	60	89	69
Average			63	48

- In a field trial with rice, disease outbreak was markedly reduced in the potassium plots *(Tominaga [1950]* in *Ono [1957])* (Figure 58).

Xanthomonas pruni

Potassium decreased infection percentage on peach trees of varieties Sunhigh and Red Heaven, in pot trials with nutrient solutions *(Matthee and Daines [1969])* (Figure 59).

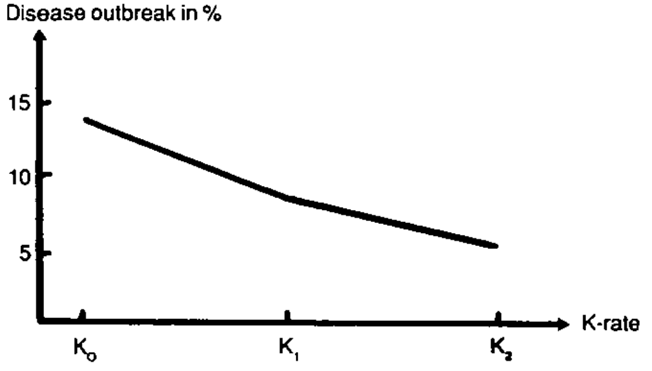

Fig. 58. Potassium and *Xanthomonas oryzae*

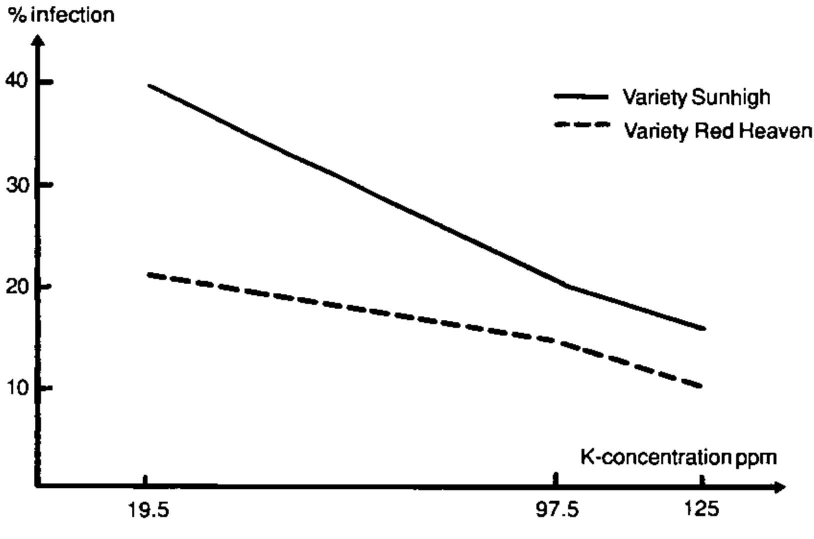

Fig. 59. Potassium and *Xanthomonas pruni*

Xanthomonas vesicatoria

In 2 nutrient solution trials with tomato, potassium slightly decreased the disease index and increased plant weight *(Nagada and Walker [1960])* (Figure 60).

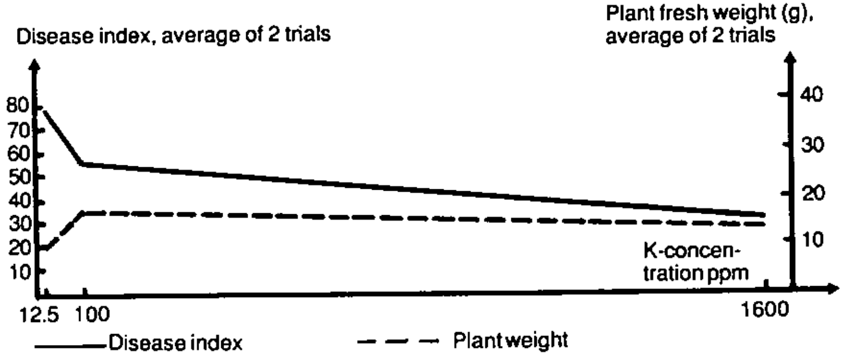

Fig. 60. Potassium and *Xanthomonas vesicatoria*

7.3. Various bacteria

Agrobacterium tumefaciens

On grapes, *Condei, Lepadata, Uglea and Glück [1980]* observed that potassium reduced the degree of attack by 25 %.

Bacillus betae

In a field trial with fodder beets, potassium considerably decreased the percentage of attack *(Niklas, Scharrer and Strobel [1927]* in *Scharrer and Bürke [1956])* (Figure 61).

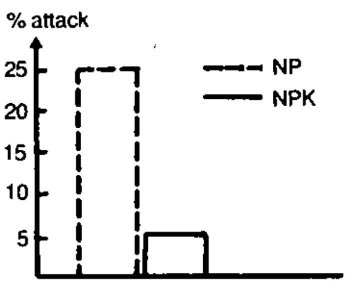

Fig. 61. Potassium and *Bacillus betae*

Table 164. Effect of potassium on various bacteria

Name	No. indications			
	Total	+	0	-
Agrobacterium tumefaciens	1	1		
Bacillus betae	1	1		
Bacillus phytophthorus	1		1	
Bacillus spp.	1	1		
Bacterium lathyri	1	1		
Corynebacterium insidiosum	2	2		
Corynebacterium michiganense	1	1		
Corynebacterium sepedonicum	2		2	
Erwinia amylovora	11	8		3
Erwinia carotovora	1	1		
Erwinia chrysanthemi	2			2
Erwinia herbicola	12	8	2	2
Phytomonas stewartii	3	2		1
Streptomyces scabies	13	5	1	7
Bacterial leaf blight	1	1		
Potato scab	2			2
Wildfire	1	1		
Total	56	33	6	17

Corynebacterium insidiosum

In nutrient solution trials, susceptibility of lucerne cultivars Buffalo and Grimm was increased when K was low *(Walters and Cralley [1959])*.

Corynebacterium michiganense

In a nutrient solution trial with tomato, potassium decreased disease index *(Walker and Kendrick [1948])* (Figure 62).

Corynebacterium sepedonicum

Walker and Gallegly [1951] report that in 2 nutrient solution trials with tomato, potassium did not significantly affect disease development.

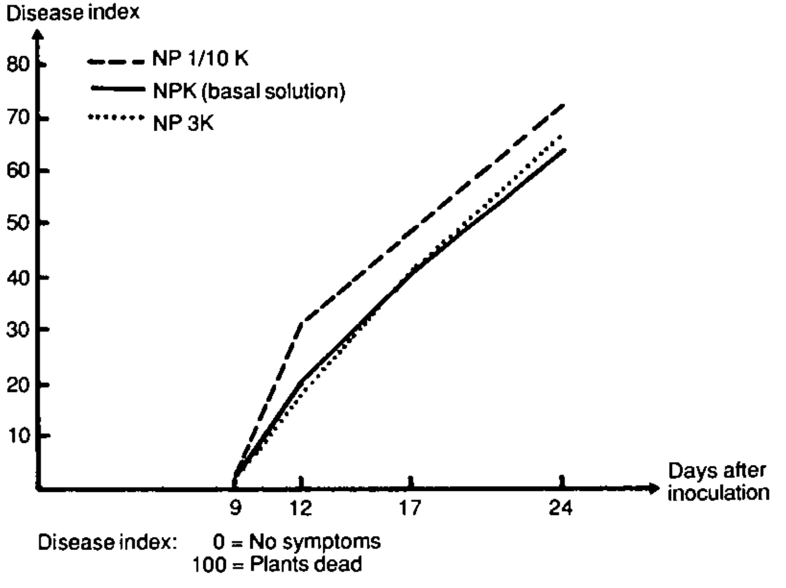

Fig. 62. Potassium and *Corynebacterium michiganense*

Erwinia herbicola (Tomato graywall)

Picha and Hall [1983] conducted field trials in spring and fall with 4 tomato cultivars in Florida. Significantly less graywall developed with K fertilization during the spring season with each cultivar (Table 165). Potassium fertilization also decreased gray wall development in Flora-Dade and Homestead-24 during the fall.

Phytomonas stewartii

In a nutrient solution trial with maize, potassium decreased number of lesions and infection index whereas the number of dead leaves was practically unchanged *(Spencer and McNew [1938])* (Table 166).

Streptomyces scabies (Potato scab)

- In a long-term field trial, potatoes were planted in 1963 and 1970. Potassium did not affect markedly the disease intensity *(Wenzl and Reichard [1974])* (Table 167).
- According to *Davis, Mc Dole and Callihan [1976]*, potassium significantly increased scab severity.

Table 165. Effect of potassium on graywall rating *

Cultivar	Season	kg K_2O/ha				
		0	112	224	448	896
Healani	Spring	2.5	0.9	0.9	0.5	0.5
	Fall	2.4	2.7	2.3	2.4	2.3
Homestead-24	Spring	1.7	0.7	0.6	0.5	0.3
	Fall	1.0	0.6	0.7	0.6	0.6
Walter	Spring	3.0	1.3	0.8	0.9	0.8
	Fall	1.9	1.6	1.9	2.1	1.8
Flora-Dade	Spring	0.6	0.5	0.7	0.3	0.3
	Fall	0.7	0.6	0.3	0.3	0.2

* 0 = no discoloration; 5 = severe browning

Table 166. Potassium and *Phytomonas stewartii*

K-concentration (mg/100 cc)	No. dead leaves	No. lesions	Infection index	Dry weight (g/plant)
0	13	195	1.35	0.36
40	14	105	0.86	0.39

Table 167. Potassium and potato scab

K_2O (kg/ha)	Disease index		K_2O (kg/ha)	Disease index	
	1963	1970		1963	1970
0	4.01	6.18	150	4.16	6.26
75	4.02	6.26	225	3.91	6.27

8. Factors influencing the effect of potassium

There are many contradictions in the literature and this doubtless results from the fact that there are many factors which can influence or modify the effect of potassium. Directly related to potassium are: availability of potassium in the soil, rate of potassium applied, and type of potassium fertilizer used. Other factors which may also play a more or less important role are: level of other nutrients applied or nutrient balance, form of other nutrients applied, crop variety, planting time, age of plants at infection, soil type, soil pH, humidity, rainfall, temperature, light intensity and cultural methods. Results may be influenced also by the type of experiment (field, pot or nutrient solution), whether infection is natural or artificial, method of assessment, time at which assessments are made. Some of the more important factors are discussed below.

8.1. Potassium status of the soil

It is unfortunate that in the majority of cases no accurate information is given on the potassium status of the soil. Though it is impossible, for lack of data, to be precise in this matter there is an indication, as would be expected, that application of potassium has a greater effect in reducing disease intensity on low K soils. Table 168 summarises data for all crops, diseases and pests arising from field trials. In 173 cases on soils of known low K status, potassium had a beneficial effect in 87 % of cases, while in 1089 cases on other soils of which the K status was unspecified (most cases) sufficient resp. high (a few cases), potassium appeared rather less effective (66 % beneficial effects).

For fungal diseases (Table 169) the average reduction in severity of disease was 57 % on low K soils but only 13 % on the other soils. It is likely that soils in the latter category would include a significant proportion of soils with medium or high K status. This general picture would be in line with the view that *potassium deficiency is detrimental to plant health.*

Table 168. Number and % indications of potassium effect in field trials

K-availability of the soil		Fungal diseases	Insects + Mites	Nema-odes	Viruses	Bac-teria	Total No.	%
Low	+	136	10		2	3	151	87
	0	4	1				5	
	-	5	10		2		17	
Total		145	21		4	3	173	
Unspecified,	+	530	113	7	39	25	714	66
sufficient	0	50	16	1	2	3	72	
or high	-	203	37	2	55	7	304	
Total		783	166	10	96	35	1090	

Table 169. Average reduction in severity of fungal diseases due to potassium in field trials

K-status of the soil	Average reduction in severity (%)	No. indications
Low	57	74
Unspecified, sufficient or high	13	498

8.2. Rate of potassium

Often, relatively low rates of potassium have little or no effect on resistance to disease while higher rates have marked beneficial effects. The following three examples illustrate this point:

- 75 kg K_2O/ha were needed to obtain a marked reduction of brown leaf spot in rice *(Okamoto [1958])* (Figure 63).
- 150 kg K_2O/ha was sufficient to eliminate leaf spot on timothy, while 75 kg had a relatively small effect *(Laughlin [1965])* (Table 170).

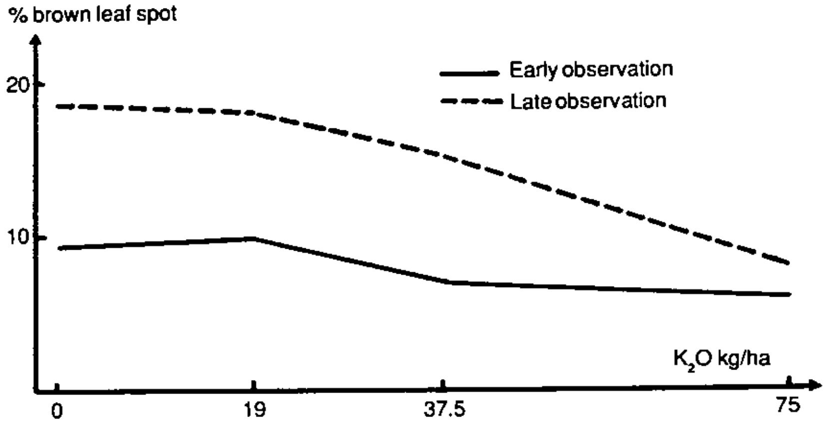

Fig. 63. Potassium and percentage brown leaf spot on 3rd leaf

Table 170. Potassium and leaf spot development in timothy

Treatment (kg/ha)			Disease rating			
N	P	K	July 9		August 14	
			A	S	A	S
168	49	0	3.0	2.0	3.0	2.5
168	49	75	1.3	0.7	2.5	2.2
168	49	149	0.0	0.2	0.5	0.2
168	49	298	0.2	0.3	0.0	0.0

Ratings: 0 = none, 1 = some, 2 = many, 3 = very many
A = autumn application
B = spring application

- In a trial with soybeans grown in cylindres, the highest potassium rate tested resulted in the greatest reduction in the percentage diseased seeds *(Crittenden and Svec [1974])* (Figure 64).

Results of this kind would be of greater interest if the effects on disease were related to effects of potassium on crop growth. Rates of K which do not improve the crop's growth may be thought unlikely to influence resistance.

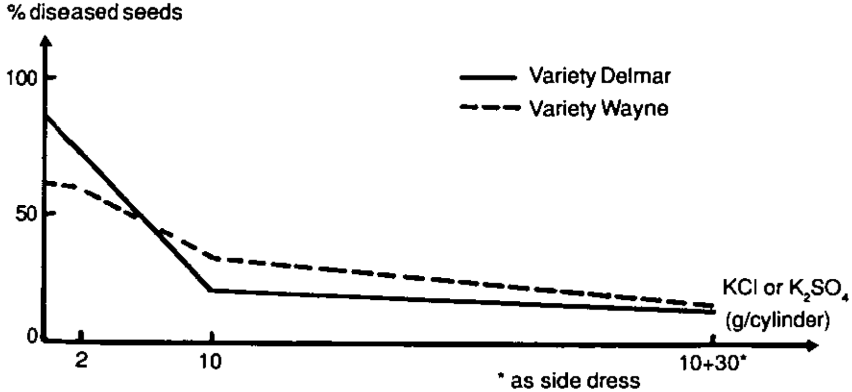

Fig. 64. Potassium level and pod and stem blight development

8.3. Type of potassium fertilizer

On the whole, it appears that KCl is more often effective in improving plant health than K_2SO_4 (Table 171). This applies to fungal diseases and insects + mites while the tendency is reverse in the case of viruses and there seems to be no difference in the case of bacteria. The differences observed may be due to direct effects of the anion.

Table 171. Potassium form and potassium effect

	No. or % indications					
	KCl			K_2SO_4		
	+	% of total	Total	+	% of total	Total
Fungal diseases	383	71	541	115	51	226
Insects + mites	37	68	54	19	49	39
Nematodes	13	54	24	1		9
Viruses	29	36	81	6	50	12
Bacteria	14	67	21	15	68	22
Total	476	66	721	156	51	308

8.4. Nutrient balance

All nutrients may affect plant health but two play a major role: *nitrogen and potassium*. The effect of other nutrients is less frequently mentioned. Most authors agree that N generally decreases crop resistance to pests and diseases while K generally increases it. The *balance between nutrients* is as important as their absolute rates and relative N excess or relative K deficiency generally have the same effect in decreasing crop resistance. Some contradictory observations of the effect of K in increasing susceptibility can be explained by differences in the availability of other nutrients, especially nitrogen. Reference is made to several extensive reviews of this subject in chapter 2.3.

8.4.1. NxK interaction

The interaction between nitrogen and potassium is almost always positive which means that potassium increases crop resistance more when plants receive increasing rates of nitrogen than when they receive no nitrogen, or in other words, increasing N rates decrease crop resistance less when K fertilization is adequate. Thus potassium generally reduces the detrimental effects of nitrogen on plant health. Most observations concern fungal diseases for which positive NxK interactions were recorded in the case of rice blast *(Abdel Hak, Ashour, Ayad, Fahmy and Risk [1966]; Malaguti, Silva and Ravanella [1951])*, sheath blight on rice *(Kannaiyan and Prasad [1978 b]*, stem rot on rice *(Yoshi, Koba and Watanabe [1949]* in *Ismunadji [1976]*, stalk rot on maize *(Koehler [1960])*, rust on wheat *(Singh [1978])*, Drechslera leaf spot on coconut *(Fagan [1985])*, stem rot on oil palm *(Navaratnam and Chee [1965]* in *Thiagalingam [1977])*, Cercospora leaf spot on cassava *(Muthuswamy, Sivaprakasam, Krishnamoorthy and Kandasamy [1977])*, grey mould on potato *(Harper and Will [1968])*, *Pyricularia setariae* on finger millet *(Muthuswamy, Thalamutha and Narayanan [1985]* and *Phytophthora drechsleri* on pigeon peas *(Pal and Grewal [1976])*. Positive NxK interactions were also noted in the case of bacterial leaf blight on rice *(Kim and Cho [1970], Lee [1966], Tominaga [1950]* in *Ono [1957]*, maize *(Webb and George [1968])* and philodendron *(Haygood, Strider and Nelson [1982])*, *Leucinodes orbonalis* on eggplants *(Sinha, Chakraborty, Dasgupta and Dhua [1976])* and *Meloidogyne incognita* on coffee *(Jaehn, Monteiro, Lordello, Barbim and Demétrio [1983])*.

The following examples illustrate the importance of the balance between nitrogen and potassium:

- In a field trial with rice, stem rot damage reduction due to potassium was more marked at higher N-rate *(Yoshi, Koba and Watanabe [1949]* in *Ismunaji [1976])* (Figure 65).

- In a field trial conducted in India, a positive NxK interaction was observed on rust on wheat by *Singh [1978]* (Table 172).

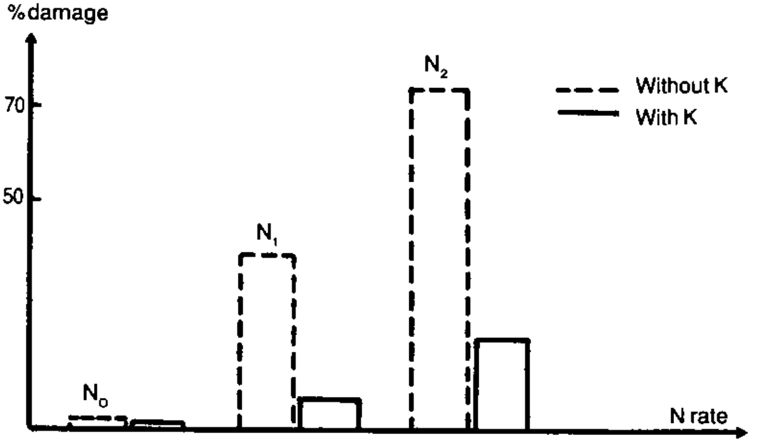

Fig. 65. Effect of potassium and nitrogen on stem rot damage in rice

Table 172. Effect of nitrogen and potassium on rust on wheat

Treatment	Infection rate (%)
Control	64.9
N	80.5
P	63.8
K	29.3
NP	78.4
NK	29.3
PK	26.1
NPK	29.1

- On a soil low in potassium, K decreased the percentage of stalk rot damage on maize to a much larger extent when 90 kg N/ha were also applied *(Koehler [1960])* (Figure 66).

- According to *Harper and Will [1968]*, potassium reduced the percentage of potato plants infected by grey mould more in presence of high N rates than when no N was applied (Figure 67).

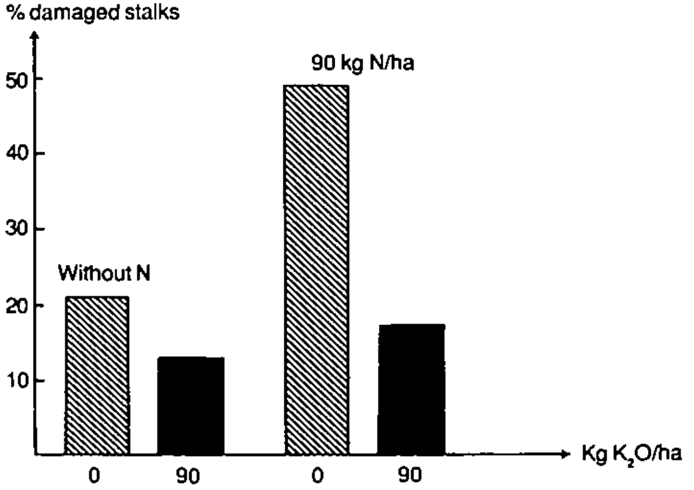

Fig. 66. Effect of nitrogen and potassium on stalk rot in maize

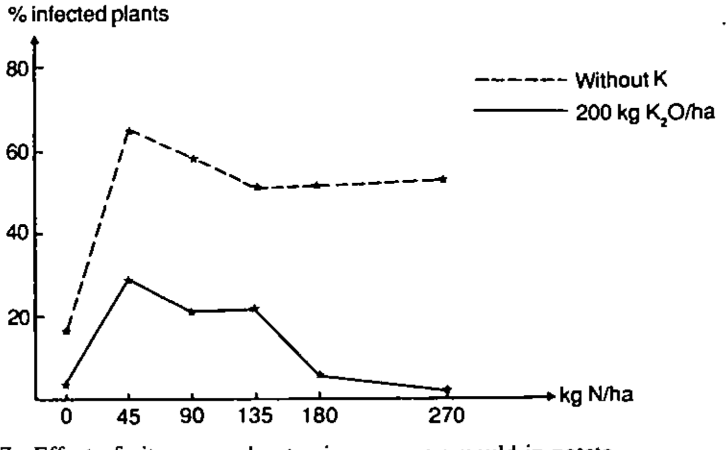

Fig. 67. Effect of nitrogen and potassium on grey mould in potato

- A strong positive NxK interaction was observed by *Muthuswamy, Thalamutha and Narayanan [1985]* with finger millet infected by *Pyricularia setariae* (Table 173).

- The effect of potassium on bacterial leaf blight in rice was more marked at higher N rates *(Tominaga [1950]* in *Ono [1957])* (Table 174).

Table 173. Effect of N and K on disease incidence (%) in finger millet

	kg N/ha		
kg K_2O/ha	0	45	90
0	39.2	65.8	76.7
45	14.7	20.8	35.8

Table 174. Effect of potassium and nitrogen on bacterial leaf blight in rice

Treatment	Disease outbreak (%)
N_0K_0	4
N_0K_2	2
N_1K_0	21
N_1K_2	17
N_2K_0	17
N_2K_2	6

- In a field trial in Korea, potassium decreased the size of spots due to bacterial leaf blight on rice by 0.3 mm without N and by 6.8 mm when the standard rate of N was applied *(Lee [1966])*.

- On eggplants, potassium slightly increased the percentage of fruits infested by *Leucinodes orbonalis* in absence of N fertilization and decreased it when 120 kg N/ha were applied *(Sinha, Chakraborty, Dasgupta and Dhua [1976])* (Table 175).

Table 175. Effect of nitrogen and potassium on *Leucinodes orbonalis*

kg N/ha	% infested fruits	
	Without K	50 kg K_2O/ha
0	5.05	5.87
60	8.25	6.01
120	8.61	7.11

8.4.2 Type of nitrogen fertilizer

In recent years, a few authors have investigated the effect of potassium in presence of various nitrogen forms.

- The most detailed study has been made by *Schneider [1985]* with fusarium yellows on celery. In this study, the use of NH_4 clearly resulted in more severe disease than did NO_3 regardless of the accompanying ion. In 3 greenhouse trials, the form of N affected the effect of KCl which reduced disease more when combined with NO_3 than with NH_4 (Table 176). The effect of K_2SO_4 tended to be less marked in combination with NH_4Cl.

Table 176. Effect of nitrogen and potassium form on fusarium yellows in celery

Treatment	Disease index *		
	Trial 1	Trial 2	Trial 3
$(NH_4)_2SO_4$	5.6	5.4	5.9
$(NH_4)_2SO_4$ + KCl	5.0	5.4	5.5
$(NH_4)_2SO_4$ + K_2SO_4	6.8	6.8	6.1
NH_4Cl	5.6	5.5	6.3
NH_4Cl + KCl	5.4	5.1	5.9
NH_4Cl + K_2SO_4	6.1	5.6	6.0
Ca $(NO_3)_2$	3.6	3.1	3.4
Ca $(NO_3)_2$ + KCl	2.1	2.0	2.1
Ca $(NO_3)_2$ + K_2SO_4	3.8	3.9	5.2

* 1 = healthy; 7 = wilted or dead

In a field trial, the effect of KCl was also affected by the form of N (Table 177).

Table 177. Effect of nitrogen form and KCl on fusarium yellows in celery

Treatment	Disease incidence (%)
Ca $(NO_3)_2$	16.2
Ca $(NO_3)_2$ + KCl	7.5
$(NH_4)_2$ SO_4	61.2
$(NH_4)_2$ SO + KCl	66.9

- In a field trial with wheat, the effect of potassium on take-all depended on soil pH and form of nitrogen *(Taylor, Jackson, Powelson and Christensen [1983])*. At pH 6.0 K slightly increased infection in the presence of NH_4Cl and decreased it in the presence of $(NH_4)_2SO_4$ and $Ca(NO_3)_2$. At pH 6.2 K slightly decreased infection when combined with NH_4Cl and $(NH_4)_2SO_4$ while it increased it when N was applied as $Ca(NO_3)_2$.

8.5. Trial type

It is interesting to note that beneficial effects of potassium appear to be more frequent in field trials than in pots, laboratory and nutrient solution trials. This applies to all pests and diseases groups (Table 178).

Table 178. Trial type and potassium effect

	% indications of a beneficial potassium effect - ( ) Total no. indications	
	Field trials	Pot, laboratory, greenhouse trials
Fungal diseases	72 % (928)	63 % (455)
Insects + mites	66 % (187)	62 % (224)
Nematodes	70 % (10)	38 % (92)
Viruses	41 % (100)	38 % (69)
Bacteria	74 % (38)	60 % (86)
Total	68 % (1263)	58 % (926)

8.6. Varietal susceptibility

According to Table 179 potassium tends to have slightly more frequently a beneficial effect with resistant varieties than with susceptible and very susceptible varieties.

Table 179. Varietal susceptibility and K-effect

Varieties	Number indications	% indications of a beneficial K-effect
Susceptible and very susceptible	83	55
Resistant	61	66

9. Nature of the potassium effect

9.1. The various aspects of the potassium effect

Potassium can affect both *parasite development* and the *damage* to the host caused by the parasite and consequently the *yield*. Modifications of parasite development and damage might be explained by changes in host morphology and physiology caused by potassium. Potassium may also influence other biotic factors which could affect the host-parasite relationship. The various types of data available concerning the potassium effect as well as their frequency are presented in Table 180.

Table 180. Percentage of indications for the various aspects of K-effect

Aspect	% indications	
Effect on the host		
- Infestation (attack) intensity	49	
- Disease index	11	
- Spots and lesions (size, number)	6	75
- Damage, dead plants	4	
- Crop susceptibility	3	
- Disease symptoms, virus content, galls, necroses	2	
Effect on parasites		
- Number	10	
- Multiplication	8	
- Development	4	25
- Longevity, mortality, weight, host preference, spread or penetration in plants, feeding	3	

The majority of data concern effects on the host (75 %) while 25 % concern direct effects on the parasite. Observations on parasites concern mainly their numbers, multiplication and development. Occasionally, longevity, mortality, weight, host preference, spread or penetration in plants and feeding were also mentioned. On the host, infestation intensity, disease index, spots, lesions, damage, dead plants and crop susceptibility are the most frequently mentioned. Disease symptoms, virus content, galls, necroses are mentioned less frequently.

9.2. Magnitude of the effect of potassium

According to Table 181 potassium reduces parasites development or damage by more than 10 % in 55 % of the cases and increases it by more than 10 % in 24 % of the cases. The effect is less than 10 % in 21 % of the cases.

Table 181. Magnitude of the effect of potassium on parasites development and damage

Effect type	Effect in %	No. indications	% indications
Decrease	> 90	26	2
Decrease	50 - 90	203	16
Decrease	30 - 50	198	16
Decrease	10 - 30	271	21
Decrease	< 10	101	8
No effect	0	38	3
Increase	< 10	128	10
Increase	10 - 30	106	8
Increase	30 - 50	61	5
Increase	50 - 90	48	4
Increase	> 90	87	7

9.3. Effect on plant metabolism

It is beyond the scope of this publication to discuss in detail the various and sometimes contradictory results and theories and we try simply to summarize the main effects which are known at present.

Usually, an insufficient K supply induces in the plant a reduced K level and with few exceptions, the accumulation of soluble compounds of low molecular weight. The compounds most frequently mentioned are *soluble N compounds* (total level of non-protein N-compounds) and *soluble carbohydrates* (reducing sugars).

According to *Trolldenier and Zehler [1976]*, this accumulation of soluble low molecular compounds is due to increased activity of decomposing enzymes such as amylase, saccharase, glucosidase and protease. Furthermore, K-deficiency restricts phosphorylation, so that carbohydrates of low molecular weight and soluble N-compounds will accumulate *(Mengel [1972]* in *Trolldenier and Zehler [1976])*.

This accumulation of soluble low molecular compounds due to potassium deficiency is often accompanied by increased development of parasites. Hypotheses on the effect of potassium on the host-parasite relationship seem to involve more guesswork than fact. However most authors agree that for optimal development parasites require in their diet large amounts of soluble compounds of low molecular weight. Phenols can also play a beneficial role in plant resistance and with a few exceptions, adequate potassium nutrition increases the content of total phenols and ortho dihydroxy phenols in plants.

Each parasite has probably specific nutritional requirements especially for various individual substances (*e.g.* individual aminoacids, sugars, etc.) but indications on this subject are not yet numerous enough to indicate clear tendencies. *Chaboussou [1972]* wrote: "According to our view, the plant will be attacked to the extent that its biochemical state corresponds to the trophic demand of the parasite in question."

9.4. Effect on plant morphology

A sufficient potassium supply tends to harden plant structures, including the following aspects:

- stronger cuticle
- stronger outer wall of epidermis
- stronger cell walls
- improved formation of sclerenchymatous tissues
- lignification stimulated
- silicification stimulated
- thicker and harder stems

The effect of potassium on silicification and thickness of the sclerenchymatous layer is illustrated by the results obtained by *Vaithilingam and Balasubramaniam [1976]* (Table 182).

Table 182. Effect of potassium on silicification and thickness of sclerenchymatous layer in rice

kg K_2O/ha	Silica content of the rice culm in ppm (average for 6 dates)		Thickness of sclerenchymatous layer in microns (average of 6 dates)	
	Variety Kannagi	Variety IR 20	Variety Kannagi	Variety IR 20
0	0.20	0.17	31	33
67	0.28	0.22	42	41
112	0.37	0.26	53	51

Furthermore, stimulation of natural cork formation was reported by *Saburova [1951]* in *Fuchs and Grossmann [1972]* and more rapid formation of wound cork in cabbage by *Leuchs [1959]* in *Fuchs and Grossmann [1972]*.
This hardening of plant structures is generally considered to improve mechanical resistance to penetration of diseases and to feeding of insects especially sucking insects. In K deficiency the mechanism of opening and closing of stomata is impaired and it may by that if stomata are open more often this facilitates the entry of fungal and bacterial pathogens. Potassium stimulates the growth of meristem tissues so that lost tissue can be easier replaced.

Allington and Johnson [1942] and *Matthee and Daines [1969]* in *Fuchs and Grossmann [1972]* reported that leaves of K-deficient plants have an increased tendency to water-soaking which favours infection by bacteria.

Krüger [1951] reported that severe K-deficiency caused heavy leaf losses during the growth period so that virus spread within plant is reduced. This could explain why a slight tendency to stimulated virus development was observed in potatoes sufficiently supplied with potassium (Chapter 6).

10. Effect of potassium on yield or growth

Farmers are primarily concerned with yield and we have summarized the available data concerning the effects of potassium on yield and growth of infested plants in three ways:

a) Effect on yield of infested plants for the various parasite groups.
b) Comparison of effect on parasites and on yields of infested plants.
c) Effect on yield of infested vs. healthy plants.

10.1. Effect of potassium on yield or growth of infested plants according to parasite groups

We found 342 quantified data concerning K-effect on yields and 97 on growth - which corresponds to only about 18 % of the total indications evaluated in this study and this aspect was therefore not included in the summarizing Tables 187 - 192.

Table 183. Potassium and average yield or growth increase of infested plants

Parasite group	Average increase in % - () No. data	
	Yield	Growth
Fungal diseases	42 (320)	31 (43)
Insects + mites	36 (8)	18 (6)
Nematodes	19 (6)	85 (17)
Viruses	78 (2)	49 (28)
Bacteria	57 (6)	45 (3)

Table 183 shows that potassium increased yield or growth in the different parasite groups by more than 30 %, except in the case of growth of plants infected by insects + mites and yield of those infested by nematodes where the effect was less important (+ 18 % and + 19 %). This considerable effect of potassium on yield or growth is also observed in the case of plants infested by nematodes and viruses despite these parasites being more often stimulated by potassium. This shows that adequate potassium nutrition helps plants to better tolerate pathogen attacks or to better recover from them.

10.2. Effect of potassium on parasites and on yield or growth of infested plants

There were 336 cases where measurements were made of both parasite development and crop yield. Most (275) were concerned with fungal diseases for which on the average 40 % increase in yield accompanied a 16 % reduction in parasites (Table 184).

It is interesting to note that in the case of viruses and nematodes, potassium considerably increased yield or growth of infested plants in spite of its stimulating effect on these pathogens. This probably means that plants adequately supplied with potassium have an improved ability to withstand or recover from attacks.

Table 184. Effect of potassium on parasites and yield resp. growth

Parasite group	Number data	Average reduction (-) or increase (+) in %	
		Parasites	Yield or growth
Fungal diseases	275	- 16	+ 40
Viruses	25	+ 42	+ 51
Nematodes	17	+ 70	+ 45
Insects and mites	12	- 21	+ 30
Bacteria	7	- 25	+ 50

10.3. Effect of potassium on yield or growth of infested and healthy plants

Only a few authors have attempted to compare yield or growth response to potassium in healthy and infested plants.

- For example, *Oteifa [1952]* conducted a pot trial with beans infested with *M. incognita* at 3 levels of K. Potassium deficiency and nematode infection both decreased growth and it appeared that a high level of potassium lessened the growth reduction caused by the lower level of infection though it had little effect at the high infection level (Table 185).
- *Trolldenier [1984]* studied the effect of 3 potassium rates and 4 take-all infection densities on wheat grown in pots. Grain yield of healthy plants was not significantly different between the medium and high K rates but infected plants yielded much more when they were supplied the higher K rate (Table 186).

Table 185. Effect of infestation by *Meloidogyne incognita* on growth of beans at various levels of K

K-concentration (milliequivalents/l)	Dry weight (g/plant) Number eggmasses inoculated		
	0	50	200
0.5 (deficiency)	22.6	19.9	16.0
6.0 (medium)	38.6	28.0	19.1
10.0 (excess)	39.5	36.1	22.5

Table 186. Effect of potassium and take-all intensity on wheat grain yield (g/pot)

g K_2O/pot	Infection density			
	Nil	Low	Medium	High
0.75	47.3	36.7	37.2	38.5
1.5	71.1	40.0	43.9	39.0
3.0	73.2	55.2	55.4	56.0

- In a pot trial reported by *Trolldenier [1982 b]* the effect of 3 potassium rates (K_1, K_2 and K_3 *i.e.* 0.75, 1.5 and 3 g K_2O/pot) on yield of a barley variety very susceptible to mildew was measured in presence of 3 intensities of fungicides use: nil, low (2 applications) and high (8 applications). In the absence of fungicides use, the yield loss due to mildew amounted to 70 % with the low K rate and to only 48 % with the high K rate (Figure 68).

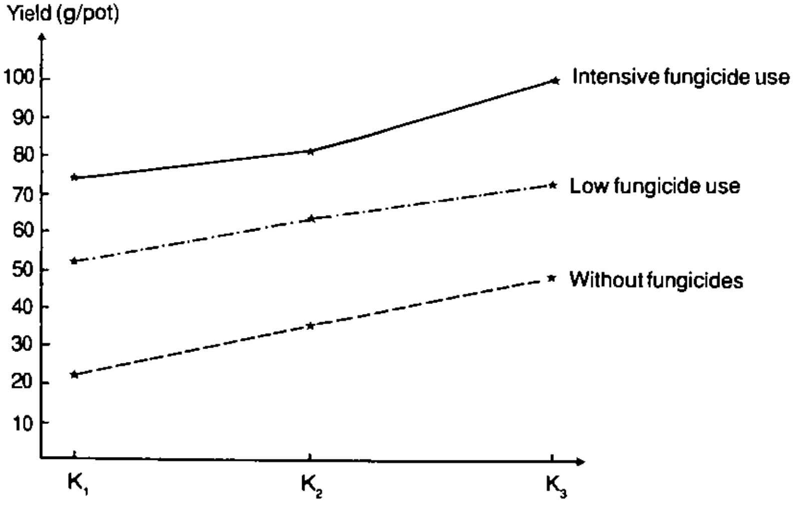

Fig. 68. Effect of potassium on yield of barley infested with mildew in presence of 3 fungicide use intensities

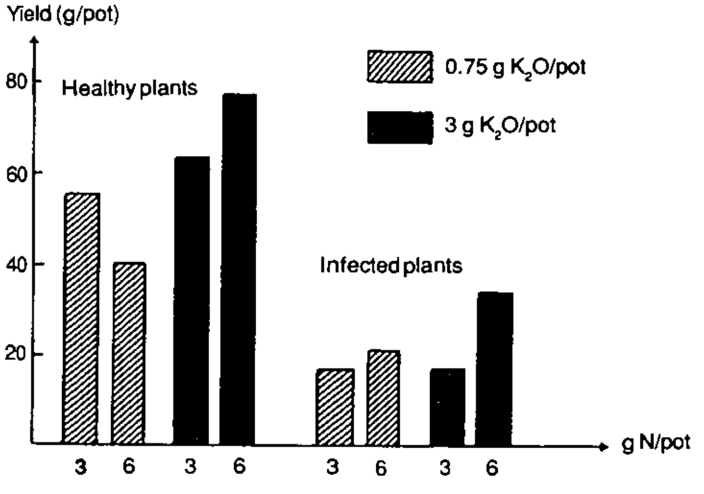

Fig. 69. Effect of nitrogen and potassium on yield of wheat with and without take-all infection

- In a nutrient solution trial, potassium increased grain yield of healthy barley plants by 88 % and of those infested with powdery mildew by 94 % *(Beringer and Koch [1980 a])*.

- A positive interaction between N and K was found in the case of healthy and take-all infected wheat grown in pots *(Trolldenier [1984])* (Figure 69). 2 N rates (3 and 6 g/pot) and 2 K rates (0.75 and 3 g K_2O/pot) were used in this trial. Nitrogen increased grain yield of healthy and infected plants much more in presence of the high potassium rate.

It can be concluded from the data available that the yield or growth of infested plants is usually lower than that of healthy plants even when potassium nutrition is adequate.

11. Practical significance

There seems to be little doubt that, with very few exceptions, potassium has generally an effect in reducing the damage which crops suffer through pest and disease. To what extent this general effect is due to possible effects of the nutrient on the pathogen or on resistance to infection and to what extent it is due simply to the fact that the properly nourished plant is better able to recover from damage caused by the pathogen may be of less consequence to the farmer than it is to the scientist. Where there is a beneficial effect of a nutrient on yield of a crop infected by, or exposed to infection by a disease or pest it is impossible in most of the work reviewed here to say whether such effect may be due to an effect on resistance or merely to an effect of the nutrient in improving growth, quite independent of the effect on disease, *i.e.* the same type of response as that shown by a healthy crop.

It is clear that in some cases, *e.g.* in virus and nematodes infections, the most important effect of potassium is in conferring in the plant the ability to recover from attack rather than in curtailing pathogen development or improving resistance to infection.

The farmer uses fertilizer in order to obtain maximum yield, or, more specifically, the maximum economic return possible from the farming enterprise. To achieve this aim, fertilizers must be applied in adequate quantities and the balance between nutrients must be correctly adjusted. Nutrient balance is particularly important in the context of plant health. The widely accepted view that excessive use of nitrogen is damaging to plant health is due not so much to a deleterious effect of nitrogen *per se* as to the fact that "excessive" use of nitrogen implies a lack of balance. Similarly potassium has an ability to counteract the unfavourable effects of nitrogen, since in most cases, it improves nitrogen efficiency by reducing the stimulating effect of N on pathogens or by increasing its beneficial effect on yield. This survey has shown the importance of the balance betweeen fertilizers, especially between nitrogen and potassium. Furthermore, potassium improves plant health in the majority of cases. It cannot be suggested that disease could be controlled by the use of fertilizers alone; the improvements in resistance due to potassium noted in this report, usually do not compare with the effects of spray chemicals but the application of potassium fertilizer in adequate quantity can be regarded as a kind of insurance policy which helps to reduce crop damage especially on soils which are not sufficiently provided with potassium or in situations where the conditions for plant protection are not optimal. It may not be too sweeping a statement to say that when fertilizers are applied according to the dictates of common sense in order to achieve maximum economic returns from crops, the return in terms of improved plant health will also be optimised.

12. Recommendations for future work

While we may have been able to show that knowledge in the field surveyed is at such a stage that, for practical purposes we can say with conviction that, far from having any effect in increasing crop susceptibility, potassium more often improves plant health, there is still much that we do not understand about the way in which nutrients are concerned in pathogen development and the mechanisms of crop resistance and there is still a lack of precise data which relates the effects of pest or disease with the effect of fertilizer in terms of crop performance and yield. Many of the results cited here arise from investigations that were in one or more respects incomplete. This is not to say that such data are of no value but it does point a need for more, and more systematic, investigation in the future.

The following essential requirements should always be fulfilled in order that the results of the various experiments can be compared:

1) **The soil K status** which may influence the effect of potassium should be indicated. We suggest to use the level of K (ppm or mg/100 g or kg/ha) rather than to speak only of soil low, medium or high in K since the meaning of these terms may differ considerably between the authors, countries, etc.

2) **Rates of fertilizer K applied** should be well differentiated and should include at least three levels representing *deficiency, sufficiency* and a *higher rate*. The rate corresponding to sufficiency would normally be that usually recommended. The rates applied should of course be indicated (in kg or g).

3) **The rates of the other nutrients**, especially of **nitrogen,** should also be stated in quantitative terms due to their possible interactions with potassium.

4) **The effect of the different K rates on pests or diseases** should always be measured, in terms of the various aspects of the effect: number of pests per unit chosen (*e.g.* per leaf, fruit, plant), pest mortality, pest fecundity, disease incidence in %, disease index, number and size of lesions, number of dead plants, etc.

5) Since high yields are the aim of modern agriculture, it is important to examine the effect of potassium on pests or diseases as well as on yield of infested plants.

Furthermore more detailed investigation is needed concerning:

1) Mechanisms involved in the effect of potassium on plant metabolism and plant morphology as they affect plant health.

2) As it is necessary to establish K-effects on yields over several years in trials at the same place - so K-effects on plant health should be investigated preferably in long-term trials (*e.g.* at least 3 - 5 years).

3) Comparison in the same experiment of the effect of potassium on yield/ growth of infested as well as healthy plants according to the following scheme:

Treatment	Rate of K-fertilizer	Plant
1	Deficient	Healthy
2	Sufficient	Healthy
3	High	Healthy
4	Deficient	Infested
5	Sufficient	Infested
6	High	Infested

Finally, the K-form (KCl, K_2SO_4, etc.) and the degree of susceptibility towards pests and diseases of the variety used should be indicated as they may influence the potassium effect.

The furthering of research into these problems will require the closest collaboration between agronomists, pathologists, physiologists and biochemists.

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14. Annexes

Table 187 **K-effect on fungal diseases** (Diseases ordered alphabetically according to English name)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
		Cereals				
Brown rust of barley	*Puccinia simplex*	Barley	+	L - Very susceptible varieties		*Gassner et al., 1931*
Common root rot	*Helminthosporium sativum*	Barley	+	F - Disease index	KCl	*Goos, 1986*
Common root rot	*Helminthosporium sativum*	Barley	6+	F - Disease index - 2 varieties and 3 sites	KCl	*Goos et al., 1987*
Common root rot	*Helminthosporium sativum*	Barley	5+ (56)	F - Soil very low in K - Percentage of plants infected -5 varieties		*Piening, 1982*
Common root rot	*Helminthosporium sativum*	Barley	2- (6)	F - Infection percentage - 2 varieties	KCl	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	3+ (22)	F - Infection percentage - 3 varieties	KCl	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	- (77)	F - Infection percentage - 1 variety	K_2SO_4	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	4+ (8)	F - Infection percentage - 4 varieties	K_2SO_4	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	-	F - Disease index - 1 variety	KCl	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	2 0	F - Disease index - 2 varieties	KCl	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	2+	F - Disease index - 2 varieties	KCl	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	3-	F - Disease index - 3 varieties	K_2SO_4	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	0	F - Disease index - 1 variety	K_2SO_4	*Timm et al., 1986*
Common root rot	*Helminthosporium sativum*	Barley	+	F - Disease index - 1 variety	K_2SO_4	*Timm et al., 1986*
Dryland root rot	*Fusarium* spp.	Barley	+	F - Disease severity	KCl	*Garvin et al., 1981*

Dryland root rot	*Fusarium* spp.	Barley	0	F - Disease severity	K_2SO_4	*Garvin et al., 1981*
Leaf stripe of barley	*Helminthosporium gramineum*	Barley	+	F - Disease percentage		*Russell, 1928*
Mildew		Barley	+	Penetration of conidia in leaves		*Dentler, 1958 in Trolldenier, 1969*
Mildew		Barley	0	Number germinating spores on plants		*Dentler, 1958 in Trolldenier, 1969*
Mildew		Barley	+	F - Disease index	K_2SO_4	*Spinks, 1913*
Net-blotch of barley	*Helminthosporium teres*	Barley	+			*Bonning et al., 1934 in Singh, 1963*
Net-blotch of barley	*Helminthosporium teres*	Barley	-	L - Disease index		*Singh, 1963*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Disease symptoms	K_2SO_4	*Beringer et al.,1980a*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Disease symptoms	K_2SO_4	*Beringer et al.,1980b*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Isaria - Infection intensity	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Isaria - Infection intensity	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	0	L - Variety Isaria - Infection type	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Isaria - Infection type	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Donaria - Infection intensity	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Donaria - Infection intensity	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Donaria - Infection type	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Donaria - Infection type	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Siegesgerste - Infection intensity	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Siegesgerste - Infection intensity	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	0	L - Variety Siegesgerste - Infection type	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Siegesgerste - Infection type	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Haisa II - Infection intensity	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	-	L - Variety Haisa II - Infection intensity	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Haisa II - Infection type	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Variety Haisa II - Infection type	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (17)	L - Incubation rapidity	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	0 (0)	L - Incubation rapidity	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (6)	L - Fructification rapidity	KCl	*Hopfengart, 1953*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Powdery mildew	*Erysiphe graminis*	Barley	0 (0)	L - Fructification rapidity	K_2SO_4	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	- (17)	L - Variety Isaria - Inoculation 19 days after sowing - Number diseased sites per leaf	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (4)	L - Variety Isaria - Inoculation 15 days after sowing - Number diseased sites per leaf	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (59)	L - Variety Isaria - Inoculation 11 days after sowing - Number diseased sites per leaf	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	- (26)	L - Variety Donaria - Inoculation 19 days after - Number diseased sites per leaf	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (8)	L - Variety Donaria - Inoculation 15 days after sowing - Number diseased sites per leaf	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (64)	L - Variety Donaria - Inoculation 11 days after sowing - Number diseased sites per leaf	KCl	*Hopfengart, 1953*
Powdery mildew	*Erysiphe graminis*	Barley	+ (19)	F - Infection percentage		*Last, 1962*
Powdery mildew	*Erysiphe graminis*	Barley	0	L - Infection intensity		*Nagy, 1985*
Powdery mildew	*Erysiphe graminis*	Barley	+	L - Crop susceptibility		*Vanova, 1973 in Baier, 1976*
Take-all	*Gaeumannomyces graminis*	Barley	3-(100)	F - Long-term trial - Infection percentage - 3 years average		*Slope et al.,1974*
Yellow rust		Barley	+	Disease incidence		*Kratschmer, 1933*
Disease unspecified		Barley	+	Crop susceptibility		*Remy, 1898 in Lowig, 1935*
Brown rust		Cereals unspecified	+	F		*Bocev, 1971*
Powdery mildew	*Erysiphe graminis*	Cereals unspecified	+	F - Soil poor in K - Attack intensity		*Gram, 1930 in Stapel, 1958*
Powdery mildew	*Erysiphe graminis*	Cereals unspecified	+	F - Soil poor in K - Attack intensity		*Jörgensen, 1940 in Stapel, 1958*

Powdery mildew	*Erysiphe graminis*	Cereals unspecified	+			*Schaffnit et al., 1927 in Krauss, 1969*
Rusts unspecified		Cereals unspecified	+	Crop susceptibility		*Bollard, 1953 in Fuchs et al., 1972*
Rusts unspecified		Cereals unspecified	+	Crop susceptibility		*Schaffnit et al., 1927 in Fuchs et al., 1972*
Rusts unspecified		Cereals unspecified	+	Crop susceptibility		*Zimmermann, 1925 in Fuchs et al., 1972*
Ragi blast	*Pyricularia setariae*	Finger millet	+ (53)	F - Soil low in K-Disease incidence		*Muthuswamy et al., 1985*
Charcoal rot	*Sclerotium bataticola*	Maize	+ (40)	L - Number infected plants	K_2SO_4	*Sabet et al., 1968*
Corn root rot	*Gibberella saubinetti*	Maize	3+	L - Crop susceptibility - Average for 3 varieties		*Hoffer, 1925*
Corn root rot	*Gibberella*	Maize	+	F - Resistent line W 22 - Root necrosis index - Average of 5 evaluations (10.8.-24.9)	KCl	*Martens et al., 1967*
Corn root rot	*Gibberella*	Maize	+	F - Intermediate line W 575 - Root necrosis index - Average of 5 evaluations (10.8.-24.9)	KCl	*Martens et al., 1967*
Corn root rot	*Gibberella*	Maize	+	F - Suceptible line W 23 - Root necrosis index - Average of 5 evaluations (10.8-14.9)	KCl	*Martens et al., 1967*
Corn root rot	*Gibberella zeae*	Maize	0	F - Disease index		*Parker et al., 1959*
Corn root rot	*Gibberella zeae*	Maize	0	F - Number dead plants		*Parker et al., 1959*
Corn root rot	*Gibberella roseum*	Maize	+	L - Disease index		*Thayer et al., 1960*
Corn rust	*Puccinia sorghi*	Maize	-	F - Long-term trial - Artificial infection -	KCl	*Gassner et al., 1934*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
				Disease index		
Corn smut	*Ustilago zeae*	Maize	+	F - Infection frequency		*Gurevic, 1971*
Corn smut	*Ustilago maydis*	Maize	+	Disease development	KCl	*Kolomiets, 1960*
Corn smut	*Ustilago maydis*	Maize	+	Crop susceptibility	KCl	*Kolomiets, 1960*
Corn smut	*Ustilago maydis*	Maize	+ (23)	F - Long-term trial - Infection intensity on cobs, 1963	KCl	*Mühle et al., 1966*
Corn smut	*Ustilago maydis*	Maize	+ (6)	F - Long-term trial - Infection intensity on stalks, 1963	KCl	*Mühle et al., 1966*
Corn smut	*Ustilago maydis*	Maize	+ (18)	F - Long-term trial - Infection intensity on cobs, 1964	KCl	*Mühle et al., 1966*
Corn smut	*Ustilago maydis*	Maize	+ (4)	F - Long-term trial - Infection intensity on stalks, 1964	KCl	*Mühle et al., 1966*
Corn smut	*Ustilago zeae*	Maize	+			*Schaffnit et al., 1927 in Krauss, 1969*
Late wilt	*Cephalosporium maydis*	Maize	+ (16)	L - Trial I 1977 - N applied as urea - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	+ (10)	L - Trial I 1977 - N applied as ammonium sulphate - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	- (12)	L - Trial I 1977 - N applied as ammonium nitrate - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	- (35)	L - Trial I 1978 - N applied as urea - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	- (1)	L - Trial I 1978 - N applied as ammonium sulphate - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	+ (12)	L - Trial I 1978 - N applied as ammonium nitrate - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	- (6)	L - Trial II 1977 - Infection percentage	KCl	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium maydis*	Maize	- (2)	L - Trial II 1977 - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*

Late wilt	*Cephalosporium maydis*	Maize	+ ([illegible])	L - Trial II 1978 - Infection percentage	KCl	*Abdel-Rahim et al., 1984*
Late wilt	*Cephalosporium moydis*	Maize	+ (51)	L - Trial II 1978 - Infection percentage	K_2SO_4	*Abdel-Rahim et al., 1984*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	2 +	F - Disaese index - 2 trials	KCl	*Bogyo, 1955*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	L - Variety Golden Glow - 20°C - Disease index		*Edwards, 1941*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	0	L - Variety Golden Glow - 28°C - Disease index		*Edwards, 1941*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	-	L - Variety Funk's Yellow - 20°C - Disease index		*Edwards, 1941*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	0	L - Variety Funk's Yellow - 28°C - Disease index		*Edwards, 1941*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	F - Long-term trial - Evaluation 1961 - Disease index	KCl	*Hooker et al., 1963*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	F - Observation at Brownstown before 1961 - Disease index		*Hooker et al., 1963*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	F - Observation in southern Illinois 1961 - Disease index		*Hooker et al., 1963*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	F - Observation in southern Illinois 1962 - Disease index		*Hooker et al., 1963*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	F - Various observations - Disease index		*Hooker et al., 1963*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	0	F - Soil low in K		*Karlen, 1973*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	-	L - Disease index	K_2SO_4	*Roy et al., 1966*
Northern corn leaf blight	*Helminthosporium turcicum*	Maize	+	F - Disease incidence		*Singh, 1958 in Roy et al., 1966*
Northern leaf blight	*Exserohilum turcicum*	Maize	+	Disease incidence		*Nelson, 1963 in Huber et ol., 1985*
Root rot	*Fusarium* spp.	Maize	3+(35)	F - Disease percentage - Average for 3 years		*Howell, 1969*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Stalk rot		Maize	2+(18)	F - Susceptible hybrid - N applied as urea - Infection percentage - 2 trials	K_2SO_4	*Abdel-Rahim et al., 1984*
Stalk rot		Maize	2+(22)	F - Susceptible hybrid - N applied as ammonium sulphate - Infection percentage - 2 trials	K_2SO_4	*Abdel-Rahim et al., 1984*
Stalk rot		Maize	2+(17)	F - Susceptible hybrid - N applied as ammonium sulphate - Infection percentage - 2 trials	K_2SO_4	*Abdel-Rahim et al., 1984*
Stalk rot		Maize	2+(11)	F - Resistant hybrid - N applied as urea - Infection percentage - 2 trials	K_2SO_4	*Abdel-Rahim et al., 1984*
Stalk rot		Maize	2+(9)	F - Resistant hybrid - N applied as ammonium sulphate - Infection percentage - 2 trials	K_2SO_4	*Abdel-Rahim et al., 1984*
Stalk rot		Maize	2-(42)	F - Resistant hybrid - N applied as ammonium nitrate - Infection percentage - 2 trials	K_2SO_4	*Abdel-Rahim et al., 1984*
Stalk rot		Maize	3+(24)	F - 60 days after mild silk - Percentage rotted stalk - 3 hybrids		*Abney et al., 1971*
Stalk rot		Maize	3-(4)	F - 10 days after first frost - Percentage rotted stalk - 3 hybrids		*Abney et al., 1971*
Stalk rot		Maize	+	F - Soil low in K - Rapidity of disease development		*Andrew, 1954 in Otto et al., 1956*
Stalk rot		Maize	+	F - Soil deficient in K		*Boeriu, 1972*
Stalk rot		Maize	3+(80)	F - Strongly K fixing soil - Infection percentage - 3 trials		*Burkart et al., 1976*
Stalk rot		Maize	+ (99)	F - Soil low in K - Infection percentage		*Farina et al., 1983*
Stalk rot	*Gibberella zeae, Diplodia zeae* and *Pythium* spp.	Maize	+	F - Artificial inoculation - Percentage internal rot - 3 hybrids		*Foley et al., 1957*
Stalk rot		Maize	+ (65)	F - Percentage attack		*Hooker, 1966*
Stalk rot		Maize	+	F - Soil low in K - Rapidity of disease development		*Koehler et al., 1950 in Otto et al., 1956*
Stalk rot	*Gibberella zeae, Diplodia zeae*	Maize	+ (65)	F - Soil low in K - % damaged stalks	KCl	*Koehler, 1960*
Stalk rot		Maize	0	F - Soil rich in K - Long-term trial - Disease intensity	KCl	*Krüger et al., 1965*

Stalk rot	*Rhizoctonia bataticola*	Maize	+	F - Trial 1964-65 - Overall application in winter - Disease intensity	*Krüger, 1970*
Stalk rot	*Rhizoctonia bataticola*	Maize	+	F - Trial 1964-65 - Overall application in spring - Disease intensity	*Krüger, 1970*
Stalk rot	*Rhizoctonia bataticola*	Maize	0	F - Trial 1964-65 - Row application in spring - Disease intensity	*Krüger, 1970*
Stalk rot	*Fusarium* spp.	Maize	-	F - Trial 1965-66 - Overall application in winter - Disease intensity	*Krüger, 1970*
Stalk rot	*Fusarium* spp.	Maize	-	F - Trial 1965-66 - Overall application in spring - Disease intensity	*Krüger, 1970*
Stalk rot	*Fusarium* spp.	Maize	-	F - Trial 1965-66 - Row application in spring - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	0	F - Trial 1966-67 - Overall application in winter - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	+	F - Trial 1966-67 - Overall application in spring - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	+	F - Trial 1966-67 - Row application in spring - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	+	F - Trial 1966-67 - Overall application in winter - Number picnidia	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	+	F - Trial 1966-67 - Overall application in spring - Number picnidia	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	-	F - Trial 1966-67 - Row application in spring - Number picnidia	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	+	F - Artificial infection - Injection of spores in stem - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	0	F - Artificial infection - Spraying of a spore suspension - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	+	F - Natural infection - Disease intensity	*Krüger, 1970*
Stalk rot	*Diplodia zeae*	Maize	-	F - Natural infection - Number picnidia	*Krüger, 1970*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Stalk rot		Maize	+ (40)	F - Trial 1972 - Percentage infected stalks		*Krüger, 1976*
Stalk rot		Maize	+ (41)	F - Trial 1973 - Percentage infected stalks		*Krüger, 1976*
Stalk rot		Maize	+ (15)	F - Trial 1974 - Percentage infected stalks		*Krüger, 1976*
Stalk rot		Maize	+ (41)	F - Trial 1975 - Percentage infected stalks		*Krüger, 1976*
Stalk rot	*Diplodia maydis*	Maize	-	F - Resistant line W 22 - Artificial infection - Stalk rot index	KCl	*Martens et al., 1967*
Stalk rot	*Diplodia maydis*	Maize	-	F - Susceptible line W 23 - Artificial infection - Stalk rot index	KCl	*Martens et al., 1967*
Stalk rot	*Diplodia maydis*	Maize	-	F - Intermediate line W 575 - Artificial infection - Stalk rot index	KCl	*Martens et al., 1967*
Stalk rot	*Diplodia zeae*	Maize	+	Disease incidence		*Nelson, 1963 in Huber et al., 1985*
Stalk rot	*Fusarium* spp.	Maize	29+(54)	F - Stalk rot percentage - 29 trials		*Orlovius, 1986*
Stalk rot	*Gibberella* spp.	Maize	+ (67)	F - Trial 1953 - Hybrid Ohio 26 x Ohio 51 - Artificial inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	0 (0)	F - Trial 1953 - Hybrid III A x Wisc. W 23, highly susceptible - Artificial inooculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	+ (26)	F - Trial 1953 - Hybrid N.Y.3 x N.Y.4 - Artificial inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	+ (43)	F - Trial 1953 - Hybrid N.Y.2 x N.Y.1 - Artificial inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	+ (77)	F - Trial 1953 - Hybrid Ohio 51 A x Iowa B 8 - Artificial inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	+ (52)	F - Trial 1953 - Hybrid N.Y.3 x Idaho D 50 - Artificial inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	- (4)	F - Trial 1954 - Hybrid III A x Wisc. W 23, highly susceptible - Artificial inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* spp.	Maize	+ (15)	F - Trial 1954 - N.Y.3 x Idaho D 50 - Artificial inoculation - % diseased plants		*Otto et al., 1956*

Stalk rot	*Gibberella* spp.	Maize	+ (25)	F - Trial 1954 - Ohio 51 A x Iowa B 8 - inoculation - % diseased plants		*Otto et al., 1956*
Stalk rot	*Gibberella* sp.	Maize	+ (2)	F - Disease index		*Parker et al., 1959*
Stalk rot	*Gibberella* sp.	Maize	+ (2)	F - % dead plants		*Parker et al., 1959*
Stalk rot	*Fusarium* spp.	Maize	3+(93)	F - Strongly K fixing soils - % stalk rot - 3 trials 1972		*Siebold, 1973*
Stalk rot	*Fusarium* spp.	Maize	4+(78)	F - Strongly K fixing soils - % stalk rot - 4 trials 1973		*Siebold, 1974*
Stalk rot	*Fusarium* spp.	Maize	+	F - Trial Münster - Soil with normal K availability - Disease severity		*Siebold, 1974*
Stalk rot	*Fusarium* spp.	Maize	3+(62)	F - K fixing soils - % stalk rot - 3 trials 1974		*Siebold, 1975*
Stalk rot	*Gibberella roseum*	Maize	+ (5)	L - Disease severity		*Thayer et al., 1960*
Stalk rot	*Gibberella* spp.	Maize	+ (53)	F - Trial I - % infested plants - Broadcast application	KCl	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	+ (40)	F - Trial I - % infested plants - Row application	KCl	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	- (4)	F - Trial I - % infested plants - Broadcast application	K_2SO_4	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	+ (20)	F - Trial I - % infested plants - Row application	K_2SO_4	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	+ (31)	F - Trial II - % infested plants - Broadcast application	KCl	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	+ (24)	F - Trial II - % infested plants - Row application	KCl	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	+ (5)	F - Trial II - % infested plants - Broadcast application	K_2SO_4	*Younts et al., 1958*
Stalk rot	*Gibberella* spp.	Maize	- (55)	F - Trial II - % infested plants - Row application	K_2SO_4	*Younts et al., 1958*
Crown rust of oats	*Puccinia coronifera*	Oats	0	L - Very susceptible variety		*Gassner et al., 1931*
Crown rust of oats	*Puccinia coronifera*	Oats	-	F - Long-term trial - Artificial infection - Disease index	KCl	*Gassner et al., 1934*
Mildew		Oats	2+	F - K-fixing soils - Disease incidence - 2 trials		*Siebold,1980*
Septoria	*Septoria avenae*	Oats	3+	L - % infection - 3 varieties		*Clark, 1964*
Downy mildew	*Sclerospora graminicola*	Pearl millet	0	F - Disease incidence	KCl	*Deshmukh et al.,1978*
Ergot	*Claviceps microcephala*	Pearl millet	+	Disease incidence		*Kannaiyan et al.,1973*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (47)	L - Variety Sabeini - % infection	K_2SO_4	*Abdel-Hak, 1973*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (72)	L - Variety Nahda - % infection	K_2SO_4	*Abdel-Hak, 1973*
Brown leaf spot	*Helminthosporium oryzae*	Rice	- (25)	F - Trial 1965 - Early sowing date - % infection	K_2SO_4	*Abdel-Hak, 1973*
Brown leaf spot	*Helminthosporium oryzae*	Rice	- (50)	F - Trial 1965 - Normal sowing date - % infection	K_2SO_4	*Abdel-Hak, 1973*
Brown leaf spot	*Helminthosporium oryzae*	Rice	0 (0)	F - Trial 1965 - Late sowing date - % infection	K_2SO_4	*Abdel-Hak, 1973*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (30)	F - Trial 1966 - % infection	K_2SO_4	*Abdel-Hak, 1973*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+			*Adaickalam, 1974 in Kannaiyan et al., 1978a*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (19)	L - Trial 1954 - Number large spots		*Akai, 1962*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (41)	L - Trial 1960 - Number large spots		*Akai, 1962*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (26)	L - Conidia germination rate		*Akai, 1962*
Brown leaf spot	*Helminthosporium oryzae*	Rice	15+	15 cases		*Fukatsu, 1955 in Ono, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	8 0	8 cases		*Fukatsu, 1955 in Ono, 1958*
Brown leaf spot	*Drechslera oryzae*	Rice	+ (15)	F - Disease incidence		*Hiremath et al., 1975*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+	F - Soil deficient in K - Disease incidence		*Hiromu, 1949 in Orsenigo, 1956*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+	F - Soil deficient in K - Disease severity		*Hiromu, 1949 in Orsenigo, 1955*

Brown leaf spot	*Helminthosporium oryzae*	Rice	+	F - Soil deficient in K - Spreading of the lesions		*Hiromu, 1949 in Orsenigo, 1956*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+	F - Disease index		*Lee Wang et al., 1979*
Brown leaf spot	*Helminthosporium oryzae*	Rice	3+(22)	L - Trials with seedlings - Disease intensity - 3 trials		*Matsuo, 1951*
Brown leaf spot	*Helminthosporium oryzae*	Rice	2+	L - Trials with fully grown leaves - Disease intensity 2 trials		*Matsuo, 1951*
Brown leaf spot	*Helminthosporium oryzae*	Rice	2+	L - Periodic K-deficiency - Disease intensity after transplanting - 2 trials		*Matsuo, 1951*
Brown leaf spot	*Helminthosporium oryzae*	Rice	2 0	L - Periodic K-deficiency - Disease intensity at end vegetative growth - 2 trials		*Matsuo, 1951*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+	Infective power of spores		*Matsuo, 1951*
Brown leaf spot	*Helminthosporium oryzae*	Rice	- (13)	F - Soil rich in K - % leaf area with lesions - Average of 3 evaluations	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (49)	F - Soil poor in K - % leaf area with lesions - Average of 3 evaluations	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	- (3)	F - Soil rich in K - Effect of basal fertilization - Attack intensity	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	- (51)	F - Soil rich in K - Effect of top-dressing - Attack intensity	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (72)	F - Soil poor in K - Effect of basal fertilization - Attack intensity	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (64)	F - Soil poor in K - Effect of top-dressing - Attack intensity	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (76)	L - Soil poor in K - Soil damp - Disease area	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (78)	L - Soil poor in K - Soil wet - Disease area	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (79)	L - Soil poor in K - Soil submerged - Disease area	K_2SO_4	*Okamoto, 1958*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (73)	L - Soil poor in K - Soil from submerged nursery bed - % leaf spot	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (81)	L - Soil poor in K - Soil from drained nursery bed - % leaf spot	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (64)	F - Soil poor in K - Low sowing density - % leaf spot	K_2SO_4	*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (74)	F - Soil poor in K - High sowing density - % leaf spot		*Okamoto, 1958*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+	F - Leaf spot size - 2 varieties		*Ono, 1953a in Ono, 1957*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+ (22)	L - % sterile spikes		*Orsenigo, 1955*
Brown leaf spot	*Helminthosporium oryzae*	Rice	+	L - Disease index		*Orsenigo, 1955*
Brown leaf spot	*Helminthosporium oryzae*	Rice	2+(30)	F - % disease incidence - 2 varieties		*Subramanian et al., 1977*
Cercospora leaf spot	*Cercospora oryzae*	Rice	+ (42)	Number spots on leaves		*Yoshida, 1948 in Ono, 1957*
Cercospora leaf spot	*Cercospora oryzae*	Rice	+ (25)	Number spots on leaf sheathes		*Yoshida, 1948 in Ono, 1957*
Dirty panicle disease	*Curvularia* spp., *Helminthosporium oryzae, Nigrospora* spp.	Rice	3 0	F - Disease index - 3 varieties		*Ayotade et al., 1980*
Dirty panicle disease	*Curvularia* spp. *Helminthosporium oryzae, Nigrospora* spp.	Rice	2 -	F - Disease index - 2 varieties		*Ayotade et al., 1980*
Rice blast	*Pyricularia oryzae*	Rice	2-(23)	F - Trial 1964 - % leaf infection - 2 varieties	K_2SO_4	*Abdel Hak et al., 1966*

Rice blast	*Pyricularia oryzae*	Rice	2-(60)	F - Trial 1964 - % neck infection - 2 varieties	K_2SO_4	*Abdel Hak et al., 1966*
Rice blast	*Pyricularia oryzae*	Rice	- (1)	F - Trial 1965 - % neck infection - Variety Yabani	K_2SO_4	*Abdel Hak et al., 1966*
Rice blast	*Pyricularia oryzae*	Rice	+ (18)	F - Trial 1965 - % neck infection - Variety Nahda	K_2SO_4	*Abdel Hak et al., 1966*
Rice blast	*Pyricularia oryzae*	Rice	+ (25)	L - Variety Sabeini - % infection	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+ (37)	L - Variety Nahda - % infection	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+ (20)	F - Trial 1965 - Early sowing date - % leaf blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	- (133)	F - Trial 1965 - Normal sowing date - % leaf blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+ (14)	F - Trial 1965 - Late sowing date - % leaf blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+ (25)	F - Trial 1965 - Early sowing date - % panicle blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	0 (0)	F - Trial 1965 - Normal sowing date - % panicle blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	0 (0)	F - Trial 1965 - Late sowing date - % panicle blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+ (25)	F - Trial 1966 - % leaf blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+ (20)	F - Trial 1966 - % panicle blast	K_2SO_4	*Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+	F - % sterile spikelets	KCl	*Baldacci, 1955*
Rice blast	*Pyricularia oryzae*	Rice	+	Disease intensity	KCl	*Chiapelli, 1931*
Rice blast	*Pyricularia oryzae*	Rice	0			*Chiba et al., 1957 in Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	+	F - Crop resistance	KCl	*De Mello, 1961*
Rice blast	*Pyricularia oryzae*	Rice	-			*Ito et al., 1932 in Abdel-Hak, 1973*
Rice blast	*Pyricularia oryzae*	Rice	3-(188)	L - Germination - 3 trials	K_2SO_4	*Kawamura et al., 1948 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	3-(147)	L - Appressoria formation in waterdrops - 3 trials	K_2SO_4	*Kawamura et al., 1948 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	-(417)	L - Appressoria formation on leaves	K_2SO_4	*Kawamura et al., 1948 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	-	F - Disease index on leaves	K_2SO_4	*Krishnaswami, 1952*
Rice blast	*Pyricularia oryzae*	Rice	+ (12)	F - % neck infection	K_2SO_4	*Krishnaswami, 1952*
Rice blast	*Pyricularia oryzae*	Rice	+	L - Infection index on leaves	KCl	*Malaguti et al., 1951*

* K-effect: + Positive i.e. parasite development or damage decreased; () = decrease expressed in %
- Negative i.e. parasite development or damage increased; () = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Rice blast	*Pyricularia oryzae*	Rice	+	F - Attack intensity	KCl	*Mariani, 1952*
Rice blast	*Pyricularia oryzae*	Rice	+	F - Number panicles with 75-100% sterility	KCl	*Mariani, 1952*
Rice blast	*Pyricularia oryzae*	Rice	+ (23)	L - % infected leaves		*Moscol Riofrio, 1975*
Rice blast	*Pyricularia oryzae*	Rice	2 0	2 varieties		*Murata et al., 1933 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	+	F - Soil rich in K - Leaf blast index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (13)	F - Soil rich in K - % neck blast	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	F - Soil poor in K - Leaf blast index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	F - Soil poor in K - % neck blast	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (575)	L - Number spots on seedlings from soil poor or rich in K (effect of soil K-level)	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (264)	L - Number spots on seedlings from soil poor in K (effect of K-fertilization)	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (144)	L - Number spots on seedlings from soil poor in K (effect of K-level of nutrient solution)	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	L - Soil poor in K - Rice inoculated at early stage - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	L - Soil poor in K - Rice inoculated at middle stage - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	+	L - Soil poor in K - Rice inoculated at late stage - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	F - Soil poor in K - Blast developed early - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	+	F - Soil poor in K - Blast developed late - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	L - Soil poor in K - Low sowing density - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	-	L - Soil poor in K - High sowing density - Disease index	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (338)	L - Soil low in K from submerged nursery bed - Number lesions per plant	K_2SO_4	*Okamoto, 1958*

Rice blast	*Pyricularia oryzae*	Rice	- (103)	L - Soil low in K from drained nursery bed - Number lesions per plant	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (62)	L - Soil semi wet - Number lesions per leaf - Average of 2 evaluations	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (51)	L - Soil wet - Number lesions per leaf - Average of 2 evaluations	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (103)	L - Soil submerged - Number lesions per leaf - Average of 2 evaluations	K_2SO_4	*Okamoto, 1958*
Rice blast	*Pyricularia oryzae*	Rice	- (318)	F - Number diseased spots - Leaf blast		*Sako, 1955 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	- (178)	F - Number diseased ears - Neck blast		*Sako, 1955 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	2 +	F - Leaf blast - 2 varieties		*Toyoda et al., 1941 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	9 0	F - Leaf blast - 9 varieties		*Toyoda et al., 1941 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	-	F - Leaf blast - 1 variety		*Toyoda et al., 1941 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	4 +	F - Neck blast - 4 varieties		*Toyoda et al., 1941 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	8 -	F - Neck blast - 8 varieties		*Toyoda et al., 1941 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	9 +	F - Node blast - 9 varieties		*Toyoda et al., 1941 in Ono, 1957*
Rice blast	*Pyricularia oryzae*	Rice	3 -	F - Node blast - 3 varieties		*Toyoda et al., 1941 in Ono, 1957*
Sclerotiniosis	*Leptosphaeria salvini*	Rice	+	F - Disease intensity		*Cralley, 1939 in Orsenigo, 1956*
Sclerotiniosis	*Leptosphaeria salvini*	Rice	+	F - Disease intensity		*Cralley, 1947 in Orsenigo, 1956*
Sclerotiniosis	*Leptosphaeria salvini*	Rice	+	F - Soil deficient in K - Disease severity		*Hiromu, 1949 in Orsenigo, 1956*

* K-effect: + Positive i.e. parasite development or damage decreased; () = decrease expressed in %
- Negative i.e. parasite development or damage increased; () = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Sheath blight	*Rhizoctonia solani*	Rice	2 +	F - Disease severity - 2 trials		*Chin, 1973 in Thiagalingam, 1977*
Sheath blight	*Thanatephorus cucumeris*	Rice	+ (29)	F - Soil low in K - % infection		*Ismunadji, 1976*
Sheath blight	*Rhizoctonia solani*	Rice	+ (24)	L - Disease incidence	KCl	*Kannaiyan et al., 1978a*
Sheath blight	*Rhizoctonia solani*	Rice	- (36)	L - % infection on seedlings	KCl	*Kannaiyan et al., 1978b*
Sheath blight	*Rhizoctonia solani*	Rice	+	F - % disease outbreaks		*Ono, 1953b in Ono, 1957*
Sheath blight	*Rhizoctonia solani*	Rice	+	F - Degree of damage		*Ono, 1953b in Ono, 1957*
Sheath rot	*Sarocladium oryzae*	Rice	+	L - Disease index	KCl	*Alagarsamy et.al., 1986*
Sheath rot	*Sarocladium oryzae*	Rice	+	L - Disease index	K_2SO_4	*Alagarsamy et.al., 1986*
Sheath rot	*Sarocladium oryzae*	Rice	+ (41)	F - Disease incidence in %		*PRII, 1986*
Stem rot	*Helminthosporium sigmoideum*	Rice	+			*Adair et al., 1950 in De Datta et al., 1985*
Stem rot	*Helminthosporium sigmoideum*	Rice	+			*Chien, 1970 in Ollagnier, 1976*
Stem rot	*Helminthosporium sigmoideum*	Rice	0	Disease incidence		*Cralley, 1939 in Trolldenier, 1969*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (2)	Disease spots on leaf sheath		*Goto et al., 1948 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (23)	Sclerotia on leaf sheath		*Goto et al., 1948 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (47)	Disease spots on stalks		*Goto et al., 1948 in Ono, 1957*

Stem rot	*Helminthosporium sigmoideum*	Rice	+ (85)	Sclerotia on stalks	*Goto et al., 1948 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (40)	Damage degree	*Goto et al., 1948 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+	F - Soil deficient in K - Disease incidence	*Hiromu, 1949 in Orsenigo, 1956*
Stem rot	*Helminthosporium sigmoideum*	Rice	+	F - Soil deficient in K - Spreading of the lesions	*Hiromu, 1949 in Orsenigo, 1956*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (97)	F - Soil low in K - Damage degree - Average for 2 seasons	*Ismunadji et al., 1979*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (98)	L - K applied at transplanting - % infection - 2 trials	*Jain, 1977*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (90)	L - K applied at tillering - % infection - 2 trials	*Jain, 1977*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (79)	L - K applied at panicle initiation - % infection - 2 trials	*Jain, 1977*
Stem rot	*Helminthosporium sigmoideum*	Rice	+	Disease severity	*Nakata, 1934 in Wingard, 1941*
Stem rot	*Helminthosporium sigmoideum*	Rice	+		*Okamoto, 1949 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	0 (0)	F - Well-drained field - Damage degree	*Ono, 1950 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (47)	F - Semi-wet field - Damage degree	*Ono, 1950 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (32)	F - Ill-drained field - Damage degree	*Ono, 1950 in Ono, 1957*
Stem rot	*Helminthosporium sigmoideum*	Rice	+	L - Disease index	*Orsenigo, 1956*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (59)	L - % sterile spikes	*Orsenigo, 1956*
Stem rot	*Helminthosporium sigmoideum*	Rice	+	Disease severity	*Reyes, 1929 in Wingard, 1941*

* K-effect: + Positive i.e. parasite development or damage decreased; () = decrease expressed in %
- Negative i.e. parasite development or damage increased; () = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Stem rot	*Helminthosporium sigmoideum*	Rice	+	Disease severity		*Sakurai, 1917 in Wingard, 1941*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (35)	F - % disease incidence - 2 varieties		*Subramanian et al., 1977*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (74)	F - % disease incidence - 2 varieties		*Vaithilingam et al., 1977*
Stem rot	*Helminthosporium sigmoideum*	Rice	2+ (51)	F - % tillers infected - 2 varieties		*Vaithilingam et al., 1977*
Stem rot	*Helminthosporium sigmoideum*	Rice	+ (75)	Damage degree		*Yoshi et al., 1949 in Ismunadji, 1976*
	Helminthosporium spp.	Rice	+	Crop susceptibility		*Baba, 1958 in Fuchs et al., 1972*
Brown rust of rye	*Puccinia dispersa*	Rye	+ (8)	L - Number pustules on leaves	K_2SO_4	*Eglits, 1934*
Brown rust of rye	*Puccinia dispersa*	Rye	0	L - Very susceptible varieties		*Gassner et al., 1931*
Powdery mildew	*Erysiphe graminis*	Rye	-	L - Disease incidence	K_2SO_4	*Eglits, 1934*
Rye ergot	*Claviceps purpurea*	Rye	+			*Tanada et al., 1964 in Chinnadurai,1971*
Rust	*Puccinia purpurea*	Sorghum	7+ (30)	F - % disease incidence - 7 varieties		*Govil et al., 1979*
Rust	*Puccinia purpurea*	Sorghum	3 0(0)	F - % disease incidence - 3 varieties		*Govil et al., 1979*
Sugary disease of sorghum	*Sphacelia sorghi*	Sorghum	+ (78)	L - % infection on inflorescences	KCl	*Chinnadurai, 1971*
Sugary disease of sorghum	*Sphacelia sorghi*	Sorghum	9 +(39)	F - % disease incidence - 9 varieties		*Govil et al., 1979*
Sugary disease of sorghum	*Sphacelia sorghi*	Sorghum	0 (0)	F - % disease incidence - 1 variety		*Govil et al., 1979*
Brown foot rot of wheat	*Fusarium culmorum*	Wheat	-	L - Young plants - Lesion index		*Onuorah, 1969*
Brown foot rot of wheat	*Fusarium culmorum*	Wheat	+	L - Adult plants - Lesion index	KCl	*Onuorah, 1969*

Brown foot rot of wheat	*Fusarium culmorum*	Wheat	-	L - Yóung plants - Fungus recovery	KCl	*Onuorah, 1969*
Brown foot rot of wheat	*Fusarium culmorum*	Wheat	+	L - Adult plants - Fungus recovery	KCl	*Onuorah, 1969*
Brown rust of wheat	*Puccinia triticina*	Wheat	+	L - Very susceptible varieties	KCl	*Gassner et al., 1931*
Brown rust of wheat	*Puccinia triticina*	Wheat	+	L - Moderately resistant varieties	KCl	*Gassner et al., 1931*
Brown rust of wheat	*Puccinia triticina*	Wheat	+	L - Moderately resistant varieties	K_2SO_4	*Gassner et al., 1931*
Brown rust of wheat	*Puccinia triticina*	Wheat	0	L - Very resistant varieties		*Gassner et al., 1931*
Brown rust of wheat	*Puccinia triticina*	Wheat	3+	F - Long term trial - Disease incidence - Year 1932 - 3 varieties	KCl	*Gassner et al., 1934*
Brown rust of wheat	*Puccinia triticina*	Wheat	-	F - Long term trial - Disease incidence - Year 1932 - 1 variety	KCl	*Gassner et al., 1934*
Brown rust of wheat	*Puccinia triticina*	Wheat	3+	F - Long term trial - Disease incidence - Year 1933 - 3 varieties	KCl	*Gassner et al., 1934*
Brown rust of wheat	*Puccinia triticina*	Wheat	-	F - Long term trial - Disease incidence - Year 1933 - 1 variety	KCl	*Gassner et al., 1934*
Brown rust of wheat	*Puccinia triticina*	Wheat	+(27)	F - Moderately resistant variety - % rust	KCl	*Stakman, 1924*
Brown rust of wheat	*Puccinia triticina*	Wheat	+(50)	F - Damage		*Trunov, 1958*
Brown rust of wheat		Wheat	+	F	KCl	*Wiese, 1932*
Bunt of wheat	*Tilletia foetida*	Wheat	-		KCl	*Ajroldi, 1937 in Tapke, 1938*
Bunt of wheat	*Tilletia* spp.	Wheat	-			*Mourashkinsky, 1932*
Common root rot	*Helminthosporium sativum*	Wheat	0	F - Disease incidence	KCl	*Fixen et al., 1986*
Common root rot	*Helminthosporium*	Wheat	2+	F - Disease index - 2 trials	KCl	*Goos, 1986*

* K-effect: + Positive i.e. parasite development or damage decreased; () = decrease expressed in %
- Negative i.e. parasite development or damage increased; () = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
	sativum					
Common root rot	*Helminthosporium sativum*	Wheat	2 0	F - Disease index - 2 trials	KCl	*Goos, 1986*
Common root rot	*Helminthosporium sativum*	Wheat	-	F - Disease index - 1 trial	KCl	*Goos, 1986*
Eyespot	*Cercosporella herpotrichoides*	Wheat	7-(50)	F - % straws with severe lesions - 1 year after fallow - Average for 7 years - Long-term trial		*Glynne, 1969*
Eyespot	*Cercosporella herpotrichoides*	Wheat	7-(34)	F - % straws with severe lesions - 2-4 years after fallow - Average for 7 years - Long-term trial		*Glynne, 1969*
Eyespot	*Cercosporella herpotrichoides*	Wheat	+(73)	F - Number diseased stalks	KCl	*Hieke, 1928*
Eyespot		Wheat	-	F - Attack intensity		*Stetter, 1971*
Flag smut	*Urocystis tritici*	Wheat	2-(50)	L - Susceptible variety - % infection - 2 trials		*Millikan, 1939a*
Flag smut	*Urocystis tritici*	Wheat	-	L - Resistant variety - % infection		*Millikan, 1939a*
Flag smut	*Urocystis tritici*	Wheat	+(22)	F - % infection - 1 trial 1934	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	2-(4)	F - % infection - 2 trials 1934	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	- (17)	F - Walpeup trial 1937 - Susceptible variety - % infection	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	+ (5)	F - Walpeup trial 1938 - Susceptible variety - % infection	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	+ (8)	F - Walpeup trial 1938 - Resistant variety - % infection	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	-	F - Walpeup trial 1937 - Susceptible variety - Disease index	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	+	F - Walpeup trial 1938 - Susceptible variety - Disease index	K_2SO_4	*Millikan, 1939b*
Flag smut	*Urocystis tritici*	Wheat	+	F - Walpeup trial 1938 - Resistant variety - Disease index	K_2SO_4	*Millikan, 1939b*
Glume blotch	*Septoria nodorum*	Wheat	+ (16)	F - Trial 1974-No artificial infection-Number pycnidia on flag leaves		*Mielke et al. 1977*
Glume blotch	*Septoria nodorum*	Wheat	- (17)	F - Trial 1974-Artificial infection-Number		*Mielke et al., 1977*

Glume blotch	*Septoria nodorum*	Wheat	- (7)	F - Trial 1975-No artificial infection-Number pycnidia on flag leaves		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	+ (16)	F - Trial 1975 - Artificial infection-Number pycnidia on flag leaves		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	+ (66)	F - Trial 1976 - Artificial infection-Number pycnidia on flag leaves		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	+ (51)	F - Trial 1974 - No artificial infection-Number pycnospora on glumes		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	+ (11)	F - Trial 1974 - Artificial infection-Number pycnospora on glumes		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	- (179)	F - Trial 1976 - No artificial infection-Number pycnospora on glumes		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	- (97)	F - Trial 1976 - Artificial infection-Number pycnospora on glumes		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	+ (34)	F - Trial 1974 - No artificial infection-Number pycnospora on flag leaves		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	+ (22)	F - Trial 1974 - Artificial infection-Number pycnospora on flag leaves		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	- (17)	F - Trial 1976 - Artificial infection-Number pycnospora on flag leaves		*Mielke et al., 1977*
Glume blotch	*Septoria nodorum*	Wheat	2+(84)	F - % infection - 2 trials		*Siebold, 1980*
Glume blotch	*Septoria nodorum*	Wheat	+ (16)	F - K very strongly fixed in soil - Variety Kolibri - Disease incidence		*Trolldenier, 1973*
Glume blotch	*Septoria nodorum*	Wheat	0	F - K very strongly fixed in soil - Variety Diplomat - Brown ears		*Trolldenier, 1973*
Glume blotch	*Septoria nodorum*	Wheat	+ (62)	F - K very strongly fixed in soil - Variety Diplomat - Number spores		*Trolldenier, 1973*
Leaf rust	*Puccinia recondita*	Wheat	- (21)	F - Trial 1981-82 - % rust	KCl	*Boquet et al., 1987*
Leaf rust	*Puccinia recondita*	Wheat	- (26)	F - Trial 1982-83 - % rust	KCl	*Boquet et al., 1987*
Leaf rust	*Puccinia recondita*	Wheat	+ (52)	F - Trial 1983-84 - % rust	KCl	*Boquet et al., 1987*
Leaf rust	*Puccinia recondita*	Wheat	-	F - Wheat following green manuring-Number pustules on leaves	KCl	*Das et al., 1971*

* K-effect: + Positive i.e. parasite development or damage decreased; () = decrease expressed in %
- Negative i.e. parasite development or damage increased; () = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Leaf rust	*Puccinia recondita*	Wheat	+	F - Wheat following jute-Number pustules on leaves	KCl	*Das et al., 1971*
Leaf rust	*Puccinia tritici*	Wheat	+	Crop susceptibility		*Doak, 1931*
Leaf rust	*Puccinia recondita*	Wheat	+ (32)	F - Disease severity	KCl	*Fixen et al., 1986*
Leafspot	*Puccinia tritici-repentis + Septoria avenae*	Wheat	2+(14)	F - Disease severity-2trials	KCl	*Fixen et al., 1986*
Mildew		Wheat	+	F - Soil poor in K - Disease intensity		*Kühn et al., 1966*
Mildew		Wheat	+	F - K fixing soil - Disease index		*Siebold, 1980*
Mildew		Wheat	+ (86)	F - Number colonies		*Woodruff, 1952*
Powdery mildew	*Erysiphe graminis*	Wheat	- (41)	F - Trial 1981 - 82 - % mildew	KCl	*Boquet et al., 1987*
Powdery mildew	*Erysiphe graminis*	Wheat	+ (50)	F - Trial 1982 - 83 - % mildew	KCl	*Boquet et al., 1987*
Powdery mildew	*Erysiphe graminis*	Wheat	- (50)	F - Trial 1983 - 84 - % mildew	KCl	*Boquet et al., 1987*
Powdery mildew	*Erysiphe graminis*	Wheat	+ (72)	F - Long-term trial - % leaf area covered with mildew - 1 year after fallow		*Glynne, 1960*
Powdery mildew	*Erysiphe graminis*	Wheat	+ (85)	F - Long-term trial - % leaf area covered with mildew - 3 years after fallow		*Glynne, 1960*
Powdery mildew	*Erysiphe graminis*	Wheat	+	L - Variety Peragis, very susceptible - Disease incidence	KCl	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	+	L - Variety Peragis, very susceptible - Disease incidence	K_2SO_4	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	+	L - Variety Janetzkis, moderately susceptible - Disease incidence	KCl	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	+	L - Variety Peragis, moderately susceptible - Disease incidence	K_2S0_4	*Lowig , 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	-	L - Variety Michigan bronce, very susceptible - Disease index	KCl	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	+	L - Variety Michigan bronce, very susceptible - Disease index	K_2S0_4	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	+	L - Variety Hopetown, moderately susceptible - Disease index	KCl	*Lowig, 1935*

Powdery mildew	*Erysiphe graminis*	Wheat	0	L - Variety Hopetown, moderately susceptible - Disease index	K_2SO_4	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Wheat	3 -	F - Disease index - Average for 3 years		*Rowaished, 1980*
Powdery mildew	*Erysiphe graminis*	Wheat	2 +	L - Disease index - 2 varieties	KCl	*Spinks, 1913*
Powdery mildew	*Erysiphe graminis*	Wheat	4 +	F - Disease index - Average for 2 years and 2 varieties	KCl	*Thier et al., 1986*
Powdery mildew	*Erysiphe graminis*	Wheat	+ (18)	L - Colony area	KCl	*Thier et al., 1986*
Powdery mildew	*Erysiphe graminis*	Wheat	- (2)	L - Number spores per colony	KCl	*Thier et al., 1986*
Powdery mildew	*Erysiphe graminis*	Wheat	+ (10)	L - Number spores per mm^2	KCl	*Thier et al., 1986*
Powdery mildew	*Erysiphe graminis*	Wheat	+			*Treelase et al., 1928 in Krauss, 1969*
Rust	*Puccinia* spp.	Wheat	+ (63)	F - % infection	K_2SO_4	*Singh, 1978*
Rust unspecifield		Wheat	+			*De Vivie de Regie et al., 1935 in Better Crops, 1966*
Rust unspecified		Wheat	+	F - Disease incidence		*Maas, 1927*
Rust unspecified		Wheat	7 +	F - Precocity of attacks - 7 varieties		*Pietschmann, 1953*
Rust unspecified		Wheat	+	F - Disease incidence		*Russell, 1928*
Rusts	*Puccinia* spp.	Wheat	+	Crop susceptibility		*Brüning, 1954 in Fuchs et al., 1972*
Rusts	*Puccinia* spp.	Wheat	+	F - Soil low in K - Disease intensity		*Capetti et al., 1964*
Rusts	*Puccinia* spp.	Wheat	+	F - Disease intensity		*Pieper, 1936*
Rusts	*Puccinia* spp.	Wheat	+	Crop susceptibility		*Weiss, 1924 in Fuchs et al., 1972*
Speckled leaf blotch	*Septoria tritici*	Wheat	+ (1)	L - % infested plants	K_2SO_4	*Temiz, 1976*
Speckled leaf blotch	*Septoria tritici*	Wheat	+	L - Disease intensity on leaves	K_2SO_4	*Temiz, 1976*
Speckled leaf blotch	*Septoria tritici*	Wheat	-	L - Formation of picnidia	K_2SO_4	*Temiz, 1976*
Stem rust	*Puccinia graminis*	Wheat	2 +	F - Disease intensity - Average for 2 years	KCl	*Agrawal et al., 1968*
Stem rust	*Puccinia graminis*	Wheat	+	L - Moderately resistant varieties		*Gassner et al., 1931*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Stem rust	*Puccinia graminis*	Wheat	+	L - Pustules production		*Mashaal, 1976 in Kiraly, 1976*
Stem rust	*Puccinia graminis*	Wheat	+			*Prasada, 1964 in Das et al., 1971*
Stem rust	*Puccinia graminis*	Wheat	- (4)	F - Trial St - Paul 1915 - Very susceptible variety - % rust	KCl	*Stakman, 1924*
Stem rust	*Puccinia graminis*	Wheat	+ (17)	F - Trial St - Paul 1915 - Very resistant variety - % rust	KCl	*Stakman, 1924*
Stem rust	*Puccinia graminis*	Wheat	- (1)	F - Trial St - Paul 1916 - Very suseptible variety - % rust	K_2SO_4	*Stakman 1924*
Stem rust	*Puccinia graminis*	Wheat	0 (0)	F - Trial St - Paul 1916 - Resistant variety - % rust	K_2SO_4	*Stakman, 1924*
Stem rust	*Puccinia graminis*	Wheat	+ (44)	F - Trial Quinn farm - Very susceptible variety - % rust	KCl	*Stakman, 1924*
Stem rust	*Puccinia graminis*	Wheat	- (33)	F - Trial Quinn farm - Resistant variety - % rust	KCl	*Stakman, 1924*
Stem rust	*Puccinia graminis*	Wheat	- (17)	F - Trial Anoka - Very susceptible variety - % rust	KCl	*Stakman, 1924*
Stripe rust	*Puccinia glumarum*	Wheat	+ (18)	F - Number pustules on leaves	KCl	*Acker et al., 1933*
Stripe rust	*Puccinia glumarum*	Wheat	+	F - Disease incidence	K_2SO_4	*Biffen, 1911*
Stripe rust	*Puccinia glumarum*	Wheat	2 +	L - Crop susceptibility - 2 susceptible varieties		*Colakoglu et al.,1979*
Stripe rust	*Puccinia glumarum*	Wheat	+	L - Moderately resistant varieties	KCl	*Gassner et al., 1931*
Stripe rust	*Puccinia glumarum*	Wheat	+	L - Moderately resistant varieties	K_2SO_4	*Gassner et al., 1931*
Stripe rust	*Puccinia glumarum*	Wheat	4 +	F - Long term trial - Artificial infection - Disease index - 4 varieties	KCl	*Gassner et al., 1934*
Stripe rust	*Puccinia glumarum*	Wheat	+			*Muller et al., 1917 in Wingard, 1941*
Stripe rust	*Puccinia glumarum*	Wheat	+	F - Disease intensity		*Remy, 1912 in von Meer, 1929*
Stripe rust	*Puccinia glumarum*	Wheat	-	L - Disease index - Variety Little Joss	KCl	*Spinks, 1913*

Stripe rust	*Puccinia glumarum*	Wheat	+	L - Disease index - Variety Michigan Bronze	KCl	*Spinks, 1913*
Stripe rust	*Puccinia glumarum*	Wheat	+	F - Disease index	K_2SO_4	*Spinks, 1913*
Stripe rust	*Puccinia glumarum*	Wheat	+	F - Disease intensity	KCl	*von Meer, 1929*
Stripe rust	*Pucicnia glumarum*	Wheat	+	F - Disease intensity	K_2SO_4	*von Meer, 1929*
Take-all	*Gaeumannomyces graminis*	Wheat	+ (68)	F - % root area attacked on 17. April	KCl	*Christensen et al., 1982*
Take-all	*Gaeumannomyces graminis*	Wheat	- (2)	F - % root area attacked on 8. June	KCl	*Christensen et al., 1982*
Take-all	*Gaeumannomyces graminis*	Wheat	+ (49)	L - % tillers with blackened stem base		*Garrett, 1941*
Take-all	*Gaeumannomyces graminis*	Wheat	+ (16)	L - % tillers with roots severely infested		*Garrett, 1941*
Take-all	*Gaeumannomyces graminis*	Wheat	+	L - Disease index		*Lucas et al., 1987*
Take-all	*Gaeumannomyces graminis*	Wheat	+	L - Disease severity		*Reis et al., 1982*
Take-all		Wheat	-	F - Attack intensity		*Stetter, 1971*
Take-all	*Gaeumannomyces graminis*	Wheat	-	F - pH 6.0 - N applied as NH_4Cl - % infection	KCl	*Taylor et al., 1983*
Take-all	*Gaeumannomyces graminis*	Wheat	+	F - pH 6.2 - N applied as NH_4Cl - % infection	KCl	*Taylor et al., 1983*
Take-all	*Gaeumannomyces graminis*	Wheat	+	F - pH 6.0 - N applied as $(NH_4)_2SO_4$ - % infection	KCl	*Taylor et al., 1983*
Take-all	*Gaeumannomyces graminis*	Wheat	+	F - pH 6.2 - N applied as $(NH_4)_2SO_4$ - % infection	KCl	*Taylar et al., 1983*
Take-all	*Gaeumannomyces graminis*	Wheat	+	F - pH 6.0 - N applied as $Ca(NO_3)_2$ - % infection	KCl	*Taylor et al., 1983*
Take-all	*Gaeumannomyces graminis*	Wheat	-	F - pH 6.2 - N applied as $Ca(NO_3)_2$ - % infection	KCl	*Taylor et al., 1983*
Take-all	*Gaeumannomyces graminis*	Wheat	+	L - Disease symptoms		*Trolldenier, 1984*
Yellow rust		Wheat	+	Crop susceptibility		*Finger, 1927*

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0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Yellow rust		Wheat	+	F - Soil low in K - Disease incidence - Long term trial		*Jentsch, 1933*
	Fusarium spp.	Wheat	-	F - Disease index		*Fehrmann et al.,1980*
	Linocarpon cariceti	Wheat	- (19)	F - Disaese intensity		*Ponchet et al., 1962*
		Fibre Crops				
Cotton wilt	*Fusarium oxysporum*	Cotton	+	L - Incubation velocity		*Abdel-Raheem et al., 1967*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	L - Susceptible variety		*Albert et al., 1941*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	L - Resistant variety		*Albert et al., 1941*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Soil deficient in K - Disease intensity		*Armstrong et al., 1941 in El Gindi et al., 1974*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Disease incidence		*Dick et al., 1938*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	L - Resistant variety - No nematodes - % infection		*El Gindi et al., 1974*
Cotton wilt	*Fusarium oxysporum*	Cotton	-	L - Resistant variety - With nematodes - % infection		*El Gindi et al., 1974*
Cotton wilt	*Fusarium oxysporum*	Cotton	-	L - Susceptible variety - No nematodes - % infection		*El Gindi et al., 1974*
Cotton wilt	*Fusarium oxysporum*	Cotton	-	L - Susceptible variety - With nematodes - % infection		*El Gindi et al., 1974*
Cotton wilt	*Fusarium oxysporum*	Cotton	+ (17)	L - Inoculation 6 days after planting - % wilted seedlings	K_2SO_4	*Fahim et al., 1971*
Cotton wilt	*Fusarium oxysporum*	Cotton	+ (39)	L - Inoculation 21 days after planting - % wilted seedlings	K_2SO_4	*Fahim et al., 1971*
Cotton wilt	*Fusarium oxysporum*	Cotton	+ (66)	L - Inoculation 36 days after planting - % wilted seedlings	K_2SO_4	*Fahim et al., 1971*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Soil low in K - Very susceptible variety - Disease intensity		*Miles, 1936 in Walker, 1946*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Soil low in K - Moderately susceptible variety - Disease intensity		*Miles, 1936 in Walker, 1946*

Cotton wilt	*Fusarium oxysporum*	Cotton	0	F - Soil low in K - Very resistant variety - Disease intensity		*Miles, 1936 in Walker, 1946*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	L		*Neal, 1927 in Walker, 1946*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F		*Neal, 1927 in Walker, 1946*
Cotton wilt		Cotton	+	F		*Rast, 1922*
Cotton wilt	*Fusarium oxysporum*	Cotton	+			*Sadasivan, 1965*
Cotton wilt	*Fusarium oxysporum*	Cotton	- (1)	L - % wilted plants	K_2SO_4	*Sharoubeem, 1967*
Cotton wilt	*Fusarium spp.*	Cotton	+	F - Number infected plants		*Smith, 1939*
Cotton wilt	*Fusarium oxysporum*	Cotton	+			*Tharp et al., 1939*
Cotton wilt	*Fusarium oxysporum*	Cotton	10+(44)	F - Trial Auburn 1936 - % wilted plants - 10 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	11+(43)	F - Trial Auburn 1937 - % wilted plants - 11 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	11+(61)	F - Trial Auburn 1938 - % wilted plants - 11 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	12+(14)	F - Trial Moundville 1937 - % wilted plants - 12 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	12+(30)	F - Trial Moundville 1938 - % wilted plants - 12 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	12+(26)	F - Trial Moundville 1939 - % wilted plants 12 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	12+(17)	F - Trial Alexandria 1937 - % wilted plants - 12 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	12 - (1)	F - Trial Alexandria 1938 - % wilted plants - 12 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	12 - (5)	F - Trial Alexandria 1939 - % wilted plants - 12 varieties	KCl	*Tisdale et al., 1942*
Cotton wilt	*Fusarium oxysporum*	Cotton	0	F		*Walker, 1930 in Walker, 1946*

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 0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Cotton wilt		Cotton	+ (39)	F - Soil poor in K - Trial Lee County 1929 - Disease intensity	KCl	*Young et al., 1932*
Cotton wilt		Cotton	+ (65)	F - Soil poor in K - Trial Lee County 1930 - Disease intensity	KCl	*Young et al., 1932*
Cotton wilt		Cotton	+ (57)	F - Soil poor in K - Trial Lee County 1931 - Disease intensity	KCl	*Young et al., 1932*
Cotton wilt		Cotton	+ (25)	F - Soil with enough K - Trial Little Rock 1930 - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (95)	F - Soil poor in K - Trial Scott 1930 - Fairly resistant variety - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (94)	F - Soil poor in K - Trial Altheimer 1930 - Fairly resistant variety - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (61)	F - Soil poor in K - Trial Wynne 1930 - Partially resistant variety - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (76)	F - Soil poor in K - Trial Paragould 1930 - resistant variety - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (60)	F - Soil poor in K - Trial Forest City 1931 - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (52)	F - Soil poor in K - Trial Palestine 1931 - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (79)	F - Soil poor in K - Trial Wheatley 1931 - Disease intensity		*Young et al., 1932*
Cotton wilt		Cotton	+ (37)	F - Soil poor in K - Trial Colt 1931 - Disease intensity	KCl	*Young et al., 1932*
Cotton wilt		Cotton	+ (56)	F - Soil poor in K - Trial Wynne 1931 - Disease intensity	KCl	*Young et al., 1932*
Cotton wilt		Cotton	+ (79)	F - Soil poor in K - Trial Barton 1931 - Disease intensity	KCl	*Young et al., 1932*
Cotton wilt		Cotton	+ (28)	F - Soil poor in K - Trial Marvell 1931 - Disease intensity	KCl	*Young et al., 1932*

Cotton wilt	*Fusarium oxysporum*	Cotton	+	Disease intensity		*Young et al., 1938 in Wingard, 1941*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Soil poor in K - Susceptible variety		*Young et al., 1941 in Walker, 1946*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Soil poor in K - Moderately resistant variety		*Young et al., 1941 in Walker, 1946*
Cotton wilt	*Fusarium oxysporum*	Cotton	+	F - Soil poor in K - Highly resistant variety		*Young et al., 1941 in Walker, 1946*
Damping-off	*Rhizoctonia solani*	Cotton	+			*Zyngas, 1963*
Leaf blight	*Cercospora + Alternaria*	Cotton	+ (41)	F - Clarkton trial 1966 - Cotton irrigated - Disease severity		*Miller, 1969*
Leaf blight	*Cercospora + Alternaria*	Cotton	+ (29)	F - Clarkton trial 1966 - Cotton not irrigated - Disease severity		*Miller, 1969*
Leaf blight	*Cercospora + Alternaria*	Cotton	0	F - Observation 1967		*Miller, 1969*
Leaf spot	*Alternaria* spp.	Cotton	+	F - Soil deficient in K - Rapidity of infection		*Last, 1956*
Rhizoctonia seedling disease		Cotton	+ (32)	L - Disease incidence		*Ramasami et al.,1976*
Verticillium wilt	*Verticillium albo-atrum*	Cotton	+	L - Incubation velocity		*Abdel-Raheem et al., 1967*
Verticillium wilt	*Verticillium dahliae*	Cotton	0	F		*Hafez et al., 1973 in Hafez et al., 1975*
Verticillium wilt	*Verticillium dahliae*	Cotton	+ (74)	F - Soil low in K		*Hafez et al., 1975*
Verticillium wilt	*Verticillium albo-atrum*	Cotton	+	F - Disease incidence		*Presley, 1950*
Verticillium wilt	*Verticillium dahliae*	Cotton	+ (26)	F - % infection		*Satlarov, 1977*
Verticillium wilt	*Verticillium sp.*	Cotton	+ (74)	F - Disease incidence		*Thompson, 1983*
Flax rust	*Melampsora lini*	Flax	+ (72)	F - Soil low in K - % infected stalks	KCl	*Budberg, 1929*
Flax rust		Flax	+	Disease development		*Sharvelle, 1936 in Wingard, 1941*
Wilt	*Fusarium lini*	Flax	+	Crop susceptibility		*Nair, 1957*

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0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Wilt		Flax	+			*Russell, 1918 in Wingard, 1941*
Jute anthracnose	*Colletotrichum corchorum*	Jute	2+(12)	L - Lesion formation - 2 varieties		*Purkayastha et al., 1977*
Jute anthracnose	*Colletotrichum corchorum*	Jute	2+(11)	L - Lesion extension - 2 varieties		*Purkayastha et al., 1977*
Jute stem rot		Jute	+	F - Disease intensity	KCl	*Cheng and Tu, 1970*
Jute stem rot	*Macrophomina phaseoli*	Jute	2+(40)	F - % infected plants - Average for 2 years	KCl	*Ji, 1974*
Jute stem rot	*Macrophomina corchori*	Jute	+	Disease incidence		*Sawada, 1916 in Ji, 1974*
Root rot		Jute	+			*Finlow, 1918 in Wingard, 1941*
Anthracnose	*Colletotrichum hibisci*	Kenaf	- (100)	L - Plants mortality		*Follin, 1978*
	Pythium butleri	Sunn hemp	+ (44)	F - Plants mortality		*Pal et al., 1980*
	Rhizoctonia solani	Sunn hemp	+ (46)	F - Plants mortality		*Pal et al., 1980*
	Rhizoctonia sp.	Sunn hemp	+ (40)	F - Plants mortality		*Pal et al., 1980*
	Sclerotium rolfsii	Sunn hemp	+ (42)	F - Plants mortality		*Pal et al., 1980*
		Forage crops				
Dollarspot	*Sclerotinia homoeocarpa*	Bermuda-grass	4 +	F - Soil low in K - Disease index - 4 varieties	KCl	*Juska et al., 1973*
Dollarspot		Bermuda-grass	+	F	KCl	*Pritchett et al, 1966*

Dollarspot		Bermuda-grass	+	F	K_2SO_4	*Pritchett et al., 1966*
Helminthosporium leafspot	*Helminthosporium cynodontis*	Bermuda-grass	+	F - Stand loss		*Eichhorn, 1976*
Helminthosporium leafspot	*Helminthosporium cynodontis*	Bermuda-grass	2 +	F - Soil low in K - Trial 1971 - Disease index - 2 varieties	KCl	*Juska et al., 1973*
Helminthosporium leafspot	*Helminthosporium cynodontis*	Bermuda-grass	3 +	F - Soil low in K - Trial 1972 - Disease index - 3 varieties	KCl	*Juska et al., 1973*
Helminthosporium leafspot	*Helminthosporium cynodontis*	Bermuda-grass	+	F - Disease index - Average of 3 evaluations	KCl	*Kresge et al., 1966*
Helminthosporium leafspot	*Helminthosporium cynodontis*	Bermuda-grass	2 +	F - Disease index - 2 trials		*Matocha et al., 1981*
Leafspot		Bermuda-grass	+ (92)	F - Number spots per leaf		*Evans et al., 1964*
Leafspot		Bermuda-grass	+	L - Number spots per leaf		*Evans et al., 1964*
Leafspot		Bermuda-grass	10 +	F - Soils low in K - Disease incidence - 10 trials		*Jordan et al., 1966*
Leafspot	*Pseudopeziza trifolii*	Clover	2 +	F - % infected plants - 2 years		*Khar'kov et al., 1972*
Northern anthracnose	*Kabatiella caulivora*	Clover	2 +	F - % infected plants - 2 years		*Khar'kov et al., 1972*
Root rot	*Fusarium oxysporum*	Clover	+	L - Clover inoculated with Rhizobium - Disease intensity		*Chi et al., 1961*
Root rot	*Fusarium oxysporum*	Clover	+	L - Clover not inoculated with Rhizobium - Disease intensity		*Chi et al., 1961*
Root rot	*Fusarium roseum*	Clover	+	L - Clover inoculated with Rhizobium - Disease intensity		*Chi et al., 1961*
Root rot	*Fusarium roseum*	Clover	0	L - Clover not inoculated with Rhizobium - Disease intensity		*Chi et al., 1961*
Root rot	*Fusarium solani*	Clover	+	L - Clover inoculated with Rhizobium - Disease intensity		*Chi et al., 1961*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Root rot	*Fusarium solani*	Clover	+	L - Clover not incoculated with Rhizobium - Disease intensity		*Chi et al., 1961*
	Ascochyta trifolii	Clover	2 +	F - % infested plants - 2 years		*Khar'kov et al., 1972*
	Erysiphe polygoni	Clover	+	Velocity of incubation		*Sturm, 1958 in Fuchs et al., 1972*
Leaf fleck	*Mastigosporium rubricosum*	Cocks-foot	+	F - Disease severity		*Buhl et al., 1965 in Leath et al., 1974*
Leaf spot	*Mastigosporium rubricosum, Rhynchosporium orthosporum, Helminthosporium* spp.	Cocks-foot	+	F - Disease incidence		*Welling, 1976*
Powdery mildew	*Erysiphe graminis*	Cocksfoot	-	L - Disease index	KCl	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Cocksfoot	-	L - Disease index	K_2SO_4	*Lowig, 1935*
Leaf spot	*Helminthosporium spp.*	Fescue	+	F - Disease incidence		*Welling, 1976*
Powdery mildew	*Erysiphe graminis*	Fescue	-	L - Disease incidence	KCl	*Lowig, 1935*
Powdery mildew	*Erysiphe graminis*	Fescue	-	L - Disease incidence	K_2SO_4	*Lowig, 1935*
Beet rust	*Uromyces betae*	Fodder beet	+	F - Damage		*Russell, 1928*
	Epichloe	Grassland	+	F - Crop susceptibility		*Russell, 1928*
Leafspot	*Pseudopeziza medicaginis*	Lucerne	+	F		*Mortensen et al., 1908 n Stapel, 1958*
Phytophthora root rot	*Phytophthora megasperma*	Lucerne	+	L - Susceptible variety - Disease index	K_2SO_4	*Alva et al., 1985*
Phytophthora root rot	*Phytophthora megasperma*	Lucerne	-	L - Resistant variety - Disease index	K_2SO_4	*Alva et al., 1985*
Phytophthora root rot		Lucerne	+	F - Disease severity		*Kelling et al., 1982*
Root rot	*Fusarium tricinctum*	Lucerne	0	L - Disease intensity		*Leath et al., 1971 in Leath et al., 1974*

Root rot	*Fusarium* spp.	Lucerne	+	F - Trial Washington - Recovery of Fusarium isolates		*O'Rourke et al., 1966*
Root rot	*Fusarium* spp.	Lucerne	+	F - Trial Washington - Disease severity		*O'Rourke et al., 1966*
Root rot	*Fusarium* spp.	Lucerne	+	F - Trial Saratoga - Recovery of Fusarium isolates		*O'Rourke et al., 1966*
Root rot	*Fusarium* spp.	Lucerne	+	F - Trial Saratoga - Disease severity		*O'Rourke et al., 1966*
Root rot	*Fusarium oxysporum*	Lucerne	+ (19)	F - Long-term trial - % attacked plants - Average for 3 cuts in the 3rd trial year		*Ubajdullaev, 1969*
Southern anthrac-nose of alfalfa		Lucerne	+	F - Disease severity		*Schneider et al., 1971 in Leath et al, 1974*
Stemphylium leaf spot	*Stemphylium sarciniforme*	Lucerne	+	F - Disease severity		*Schneider et al., 1971 in Leath et al., 1974*
Verticillium wilt		Lucerne	-	Rapidity of incubation - Artificial inoculation	K_2SO_4	*Isaac, 1957 in Leath et al., 1974*
Verticillum wilt		Lucerne	0	L - Disease severity		*Jarman et al., 1982*
Leaf spot	*Helminthosporium* spp.	Ryegrass	+	F - Disease incidence		*Welling, 1976*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial I - Damage estimated by colour	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial I - Mycelium formation	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+ (31)	L - Trial I - % dead plants	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial II - Damage estimated by colour	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	-	L - Trial II - Mycelium formation	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+ (44)	L - Trial II - % dead plants	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial III - pH 4.7 - Damage estimated by colour	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial III - pH 6.5 - Damage estimated by colour	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial III - pH 4.7 - Mycelium formation	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+	L - Trial III - pH 6.5 - Mycelium formation	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+ (31)	L - Trial III - pH 4.7 - % dead plants	KCl	*Nissinen, 1970*
Snow mold	*Fusarium nivale*	Ryegrass	+ (23)	L - Trial III - pH 6.5 - % dead plants	KCl	*Nissinen, 1970*
Leafspot	*Heterosporium phlei*	Timothy	+	F - K applied in fall - Disease index lst cut 1962		*Laughlin, 1965*
Leafspot	*Heterosporium phlei*	Timothy	+	F - K applied in fall - Disease index lst cut 1963		*Laughlin, 1965*
Leafspot	*Heterosporium phlei*	Timothy	+	F - K applied in spring - Disease index lst cut 1962		*Laughlin, 1965*
Leafspot	*Heterosporium phlei*	Timothy	+	F - K applied in spring - Disease lst cut 1963		*Laughlin, 1965*
Leafspot	*Cladosporium phlei + Helminthosporium*	Timothy	+	F - Disease incidence		*Welling, 1976*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
	phlei					
Snow mold	*Fusarium nivale*	Timothy	2+(11)	L - % damage - 2 trials		*Arsvoll et al., 1977*
Snow mold	*Sclerotinia borealis*	Timothy	+ (13)	L - % damage		*Arsvoll et al., 1977*
Snow mold	*Typhula ishikariensis*	Timothy	- (16)	L - % damage - 1 trial		*Arsvoll et al., 1977*
Snow mold	*Typhula ishikariensis*	Timothy	3+(5)	L - % damage - 3 trials		*Arsvoll et al., 1977*
Snow mold	*Sclerotinia borealis*	Timothy	+	F - Crop resistance		*Ekstrand, 1955 in Arsvoll et al., 1977*
Snow mold	*Typhula ishikariensis*	Timothy	+	F - Crop resistance		*Ekstrand, 1955 in Arsvoll et al., 1977*
	Fusarium nivale	Various fodder-grasses	+	F - Trial I - Crop susceptibility		*Fernandez et al.,1970*
	Helminthosporium	Various fodder-grasses	+	F - Trial I - Crop susceptibility		*Fernandez et al.,1970*
		Forest				
	Nectria ditissima	Beech	-	L - Trial 1978 - Necrosis length - Average of 2 evaluations	K_2SO_4	*Perrin et al., 1984*
	Nectria ditissima	Beech	+	L - Trial 1979 - Necrosis length	K_2SO_4	*Perrin et al., 1984*
Walnut anthrac-nose	*Gnomonia leptostyla*	Black walnut	6 - (9)	F - % leaflets with lesions - 6 trials	KCl	*Neely, 1981*
	Coryneum cardinale	Cupressus	-	L - Lesions area		*Blanc, 1984*
Mildew		Oak	+	L - Attack intensity		*Penningsfeld, 1964 in Baule et al., 1970*
Pine needle cast	*Lophodermium pinastri*	Pine	2+(35)	F - Soils low in K - % infested trees - 2 trials	K_2SO_4	*Brüning, 1965*

Pine needle cast	*Lophodermium pinastri*	Pine	+ (90)	F - Soil low in K - Number necroses on needles	K_2SO_4	*Brüning, 1965*
Pine needle cast	*Lophodermium pinastri*	Pine	+ (60)	L - Number defoliated seedlings	KCl	*Chung et al., 1970*
Pitch canker	*Fusarium moniliforme*	Pine	2+(10)	L - Canker length on slash pine seedlings - 2 trials	KCl	*Fraedrich et al., 1982*
Pitch canker	*Fusarium moniliforme*	Pine	- (19)	L - Canker length on loblolly pine seedlings	KCl	*Fraedrich et al., 1982*
Pitch canker	*Fusarium moniliforme*	Pine	+ (6)	F - Artificial inoculation - Canker length on 7 year old loblolly pines	KCl	*Fraedrich et al., 1982*
Pitch canker	*Fusarium moniliforme*	Pine	+ (4)	L - Canker length on Virginia pine seedlings	KCl	*Fraedrich et al., 1982*
Pitch canker	*Fusarium moniliforme*	Pine	- (17)	F - Artificial inoculation - Canker length on 8 year old slash pines	KCl	*Fraedrich et al., 1982*
Root rot	*Macrophomina phaseolina + Fusarium oxysporum*	Pine	-	L - Root rot index at 24 °C	KCl	*Rowan, 1971*
Root rot	*Macrophomina phaseolina + Fusarium oxysporum*	Pine	+	L - Root rot index at 35°C	KCl	*Rowan, 1971*
Root rot	*Macrophomina phaseolina*	Pine	- (5)	L - % recovery of Macrophomina at 24°C	KCl	*Rowan, 1971*
Root rot	*Macrophomina phaseolina*	Pine	+ (7)	L - % recovery of Macrophomina at 35°C	KCl	*Rowan, 1971*
Root rot	*Fusarium oxysporum*	Pine	- (51)	L - % recovery of Fusarium at 24°C	KCl	*Rowan, 1971*
Root rot	*Fusarium oxysporum*	Pine	+ (24)	L - % recovery of Fusarium at 35°C	KCl	*Rowan, 1971*
Snow blight	*Phacidium infestans*	Pine	+	F - Attack intensity 1961		*Kurkela, 1965*
Snow blight	*Phacidium infestans*	Pine	+ (90)	F - Attack intensity 1964		*Kurkela, 1965*
Leaf blotch	*Marssonina brunea*	Poplar	-	F		*Donaubauer, 1969 in Garbaye et al., 1973*
Leaf blotch	*Marssonina brunea*	Poplar	+ (13)	L - Number spots on leaves		*Garbaye et al., 1973*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Leaf blotch	*Marssonina brunea*	Poplar	+ (68)	L - Number spots on leaves		*Lahouste, 1984*
Leaf blotch	*Marssonina brunea*	Poplar	+			*Van der Meiden, 1964 in Garbaye, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	-	L - Susceptible clone P. x *japono-gigas* - Disease intensity 1969		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Susceptible clone P. x *japono-gigas* - Disease intensity 1970		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Susceptible clone *P. deltoides missouriensis* - Disease intensity		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Susceptible clone *P. deltoides x P. nigra* - Disease intensity 1967		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Susceptible clone *P. deltoides x P. nigra* - Disease intensity 1968		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	-	L - Susceptible clone *P. deltoides x P. nigra* - Disease intensity 1969		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Moderately resistant clone - Disease intensity 1967		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Moderately resistant clone - Disease intensity 1968		*Suzuki, 1973*
Poplar leaf rust	*Melampsora larici-populina*	Poplar	+	L - Resistant clone - Disease intensity		*Suzuki, 1973*
Needle mildew		Sugi	+	Attack intensity		*Shidel et al., 1955 in Baule et al., 1970*
Hypoxylon canker	*Hypoxylon mammatum*	Trembling aspen	- (33)	F - Trial I - Artificial inoculation - Number trees with cankers - Average of 2 evaluations	KCl	*Teachman et al., 1980*
Hypoxylon canker	*Hypoxylon mammatum*	Trembling aspen	+ (80)	F - Trial II - Artificial inoculation - Number trees with cankers - Average of 2 evaluations	KCl	*Teachman et al., 1980*

Hypoxylon canker	*Hypoxylon mammatum*	Trembling aspen	2+(30)	F - Artificial inoculation - Canker length - Average of 2 evaluations - 2 trials	KCl	*Teachman et al., 1980*
Snow blight	*Herpotrichia juniperi*	Tree unspecified	+	F - Damage		*Keller, 1970*
	Botrytis spp.	Tree unspecified	+			*Sato et al., 1959 in Fuchs et al., 1972*
		Fruit Crops				
Apple powdery mildew	*Podosphaera leucotricha*	Apples	0	F - Disease index	KCl	*Jancke, 1933*
Apple powdery mildew	*Podosphaera leucotricha*	Apples	+	L - Disease intensity on leaves 1927	KCl	*Schaffnit et al., 1930*
Apple powdery mildew	*Podosphaera leucotricha*	Apples	+	L - Relative length of diseased stem part	KCl	*Schaffnit et al., 1930*
Apple powdery mildew	*Podosphaera leucotricha*	Apples	0	L - Rapidity of frutification	KCl	*Schaffnit et al., 1930*
Apple powdery mildew	*Podosphaera leucotricha*	Apples	+	L - Disease intensity 1928	KCl	*Schaffnit et al., 1930*
Dry eye rot of apple	*Botrytis cinerea*	Apples	+ (82)	F - Disease incidence on Cox Orange	KCl	*Kolbe, 1977*
Dry eye rot of apple	*Botrytis cinerea*	Apples	- (112)	F - Disease incidence on Golden Delicious	KCl	*Kolbe, 1977*
Gloesporium fruit rot	*Gloesporium album*	Apples	6 - (13)	F - Long term trial - % wastage - Average for 6 years		*Montgomery et al. 1962*
Gloesporium fruit rot	*Gloesporium album*	Apples	- (60)	F - Disease incidence		*Sansavini et al., 1986*
Mildew		Apples	+	F - Disease incidence	KCl	*Kolbe, 1977*

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0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Scab	*Venturia inaequalis*	Apples	+			*Holz, 1939 in Fuchs et al., 1972*
Scab	*Venturia inaequalis*	Apples	+			*Lefter et al., 1970 in Ollagnier, 1976*
	Cystosporina ludibunda	Apples	+			*Horne, 1931 in Last, 1956*
	Gloesporium ssp.	Apples	2+(11)	F - Disease incidence - 2 varieties	KCl	*Kolbe, 1977*
	Penicillium ssp.	Apples	- (3)	F - Disease incidence on Cox Orange	KCl	*Kolbe, 1977*
	Penicillium ssp.	Apples	0 (0)	F - Disease incidence on Golden Delicious	KCl	*Kolbe, 1977*
	Polystictus sp. + *Stereum* sp.	Apples	+	F - Soil deficient in K - Disease intensity		*Baxter, 1957 in Borys, 1968*
	Disease unspecified	Apples	+	F - Soil low in K - Damage		*Kushnirenko et al., 1983*
	Disease unspecified	Apples	+	Pathogen progression in the tissues		*Muskett et al., 1938 in Fuchs et al., 1972*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (27)	F - Trial I 1951 - Soil application - % infection	KCl	*Wade, 1953*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (52)	F - Trial I 1951 - 1 foliar application - % infection	KCl	*Wade, 1953*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (35)	F - Trial I 1951 - 4 foliar applications - % infection	KCl	*Wade, 1953*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+	F - Trial II 1951- Foliar application - % infection	KCl	*Wade, 1953*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	- (10)	F - Soil low in K - Trial Rokeby 1952 - Soil application - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (27)	F - Soil low in K - Trial Rokeby 1953 - Soil application - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (40)	F - Soil low in K - Trial Sandford 1952 - Soil application - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (18)	F - Soil low in K - Trial Sandford 1952 - 1 foliar application - % infection	KCl	*Wade, 1956*

Brown rot of apricots	*Sclerotinia fructicola*	Apricots	- (2)	F - Soil low in K - Trial Sandford 1952 - 1 foliar application - % infection	K_2SO_4	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (14)	F - Soil low in K - Trial Sandford 1952 - 4 foliar applications - % infection	K_2SO_4	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (16)	F - Soil low in K - Trial Sandford 1953 - Soil application - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (28)	F - Soil low in K - Trial Sandford 1953 - Soil application, K incorporated - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (6)	F - Soil low in K - Trial Sandford 1953 - 1 foliar application - % infection	K_2SO_4	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	0 (0)	F - Soil low in K - Trial Sandford 1953 - 4 foliar applications - % infection	K_2SO_4	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (31)	F - Soil low in K - Trial Sandford 1954 - Soil application - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (25)	F - Soil low in K - Trial Sandford 1954 - Soil application, K incorporated - % infection	KCl	*Wade, 1956*
Brown rot of apricots	*Sclerotinia fructicola*	Apricots	+ (44)	F - Soil low in K - Trial Cambridge 1954 - Soil application - % infection	KCl	*Wade, 1956*
Phytophthora root rot	*Phytophtora cinnamoni*	Avocado	- (11)	L - Trial I - Disease intensity - Average of 6 evaluations		*Bingham et al., 1958*
Phytophtora root rot	*Phytophtora cinnamoni*	Avocado	+ (8)	L - Trial II - Disease intensity - Average of 5 evaluations		*Bingham et al., 1958*
Banana wilt	*Fusarium oxysporum*	Bananas	0			*Alavarez et al., 1981*
Banana wilt	*Fusarium oxysporum*	Bananas	+	L - Severity of disease symptoms	K_2SO_4	*Rishbeth, 1961*
	Armillaria mellea	Bananas	+ (70)	F - % dead trees		*Spurling et al., 1975*
Currant anthracnose	*Pseudopeziza ribis*	Black currant	0 (0)	L - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Currant anthracnose	*Pseudopeziza ribis*	Black currant	+	L - Fungus fructification	KCl	*Schaffnit et al., 1930*
Currant anthracnose	*Pseudopeziza ribis*	Black currant	+ (43)	L - Size of disease spots on leaves	KCl	*Schaffnit et al., 1930*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Ink disease	*Phytophthora cambivora*	Chesnut	+			*Akdogan, 1970 in Ollagnier, 1976*
Mal secco	*Phoma tracheiphila*	Citrus	-	L - Disease index		*Pionnat et al., 1987*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	0 (0)	L - Trial 1926 - Velocity of conidia formation	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	+	L - Trial 1926 - Disease index, average of 2 evaluations	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	+	L - Trial 1926 - Disease index after cutting diseased stems	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	-	L - Trial 1926 - Perithecia formation, average of 2 evaluations	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	0 (0)	L - Trial 1927 - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	+	L - Trial 1927 - Disease index, average of 2 evaluations	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Goose-berry	+ (64)	L - Trial 1927 - Relative length of diseased stem parts	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+(52)	F - Attack intensity		*Condei et al., 1980*
Downy mildew	*Plasmopara viticola*	Grapes	+			*Hoffmann et al., 1969 in Ollagnier, 1976*
Downy mildew	*Plasmopara viticola*	Grapes	0 (0)	L - Trial 1926 - Inoculation July - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+	L - Trial 1926 - Inoculation July - Fungus development - Average of 2 evaluations	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	0 (0)	L - Trial 1926 - Inoculation August - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+ (13)	L - Trial 1926 - Inoculation August - % successful inoculations	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+	L - Trial 1926 - Inoculation August - Disease index, average of 3 evaluations	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+	L - Trial 1926 - Fungus fructification	KCl	*Schaffnit et al., 1930*

Downy mildew	*Plasmopara viticola*	Grapes	+ (9)	L - Trial 1927 - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+ (14)	L - Trial 1927 - % successful inoculations	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	- (12)	L - Trial 1927 - Fungus development, average of 2 evaluations	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	- (25)	L - Trial 1927 - % leaf area with fungus spots	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	0	L - Trial 1927 - Fungus fructification	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+ (7)	L - Trial 1928 - Velocity of incubation - Average of evaluations on 4 plant parts	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+ (17)	L - Trial 1928 - % successful inoculations - Average of evaluations on 4 plant parts	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+	L - Trial 1928 - Fungus development - Average of evaluations on 3 plant parts	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	0	L - Trial 1928 - Fungus fructification	KCl	*Schaffnit et al., 1930*
Downy mildew	*Plasmopara viticola*	Grapes	+	L - Trial 1928 - Frequency of conidia regeneration	KCl	*Schaffnit et al., 1930*
Grey mold	*Botrytis cinerea*	Grapes	+ (68)	F - Attack intensity		*Condei et al., 1980*
Grey mold	*Botrytis cinerea*	Grapes	+	F - Crop susceptibility		*Kiraly, 1976*
Grey mold	*Botrytis cinerea*	Grapes	+	F - Disease incidence		*Perov et al., 1974*
Mildew		Grapes	+			*Arnaud, 1931 in Chaboussou, 1972*
Powdery mildew	*Uncinula necator*	Grapes	+ (9)	F - Attack intensity		*Condei et al., 1980*
Powdery mildew	*Uncinula necator*	Grapes	2 +	F - Soil deficient in K - Attack intensity - 2 varieties		*Gärtel, 1959*
Powdery mildew	*Uncinula necator*	Grapes	+			*Laurent, 1899 in Hopfengart, 1953*
Powdery mildew	*Uncinula necator*	Grapes	+	L - 1st inoculation - Disease index	KCl	*Schaffnit et al., 1930*
Powdery mildew	*Uncinula necator*	Grapes	0	L - 1st inoculation - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Powdery mildew	*Uncinula necator*	Grapes	+	L - 2nd inoculation - Disease index	KCl	*Schaffnit et al., 1930*
Powdery mildew	*Uncinula necator*	Grapes	+ (33)	L - 2nd inoculation - Relative length of diseased stem parts	KCl	*Schaffnit et al., 1930*
Powdery mildew	*Uncinula necator*	Grapes	+ (42)	L - 2nd inoculation - Number diseased internodes	KCl	*Schaffnit et al., 1930*
Brown rot		Peaches	0	Soil application	KCl	*Hutton et al., 1955 in Wade, 1956*
Brown rot		Peaches	0	Spray	KCl	*Hutton et al., 1955 in Wade, 1956*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Coryneum blight	*Clasterosporium carpophilum*	Peaches	- (26)	L - 1st inoculation - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Coryneum blight	*Clasterosporium carpophilum*	Peaches	- (10)	L - 2nd inoculation - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Coryneum blight	*Clasterosporium carpophilum*	Peaches	- (19)	L - Number successful inoculations	KCl	*Schaffnit et al., 1930*
Coryneum blight	*Clasterosporium carpophilum*	Peaches	0 (0)	L - Area occupied by the fungus	KCl	*Schaffnit et al., 1930*
	Polystictus sp. + *Stereum* sp.	Pears	+	F - Soil deficient in K - Disease intensity		*Baxter, 1957 in Borys, 1968*
Verticillium wilt	*Verticillium dahliae*	Pistachio	+	F - Disease incidence		*Ashworth et al., 1985*
Cytospora canker	*Cytospora leucostoma*	Plums	+	F - Disease incidence		*Bertrand et al., 1976*
Gooseberry mildew	*Sphaerotheca mors*	Red currant	+ (10)	L - Number successful inoculations	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Red currant	0 (0)	L - Velocity of incubation	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Red currant	+	L - 1st inoculation - Disease intensity	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Red currant	+	L - 2nd inoculation - Disease intensity	KCl	*Schaffnit et al., 1930*
Gooseberry mildew	*Sphaerotheca mors*	Red currant	+ (60)	L - Relative length of diseased stem parts	KCl	*Schaffnit et al., 1930*
		Oil crops				
Coconut heart rot		Coconut	+	F - Observation 1966 - Diseased trees found on parts of field low in K		*Mijailova, 1971*
Coconut heart rot		Coconut	+	F - Observation 1969 - Diseased trees found on parts of field low in K		*Mijailova, 1971*
Helminthosporium		Coconut	+	F - Attack intensity	KCl	*Ollagnier et al., 1983*

Leaf spot	*Pestalozzia palmarum*	Coconut	2+(94)	F - Number leaf spots on leaflets - 2 trials	KCl	*Abad et al., 1978*
Leaf spot	*Pestalozzia palmarum*	Coconut	+	F - Disease incidence		*Child, 1950*
Leaf spot	*Drechslera incurvata*	Coconut	+	F - Disease index	KCl	*Fagan, 1985*
Leaf spot	*Drechslera incurvata*	Coconut	2 +	L - Disease index - 2 trials	KCl	*Fagan, 1985*
Leaf spot	*Drechslera incurvata*	Coconut	+	L - Sporulation	KCl	*Fagan, 1985*
Leaf spot	*Drechslera incurvata*	Coconut	-	L - Number primary spots	KCl	*Fagan, 1985*
Leaf spot	*Drechslera incurvata*	Coconut	+ (12)	L - Lesions size	KCl	*Fagan, 1985*
Leaf spot	*Drechslera incurvata*	Coconut	+ (32)	L - Disease incidence	KCl	*Gallasch, 1974*
Leaf spot	*Drechslera incurvata*	Coconut	+	Crop susceptibility		*Menon et al., 1950 in Gallasch, 1974*
Leaf spot	*Pestalozzia palmarum*	Coconut	+	L - Disease incidence	KCl	*Oguis et al., 1979*
Leaf spot	*Pestalozzia palmarum*	Coconut	+	F - Attack intensity	KCl	*Ollagnier et al., 1983*
Leaf spot	*Pestalozzia palmarum*	Coconut	+	Crop susceptibility		*Smith, 1966 in Gallasch, 1974*
Shoot rot	*Gloesporium*	Coconut	+	F		*Patel et al., 1936 in Yarwood, 1959*
Boyomi disease	*Fusarium bulbigenum*	Oil palm	- (35)	F - % diseased trees		*Heim, 1949 in Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	0	L - Nursery trees		*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	2 + (5)	F - % diseased trees - 2 trials		*Ollagnier et al., 1970*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	0	F - Long-term trial - Resistant line - % diseased trees 1968	KCl	*Ollagnier, 1976*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Fusarium wilt	*Fusarium oxysporum*	Oil palm	0	F - Long-term trial - Resistant line - % diseased trees 1969	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Resistant line - % diseased trees 1971-72	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Resistant line - % diseased trees 1972-73	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Resistant line - % diseased trees 1973-74	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Resistant line - % diseased trees 1974-75	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	0	F - Long-term trial - Susceptible line - % diseased trees 1968	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	0	F - Long-term trial - Susceptible line - % diseased trees 1969	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Susceptible line - % diseased trees 1971-72	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Susceptible line - % diseased trees 1972-73	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Susceptible line - % diseased trees 1973-74	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Long-term trial - Susceptible line - % diseased trees 1974-75	KCl	*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+ (74)	F - Trial in Benin - % diseased trees		*Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	+	F - Adult trees	K_2SO_4	*Prendergast, 1957 in Ollagnier, 1976*
Fusarium wilt	*Fusarium oxysporum*	Oil palm	0	L - Nursery trees		*Prendergast, 1957 in Ollagnier, 1976*
Stem rot	*Fomes noxious*	Oil palm	+ (100)	F - Number infected or dead trees		*Navaratnam et al., 1965 in Thiagalingam,1977*

	Fusarium spp. + *Rhizoctonia solani*	Peanut	2+(54)	F - % infected pods - 2 years	K_2SO_4	*El-Wakil et al., 1984*
	Sclerotinia sclerotiorum	Rape	0	F		*Krüger, 1977*
Root rot	*Rhizoctonia solani*	Sesame	- (38)	L - % infection		*Sirry et al., 1979*
Sesame blight	*Helminthosporium* spp.	Sesame	+	Crop susceptibility		*Stone, 1959 in Fuchs et al., 1972*
Anthracnose		Soybeans	2 +	F - Soils low in K - Disease incidence - 2 trials		*Anon, 1983*
Anthracnose	*Colletotrichum dematium*	Soybeans	3 +	F - Soil low in K - Disease incidence - Average for 3 years	KCl	*Sij et al., 1985*
Brown stem rot	*Cephalosporium gregatum*	Soybeans	+ (7)	L - Length of infected area	K_2SO_4	*Aly et al., 1984*
Charcoal rot		Soybeans	+	F - Plant colonization by the fungus		*Granade et al., 1986*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	2 +	F - Disease incidence - Average for 2 years	KCl	*Henning et al., 1985*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	+ (20)	F - Napoleon trial - Soil low in K - Disease incidence		*Jeffers et al., 1982*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	+ (28)	F - Wooster trial 1975 - Artificial inoculation - Disease incidence		*Jeffers et al., 1982*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	4+(7)	F - Wooster trial 1976 - Disease incidence - 4 varieties		*Jeffers et al., 1982*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	4+(67)	F - Wooster trial 1976 - % moldy seed - 4 varieties		*Jeffers et al., 1982*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	4+(7)	F - South Charleston trial 1978 - Disease incidence - 4 varieties		*Jeffers et al., 1982*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	8+(29)	F - South Charleston trial - % moldy seed - Average for 4 varieties and 2 years		*Jeffers et al., 1982*
Phomopsis seed rot	*Phomopsis* sp.	Soybeans	+	F - Soil low in K - % infected seeds	KCl	*Sij et al., 1985*
Pod and stem blight	*Diaporthae sojae*	Soybeans	+(58)	L - % diseased seeds	KCl	*Andrews and Svec, 1976*
Pod and stem blight	*Diaporthe phaseolorum*	Soybeans	2+(95)	F - Soil low in K - Disease incidence - Average for 2 years	KCl	*Camper et al., 1977*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Pod and stem blight	*Diaporthae sojae*	Soybeans	2+(63)	L - Soil low in K - 2 varieties	K_2SO_4	*Crittenden et al., 1974*
Pod and stem blight	*Diaporthe phaseolorum*	Soybeans	- (100)	F - Disease incidence		*Jeffers et al., 1982*
Pod and stem blight	*Diaporthe phaseolorum*	Soybeans	+	F - Attack intensity	KCl	*Mascarenhas et al., 1977*
Pod and stem blight	*Diaporthe sojae*	Soybeans	7+(64)	F - Newark trial 1974 - % moldy seeds - 7 varieties	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	0 (0)	F - Newark trial 1974 - % moldy seeds - 1 variety	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	- (140)	F - Newark trial 1974 - % moldy seeds - 1 variety	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	5+(53)	F - Newark trial 1975 - % moldy seeds - 5 varieties	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	0 (0)	F - Newark trial 1975 - % moldy seeds - 1 variety	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	3-(144)	F - Newark trial 1975 - % moldy seeds - 3 varieties	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	4+(47)	F - Georgetown trial 1974 - % moldy seeds - 4 varieties	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	5-(122)	F - Georgetown trial 1974 - % moldy seeds - 5 varieties	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	5+(48)	F - Georgetown trial 1975 - % moldy seeds - 5 varieties	KCl	*Svec et al., 1976*
Pod and stem blight	*Diaporthe sojae*	Soybeans	4-(19)	F - Georgetown trial 1975 - % moldy seeds - 4 varieties	KCl	*Svec et al., 1976*
Purple seed stain	*Cercospora kikuchii*	Soybeans	2+(61)	F - Soil low in K - Disease incidence - 2 years	KCl	*Camper et al., 1977*
Purple seed stain	*Cercospora kikuchii*	Soybeans	-	F - Disease incidence	KCl	*Henning et al., 1985*
Purple seed stain	*Cercospora kikuchii*	Soybeans	-(250)	F - Disease incidence		*Jeffers et al., 1982*
Purple seed stain	*Cercospora kikuchii*	Soybeans	-(67)	F - % purple stain		*Jeffers et al., 1982*

Purple seed stain	*Cercospora kikuchii*	Soybeans	4+(30)	F - Georgetown trial 1974 - % purple stain - 4 varieties	KCl	*Svec et al., 1976*
Purple seed stain	*Cerocospora kikuchii*	Soybeans	- (25)	F - Georgetown trial 1974 - % purple stain - 1 variety	KCl	*Svec et al., 1976*
Purple seed stain	*Cercospora kikuchii*	Soybeans	4+(35)	F - Georgetown trial 1975 - % purple stain - 4 varieties	KCl	*Svec et al., 1976*
Purple seed stain	*Cercospora kikuchii*	Soybeans	5-(41)	F - Georgetown trial 1975 - % purple stain - 5 varieties	KCl	*Svec et al., 1976*
Septoria brown spot		Soybeans	2 +	F - Soils low in K - Disease incidence - 2 trials		*Anon, 1983*
Stem and crown blight	*Rhizoctonia solani*	Soybeans	2+(33)	L - Inoculation with IB_4 race - % dead plants - 2 trials		*Castano et al., 1956*
Stem and crown blight	*Rhizoctonia solani*	Soybeans	2+(5)	L - Inoculation with IB_4 race - % infected plants - 2 trials		*Castano et al., 1956*
Stem and crown blight	*Rhizoctonia solani*	Soybeans	2 -	L - Inoculation with CT_1C race - % dead plants - 2 trials		*Castano et al., 1956*
Stem and crown blight	*Rhizoctonia solani*	Soybeans	2+(10)	L - Inoculation with CT_1C race - % infected plants - 2 trials		*Castano et al., 1956*
	Diaporthe phaseolorum + Phomopsis sp.	Soybeans	+ (61)	F - Napoleon trial - Soil low in K - % moldy seeds		*Jeffers et al., 1982*
	Diaporthe phaseolorum + Phomopsis sp.	Soybeans	+ (74)	F - Wooster trial - % moldy seeds		*Jeffers et al., 1982*
	Sclerotinia sclerotiorum	Sunflower	+	F - % killed leaves		*Abia, 1984*
		Starch and sugar crops				
Beet rust	*Uromyces betae*	Beets	-	F - Attack intensity		*Gram, 1930 in Stapel, 1958*
Beet rust	*Uromyces betae*	Beets	+	F		*Martin, 1973*
Cercospora		Beets	+	F - K - fixing soil - Infection intensity		*Siebold, 1980*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Damping-off	*Pythium debaryanum*	Beets	+	F - Soil poor in K		*Esbjerg, 1937 in Stapel, 1958*
Damping-off	*Pythium debaryanum*	Beets	+	F - Soil poor in K		*Gram, 1952 in Stapel, 1958*
Damping-off	*Pythium debaryanum*	Beets	+	F - Soil poor in K		*Iversen et al., 1951 in Stapel, 1958*
Damping-off	*Pythium ultimum*	Beets	+	L - Number dead plants		*Yale et al., 1952*
Root rot	*Pythium, Rhizoctonia* and *Phoma betae*	Beets	+ (89)	F - Soil poor in K - % diseased plants		*Trocmé and Lenoir 1956*
Rust		Beets	+			*Schaffnit et al., 1927 in Krauss, 1969*
Anthracnose		Cassava	+	F - Disease incidence		*Howeler, 1985*
Anthracnose	*Colletotrichum manihotis*	Cassava	+	F - Disease incidence	KCl	*Njoku et al., 1980*
Anthracnose	*Colletotrichum manihotis*	Cassava	+	F - Disease severity	KCl	*Njoku et al., 1980*
Cercospora leaf spot	*Cercospora henningsii*	Cassava	2 +	F - Disease index - 2 varieties		*Muthuswamy et al., 1977*
Black scurf	*Rhizoctonia solani*	Potato	+	Crop susceptibility		*Janssen, 1930 in Better Crops, 1966*
Black scurf	*Rhizoctonia solani*	Potato	+	Crop susceptibility		*Van Beekom, 1945 in Fuchs et al., 1972*
Black scurf	*Rhizoctonia solani*	Potato	-	F - % diseased tubers		*Varis, 1972*
Black scurf	*Rhizoctonia solani*	Potato	+	Crop susceptibility		*Zaleski et al., 1954 in Fuchs et al., 1972*
Dry rot of potato	*Fusarium coerulum*	Potato	+ (46)	L - % of rotting		*Fehmi, 1933*
Dry rot of potato	*Fusarium coerulum*	Potato	-	F - Long-term trial - Artificial infection - Disease index		*Langerfeld, 1973*
Dry rot of potato	*Fusarium coerulum*	Potato	+	Attack intensity		*Servazzi, 1953 in Langerfeld, 1973*

Early blight of potato	*Alternaria solani*	Potato	+ (39)	F - Disease incidence	KCl	*Kumar et al., 1983*
Grey mould	*Botrytis cinerea*	Potato	+	F - % infected plants		*Harper et al., 1968*
Late blight	*Phytophthora infestans*	Potato	+			*Alten et al., 1941 in Gärtel, 1959*
Late blight	*Phytophthora infestans*	Potato	+			*Awan et al., 1957 in Krauss, 1969*
Late blight	*Phytophthora infestans*	Potato	0	L - Disease development	K_2SO_4	*Carnegie et al., 1983*
Late blight	*Phytophthora infestans*	Potato	15-(3)	F - % blighted tubers - 15 trials	K_2SO_4	*Herlihy et al., 1969*
Late blight	*Phytophthora infestans*	Potato	2+(29)	F - % blight - 2 trials	K_2SO_4	*Miles et al., 1925*
Late blight	*Phytophthora infestans*	Potato	+ (38)	F - % blight	KCl	*Miles et al., 1925*
Late blight	*Phytophthora infestans*	Potato	+	L	KCl	*Struchtemeyer, 1966*
Late blight	*Phytophthora infestans*	Potato	+	F		*Struchtemeyer, 1966*
Late blight	*Phytophthora infestans*	Potato	-	L - Crop susceptibility		*Szczotka et al., 1973*
Late blight	*Phytophthora infestans*	Potato	-	Development of lesions		*Umaerus, 1969 in Fuchs et al., 1972*
Late blight	*Phytophthora infestans*	Potato	-	Sporulation intensity		*Umaerus, 1969 in Fuchs et al., 1972*
Late blight	*Phytophthora infestans*	Potato	0	Infection frequency		*Umaerus, 1969 in Fuchs et al., 1972*
Late blight	*Phytophtora infestans*	Potato	-	L - Fructification on leaves		*Vowinckel, 1926 in Weindlmayr, 1965*
Late blight	*Phytophthora infestans*	Potato	-	L - Spots formation		*Weindlmayr, 1965*
Late blight	*Phytophthora infestans*	Potato	-	L - Spore carriers development		*Weindlmayr, 1965*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Mildew		Potato	+	F - Soil poor in K - Disease incidence		*Kühn et al., 1966*
Potato stem-end rot	*Fusarium* spp.	Potato	+ (60)	F - Long-term trial - % diseased tubers		*Brewer, 1962*
Powdery scab of potato	*Spongospora subterranea*	Potato	+	F - Long-term trial - Disease index in 1963		*Wenzl et al., 1974*
Tuber blight		Potato	0	F - % tuber blight		*Varis, 1972*
	Phytophthora spp.	Potato	+	Crop susceptibility		*Hecke, 1898 in Fuchs et al., 1972*
	Phytophthora spp.	Potato	+	Crop susceptibility		*Schaffnit et al., 1927 in Fuchs et al., 1972*
Eye spot	*Helminthosporium sacchari*	Sugar-cane	+	Disease incidence		*Lee et al., 1928 in Huber et al., 1985*
Eye spot	*Helminthosporium sacchari*	Sugar-cane	+	F - Disease intensity		*Rabindra et al., 1978*
Yellow spot disease	*Cercospora kopkei*	Sugar-cane	+ (33)	% affected plants - Average of 2 evaluations		*Deyin, 1983*
Yellow spot disease	*Cercospora kopkei*	Sugar-cane	+ (25)	% affected leaves - Average of 2 evaluations		*Deyin, 1983*
		Stimulants				
Blackpod	*Phytophthora palmivora*	Cacao	- (15)	F - Trees in juvenile phase - % infected pods	KCl	*Ahenkorah et al., 1987*
Blackpod	*Phytophthora palmivora*	Cacao	+ (3)	F - Trees in stable phase - % infected pods	KCl	*Ahenkorah et al., 1987*
Blackpod	*Phytophthora palmivora*	Cacao	- (5)	F - Trees in senescent phase - % infected pods	KCl	*Ahenkorah et al., 1987*
Verticillium wilt	*Verticillium dahliae*	Cacao	0	L - Disease incidence		*Emechebe, 1980*

Brown spot	*Cercospora coffeicola*	Coffee	0	Disease incidence	*Fernandez-Borreiro, 1973*
Brown spot	*Cercospora coffeicola*	Coffee	+	F - Disease index	*Isla et al., 1984*
Leaf rust		Coffee	+ (5)	% infected leaves - average of 7 evaluations	*Coffee Board Res. Dept. Karnataka, 1977-78*
Rust	*Hemileia vastatrix*	Coffee	+ (3)	L - Number leaves with pustules	*Figueiredo et al., 1976*
Rust	*Hemileia vastatrix*	Coffee	- (7)	L - Number pustules per leaf	*Figueiredo et al., 1976*
Rust	*Hemileia vastatrix*	Coffee	+ (6)	L - Number pustules per cm² of leaf	*Figueiredo et al., 1976*
Anthracnose	*Gloesporium theae-sinensis*	Tea	+	F - Number leaves attacked	*Kawai, 1969*
Anthracnose	*Colletotrichum gloesporiodes*	Tea	+ (83)	Number leaves attacked	*Nagata, 1954 in von Uexküll, 1982*
	Colletotrichum camelliae	Tea	+	F	*Mkervali, 1972*
	Pestalozzia theae	Tea	+	F	*Mkervali, 1972*
Disease unspecified		Tea	+	F	*Burculadze, 1971*
Brown spot	*Alternaria longipes*	Tobacco	+	Crop susceptibility	*Riley, 1949 in Fuchs et al., 1972*
Powdery mildew of tobacco	*Erysiphe cichoracearum*	Tobacco	2-(781)	L - % of leaf area infected - 2 trials	*Cole, 1964*
	Phytophthora sp.	Tobacco	+	Crop susceptibility	*Böning, 1929 in Eckstein et al., 1937*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
		Vegetables				
Anthracnose	*Colletotrichum lindemuthianum*	Beans	2 -	L - Symptoms on leaves - 2 varieties		*Drobny et al., 1984*
Anthracnose	*Colletotrichum lindemuthiamum*	Beans	3 +	L - Symptoms on leaves - 3 varieties		*Drobny et al., 1984*
Anthracnose	*Colletotrichum*	Beans	+			*Schaffnit et al., 1927 in Krauss, 1969*
Anthracnose	*Colletotrichum lindemuthiamum*	Beans	+	Crop susceptibility		*Treggi, 1965 in Fuchs et al., 1972*
Brown rust	*Uromyces phaseoli*	Beans	+			*Schaffnit et al., 1927 in Krauss, 1969*
Brown rust	*Uromyces appendiculatus*	Beans	-	Crop susceptibility		*Wei, 1937 in Fuchs et al., 1972*
Chocolate spot	*Botrytis* sp.	Beans	+	F - Disease incidence	KCl	*Scott Watson, 1936*
	Botrytis spp.	Beans	+	Crop susceptibility		*Sirry, 1956 in Fuchs et al., 1972*
Chocolate spot	*Botrytis* sp.	Broad beans	+	F - Soil deficient in K - Crop susceptibility	KCl	*Cowie, 1936*
Chocolate spot	*Botrytis* spp.	Broad beans	+	L - Lesions production		*Deverall et al., 1961*
Chocolate spot	*Botrytis* spp.	Broad beans	+	L - Lesions spread		*Deverall et al., 1961*
Chocolate spot	*Botrytis* spp.	Broad beans	+	F - Disease index - Average of 3 evaluations	KCl	*Glynne et al., 1952*
Cabbage clubroot	*Plasmodiophora brassicae*	Cabbage	-	Disease incidence		*Eddins, 1952 in Huber et al., 1985*
Cabbage clubroot	*Plasmodiophora brassicae*	Cabbage	-			*Mc New, 1953*

Cabbage clubroot	*Plasmodiophora brassicae*	Cabbage	-			*Palm, 1958 in Grossmann, 1970*
Cabbage clubroot	*Plasmodiophora brassicae*	Cabbage	-	L - % infected plants		*Pryor, 1940 in Walker, 1946*
Cabbage clubroot	*Plasmodiophora brassicae*	Cabbage	-	Disease incidence		*Wellman, 1930 in Huber et al., 1985*
Cabbage yellows	*Fusarium oxysporum*	Cabbage	3 +	L - Susceptible variety - 19°C - Disease index - 3 trials		*Walker et al., 1945*
Cabbage yellows	*Fusarium oxysporum*	Cabbage	2 +	L - Susceptible variety - 25°C - Disease index - Average of 2 evaluations - 2 trials		*Walker et al., 1945*
Cabbage yellows	*Fusarium oxysporum*	Cabbage	-	L - Resistant variety - 25°C - Disease index		*Walker et al., 1945*
Downy mildew		Cabbage	2-(68)	F - Number affected leaves - 2 trials		*Chapp, 1930*
Downy mildew	*Peronospora parasitica*	Cabbage	3 -	L - Lesions spread - 3 trials		*Felton et al., 1946*
Downy mildew	*Peronospora parasitica*	Cabbage	3 -	L - Number lesions - 3 trials		*Felton et al., 1946*
Downy mildew	*Peronospora parasitica*	Cabbage	3 -	L - Proportion of lesions sporulating - 3 trials		*Felton et al., 1946*
Downy mildew	*Peronospora parasitica*	Cabbage	3 -	L - Disease severity - 3 trials		*Felton et al., 1946*
Grey mold	*Botrytis cinerea*	Cabbage	+	Disease incidence		*Polegaev et al., 1979 in Huber et al., 1985*
Fusarium wilt of cantaloupe	*Fusarium oxysporum*	Canta-loupe	+	L		*Stoddard, 1942 in Walker et al., 1945*
	Sclerotinia	Carrots	+	Crop susceptibility		*Saburova, 1951 in Fuchs et al., 1972*
Downy mildew	*Peronospora parasitica*	Cauli-flower	+	Attack intensity		*Quanjer, 1928*
Fusarium yellows	*Fusarium oxysporum*	Celery	3 +	L - N applied as $(NH_4)_2SO_4$ - Disease index - 3 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	0	L - N applied as $(NH_4)_2SO_4$ - Disease index - 1 trial	KCl	*Schneider, 1985*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Fusarium yellows	*Fusarium oxysporum*	Celery	3 -	L - N applied as $(NH_4)_2SO_4$ - Disease index - 3 trials	K_2SO_4	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	3 +	L - N applied as NH_4Cl - Disease index - 3 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	2 -	L - N applied as NH_4Cl - Disease index - 2 trials	K_2SO_4	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	+	L - N applied as NH_4Cl - Disease index - 1 trial	K_2SO_4	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	3 +	L - N applied as NH_4NO_3 - Disease index - 3 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	3 -	L - N applied as NH_4NO_3 - Disease index - 3 trials	K_2SO_4	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	6 +	L - N applied as $Ca(NO_3)_2$ - Disease index - 6 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	3 -	L - N applied as $Ca(NO_3)_2$ - Disease index - 3 trials	K_2SO_4	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	2 +	L - N applied as $(NH_4)_2SO_4$ - Number colonies per 100 cm root - 2 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	2 +	L - N applied as $Ca(NO_3)_2$ - Number colonies per 100 cm root - 2 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	- (9)	F - N applied as $(NH_4)_2SO_4$ - Disease incidence	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	2+(66)	F - N applied as $Ca(NO_3)_2$ - Disease incidence - 2 trials	KCl	*Schneider, 1985*
Fusarium yellows	*Fusarium oxysporum*	Celery	- (1)	F - N applied as $Ca(NO_3)_2$ - Disease incidence	K_2SO_4	*Schneider, 1985*
Damping-off	*Rhizoctonia solani*	Cowpea	+ (8)	L - % infected seedlings - Trial 1	KCl	*Kataria et al., 1981*
Damping-off	*Rhizoctonia solani*	Cowpea	+ (18)	L - % infected seedlings - Trial 1	K_2SO_4	*Kataria et al., 1981*
Damping-off	*Rhizoctonia solani*	Cowpea	-	L - Disease incidence - Trial 2	KCl	*Kataria et al., 1981*
Verticillium wilt	*Verticillium albo-atrum*	Eggplant	+	L - Velocity of incubation	KCl	*Sivaprakasam et al., 1971*
Verticillium wilt	*Verticillium albo-atrum*	Eggplant	+	L - Disease index	KCl	*Sivaprakasam et al., 1971*
	Rhizoctonia solani	Lentil	+(4)	L - % mortality - Trial 1980	KCl	*Prasad et al., 1984*
	Rhizoctonia solani	Lentil	- (1)	L - % mortality - Trial 1981	KCl	*Prasad et al., 1984*
	Sclerotium rolfsii	Lentil	+ (4)	L - % mortality - Trial 1980	KCl	*Prasad et al., 1984*
	Sclerotium rolfsii	Lentil	0 (0)	L - % mortality - Trial 1981	KCl	*Prasad et al., 1984*
Botrytis rot	*Botrytis cinerea*	Lettuce	0	L - Disease incidence		*Krauss, 1971*
Downy mildew	*Pseudoperonospora cubensis*	Musk-melon	- (33)	L - Disease intensity		*Bains et al., 1978*

Downy mildew	*Pseudoperonospora cubensis*	Musk-melon	- (50)	L - Number sporangia on leaves		*Bains et al., 1978*
Downy mildew	*Pseudoperonospora cubensis*	Musk-melon	- (6)	L - Sporangia size		*Bains et al., 1978*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (42)	L - Fusarium population in rhizosphere	KCl	*Kannaiyan et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+	Fungus growth		*Kesavan et al., 1974 in Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+	Fungus sporulation		*Kesavan et al., 1974 in Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+	L - Sterile soil - Wilt incidence in soil	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+	L - Unsterile soil - Wilt incidence in soil	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (72)	L - Sterile soil - Number propagules in hypocotyl	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (77)	L - Unsterile soil - Number propagules in hypocotyl	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (40)	L - Unsterile soil - Fusarium propulation in soil	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium* spp.	Musk-melon	+ (26)	L - Sterile soil - Fusarium population in soil	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium* spp.	Musk-melon	+ (22)	L - Unsterile soil - Fusarium population in soil	KCl	*Ramasamy et al., 1974*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (29)	L - Wilt incidence - Average of 2 evaluations	KCl	*Ramasamy et al., 1975b*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (46)	L - Number propagules in tissue - Average of 3 evaluations	KCl	*Ramasamy et al., 1975b*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (30)	L - N applied as NO_3 - % wilted plants		*Spiegel et al., 1984*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (20)	L - N applied as NH_4 - % wilted plants		*Spiegel et al., 1984*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+	Disease incidence		*Stoddard, 1927 in Andrews et al., 1976*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+	L - Trial 1959 - Wilt incidence	K_2SO_4	*Wensley et al., 1965*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	2+(35)	L - Trial 1960 - Wilt incidence - 2 crops	K_2SO_4	*Wensley et al., 1965*
Muskmelon wilt	*Fusarium oxsporum*	Musk-melon	2 - (4)	L - Trial 1962 - Wilt incidence - 2 crops	K_2SO_4	*Wensley et al., 1965*
Muskmelon wilt	*Fusarium oxysparum*	Musk-melon	+ (3)	L - Trial 1962 - Wilt incidence - 1 crop	K_2SO_4	*Wensley et al., 1965*
Muskmelon wilt	*Fusarium oxysporum*	Musk-melon	+ (45)	L - Trial 1962 - Number propagules in soil - 1 crop	K_2SO_4	*Wensley et al., 1965*
Cabbage clubroot	*Plasmodiophora brassicae*	Mustard	-			*Mc New, 1953*
Basal rot	*Fusarium oxysporum*	Onions	- (192)	F - Trial 1966/67 - % infection after 3 months storage	K_2SO_4	*Ashour et al., 1973*
Basal rot	*Fusarium oxysporum*	Onions	+ (60)	F - Trial 1967/68 - % infection after 3 months storage	K_2SO_4	*Ashour et al., 1973*
Basal rot	*Fusarium oxysporum*	Onions	2+(47)	L - % infection - Average of 2 evaluations - 2 trials	K_2SO_4	*Ashour et al., 1980*
White rot	*Sclerotium cepivorum*	Onions	- (12)	F - Trial 1931 - Natural infection - % diseased plants, average of 2 evaluations	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	+ (53)	F - Trial 1931 - Artificial infection - % diseased plants, average of 2 evaluations	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	- (6)	F - Trial 1932 - Natural infection - % diseased plants, average of 2 evaluations	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	- (4)	F - Trial 1932 - Artificial infection - % diseased plants, average of 2 evaluations	K_2SO_4	*Ashtana, 1945*

White rot	*Sclerotium cepivorum*	Onions	+ (4)	F - Trial on dry light soil - Natural infection - % diseased plants	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	+ (12)	F - Trial on dry light soil - Artificial infection - % diseased plants	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	- (13)	F - Trial on peaty wet soil - Natural infection - % diseased plants	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	- (38)	F - Trial on peaty wet soil - Artificial infection - % diseased plants	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	+	L - Artificial infection - Fungus penetration in bulb	K_2SO_4	*Ashtana, 1945*
White rot	*Sclerotium cepivorum*	Onions	+	L	K_2SO_4	*Khadr, 1961 in Raafat et al., 1967*
White rot	*Sclerotium cepivorum*	Onions	2+(13)	F - % infected bulbs - 2 trials	K_2SO_4	*Sirry et al., 1974*
Disease unspecified		Onions	+		K_2SO_4	*Tico, 1952 in Raafat et al., 1967*
Anthracnose	*Colletotrichum lindemuthianum*	Peas	+			*Schaffnit et al., 1927 in Krauss, 1969*
Aphanomyces root rot	*Aphanomyces euteiches*	Peas	+	F - Soil deficient in K - Disease intensity	KCl	*Geach, 1936 in Chapman, 1965*
Aphanomyces root rot	*Aphanomyces euteiches*	Peas	+	L - Disease index	KCl	*Papavizas et al., 1962*
Aphanomyces root rot	*Aphanomyces euteiches*	Peas	+	L - Soil in K - Soil with normal moisture - Disease index	KCl	*Wade, 1955*
Aphanomyces root rot	*Aphanomyces euteiches*	Peas	+ (12)	L - Soil low in K - Soil with normal moisture - % plants with symptoms	KCl	*Wade, 1955*
Aphanomyces root rot	*Aphanomyces euteiches*	Peas	+	L - Soil low in K - Soil waterlogged 1 week after K application - Disease index	KCl	*Wade, 1955*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Aphanomyces root rot	*Aphanomyces euteiches*	Peas	+ (2)	L - Soil low in K - Soil waterlogged 1 week after K application - % plants with symptoms	KCl	*Wade, 1955*
	Botrytis spp.	Peas	+	Crop susceptibility		*Wijngaarden et al., 1968 in Fuchs et al., 1972*
Phytophthora blight of pigeon pea	*Phytophthora drechsleri*	Pigeon pea	2+(22)	F - % plants killed - Average for 2 years	K_2SO_4	*Pal et al., 1976*
	Sclerotinia sclerotiorum	Pumpkin	+	L - % killed leaves		*Abia, 1984*
Verticillium wilt	*Verticillium* sp.	Radish	+	Crop susceptibility		*Böning, 1958 in Fuchs et al., 1972*
Foot rot	*Fusarium solani*	Squash	+			*Gries, 1946 in Huber et al., 1985*
Alternaria leaf spot	*Alternaria solani*	Tomato	+ (10)	L - Velocity of incubation	KCl	*Bedi et al., 1983*
Alternaria leaf spot	*Alternaria solani*	Tomato	+ (65)	L - Disease incidence	KCl	*Bedi et al., 1983*
Alternaria leaf spot	*Alternaria solani*	Tomato	+ (31)	L - Size of necrotic spots		*Kiraly, 1976*
Fusarium wilt of tomato		Tomato	-	L - Nutrient solution sprayed before inoculation	KCl	*Bloom et al., 1955*
Fusarium wilt of tomato		Tomato	-	L - Nutrient solution sprayed after inoculation	KCl	*Bloom et al., 1955*
Fusarium wilt of tomato	*Fusarium oxysporum*	Tomato	+	Resistant variety		*Fisher, 1935 in Walker et al., 1945*
Fusarium wilt of tomato	*Fusarium oxysporum*	Tomato	-	Susceptible variety		*Fisher, 1935 in Walker et al., 1945*
Fusarium wilt of tomato	*Fusarium oxysporum*	Tomato	-	L - Very susceptible variety - Plants grown in balanced solution after inoculation - Crop susceptibility		*Foster et al., 1947*

Fusarium wilt of tomato	*Fusarium oxysporum*	Tomato	-	L - Partially resistant variety - Plants grown in balanced solution after inoculation - Crop susceptibility		*Foster et al., 1947*
Fusarium wilt of tomato	*Fusarium oxysporum*	Tomato	2 +	L - Very susceptible variety - 2 trials - Disease development		*Walker et al., 1946*
Leaf blight		Tomato	-			*Mc Cue, 1913 in Huber et al., 1985*
Leaf mold of tomato	*Cladosporium fulvum*	Tomato	+	Crop susceptibility		*Schaffnit et al., 1927 in Fuchs et al., 1972*
Stem rot	*Diplodia lycopersici*	Tomato	+	Attack intensity		*Esbjerg, 1937 in Stapel, 1958*
Verticillium wilt	*Verticillium albo-atrum*	Tomato	+	Crop susceptibility		*Roberts, 1943 in Fuchs et al., 1972*
Verticillium wilt		Tomato	0			*Walker et al., 1954 in Meyer, 1970*
	Botrytis cinerea	Tomato	5 +	L - Lesion length - 5 trials		*Verhoeff, 1965*
	Botrytis cinerea	Tomato	2 -	L - Lesion length - 2 trials		*Verhoeff, 1965*
Cabbage clubroot	*Plasmodiophora brassicae*	Turnip	-			*Mc New, 1953*
		Various				
Antirrhinum wilt	*Verticillium dahliae*	Antirr-hinum	+	L - Disease intensity	K_2SO_4	*Dutta et al., 1979*
Fusarium wilt of carnations	*Fusarium oxysporum*	Carna-tions	+	L - Symptoms on roots		*Gasiorkewicz, 1960*
	Fusarium sp.	Carna-tions	+			*Klinger, 1968*
Phoma root rot	*Phoma chrysanthemicola*	Chrysan-themum	0	F - Artificial inoculation - Disease index		*Menzies et al., 1976a*
Phoma root rot	*Phoma chrysanthemicola*	Chrysan-themum	2-(16)	L - % infected roots - 2 isolates		*Menzies et al., 1976b*

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0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Phoma root rot	*Phoma chrysanthemicola*	Chrysanthemum	2 -	L - Infection index - 2 isolates		*Menzies et al., 1976b*
Phoma root rot	*Phoma chrysanthemicola*	Chrysanthemum	+ (100)	L - % rotted roots - Isolate RC 5 C		*Menzies et al., 1976b*
Phoma root rot	*Phoma chrysanthemicola*	Chrysanthemum	0 (0)	L - % rotted roots - Isolate RL 5 C		*Menzies et al., 1976b*
Dry rot	*Stromatinia gladioli*	Gladiolus	+	L - Trial 1956 - Disease incidence		*Gould et al., 1961*
Dry rot	*Stromatinia gladioli*	Gladiolus	3 +	L - Trial 1957 - Disease index - 3 varieties		*Gould et al., 1961*
Fusarium basal rot	*Fusarium* sp.	Gladiolus	-	L - Disease incidence		*Gould et al., 1961*
Fusarium yellows	*Fusarium oxysporum*	Gladiolus	+ (17)	L - Number diseased plants		*Mc Clellan, 1947*
	Verticillium spp.	Hops	+ (55)	L - % plants with symptoms		*Maier, 1971*
	Verticillium spp.	Hops	+ (53)	L - % infested plants		*Maier, 1971*
Verticillium wilt	*Verticillium* spp.	Lion's mouth	+	Crop susceptibility		*Isaac, 1956 in Fuchs et al., 1972*
Mint rust	*Puccinia menthae*	Mint	+	Crop susceptibility		*Melian, 1964 in Fuchs et al., 1972*
Fruit rot	*Alternaria solani* and *Colletotrichum capsici*	Peppers	+	F - Disease intensity	KCl	*Sivaprakasam et al., 1976*
Phytophthora leaf spot	*Phytophthora* spp.	Philodendron	+	L - Number spots on leaves		*Harkness et al., 1964*
Mildew		Roses	+			*Hazelwaod, 1925 in Wingard, 1941*
Powdery mildew	*Sphaerotheca pannosa*	Roses	0 (0)	L - Velocity of fungus fructification	KCl	*Schaffnit et al., 1930*
Powdery mildew	*Sphaerotheca pannosa*	Roses	0	L - Disease intensity on leaves	KCl	*Schaffnit et al., 1930*

Powdery mildew	*Sphaerotheca pannosa*	Roses	0	L - Disease intensity on stem and wood	KCl	*Schaffnit et al., 1930*
Powdery mildew	*Sphaerotheca pannosa*	Roses	0	L - Perithecia formation	KCl	*Schaffnit et al., 1930*
Leaf spot	*Micosphaerella fragariae*	Straw-berry	-	F - Attack intensity		*Hernando et al., 1976*
Leaf spot	*Micasphaerella fragariae*	Straw-berry	6 +	F - Disease incidence - Average for 2 varieties and 3 years		*Kalon, 1981*
Strawberry fruit rot	*Botrytis cinerea*	Straw-berry	+	Disease incidence		*Powelson, 1959 in Harper et al., 1968*
Brown patch	*Rhizoctonia solani*	Turf-grasses	- (56)	F - Infection intensity	KCl	*Waddington et al., 1978*
Dollar spot	*Sclerotinia homoeocarpa*	Turf-grasses	-	L - Crop susceptibility		*Couch et al., 1960*
Dollar spot	*Sclerotinia homoeocarpa*	Turf-grasses	+ (15)	F - Trial I - Infection intensity in 1968	KCl	*Waddington et al., 1978*
Dollar spot	*Sclerotinia homoeocarpa*	Turf-grasses	- (3)	F - Trial I - Infection intensity in 1973	KCl	*Waddington et al., 1978*
Dollar spot	*Slerotinia homoeocarpa*	Turf-grasses	- (5)	F - Trial II - Infection intensity	KCl	*Waddington et al., 1978*
Helminthosporium red leaf spot	*Helminthosporium erythrospilum*	Turf-grasses	+ (30)	L - Disease severity		*Muse, 1974*
Ophiobolus patch	*Ophiobolus graminis*	Turf-grasses	2+(63)	F - Number disease spots - Average for 2 years	KCl	*Goss et al., 1967*
Red thred disease	*Corticium fuciforme*	Turf-grasses	2 +	F - Trial I - Disease index - Average for 2 years	K_2SO_4	*Cahill et al., 1983*
Red thred disease	*Corticium fuciforme*	Turf-grasses	+	F - Trial II - Disease index	K_2SO_4	*Cahill et al., 1983*
Red thred disease	*Corticium fuciforme*	Turf-grasses	+	F - Infection intensity	KCl	*Goss, 1968*
Red thred disease	*Corticium fuciforme*	Turf-grasses	- (2)	F - Trial I - Soil rich in K - Number leaves bearing mycelial strands in 1962 - Average of 3 evaluations	KCl	*Goss et al., 1971*

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0 No effect i.e. parasite development or damage unchanged

Table 187 **K-effect on fungal diseases** (continued)

English name	Latin name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Red thred disease	*Corticium fuciforme*	Turf-grasses	+ (13)	F - Trial I - Soil rich in K - Number leaves bearing mycelial strands in 1963	KCl	*Goss et al., 1971*
Red thred disease	*Corticium fuciforme*	Turf-grasses	+ (49)	F - Trial II - Low cut - Number spots		*Goss et al., 1971*
Red thred disease	*Corticium fuciforme*	Turf-grasses	+ (52)	F - Trial II - High cut - Number spots		*Goss et al., 1971*
Rizoctonia brown patch		Turf-grasses	+	L - % dead plants		*Bloom et al., 1960*
Snow mold	*Fusarium nivale*	Turf-grasses	+	F - Number spots	KCl	*Goss, 1968*
Snow mold	*Typhula itoana*	Turf-grasses	- (19)	F - Infection intensity	KCl	*Waddington et al., 1978*
Snow mold	*Typhula itoana*	Turf-grasses	- (11)	F - Diameter of infection sites	KCl	*Waddington et al., 1978*
Stripe smut	*Ustilago striiformis*	Turf-grasses	+	F - Disease index	KCl	*Hull et al., 1979*
Stripe smut	*Ustilago striiformis*	Turf-grasses	+ (57)	F - % smutted tillers	KCl	*Hull et al., 1979*
	Helminthosporium poae	Turf-grasses	+	F - Disease incidence		*Welling, 1976*
	Helminthosporium spp.	Turf-grasses	+	F - Disease incidence		*Welling, 1976*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (Insects ordered alphabetically according to Latin name)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Thysanoptera-Thrips						
Baliothrips biformis		Rice	+ (45)	F - Thrips population	KCl	*Subramanian et al., 1976*
Chloethrips oryzae		Rice	+	F - Variety Kannagi - Number insects		*Vaithilingam et al., 1976*
Chloethrips oryzae		Rice	+	F - Variety IR 20 - Number insects		*Vaithilingam et al.,* 1976
Frankliniella fusca	Tobacco thrips	Tobacco	2-(30)	F - Number thrips on plants - 2 varieties	K_2SO_4	*Semtner, 1984*
Thrips lini		Flax	+	Attack		*Doeksen, 1938 in Fuchs et al., 1972*
Thrips sp.		Cocoa	0	Attack		*Fennah, 1955 in Fuchs et al., 1972*
Thrips sp.		Peppers	+ (45)	F - Number thrips on leaves		*Balasubramanian et al., 1981*
Heteroptera-Bugs						
Blissus leucopterus	Chinch bug	Sorghum	+	L - Susceptible variety - Crop susceptibility	KCl	*Dahms et al., 1940*
Blissus leucopterus	Chinch bug	Sorghum	-	L - Resistant variety - Crop susceptibility	KCl	*Dahms et al., 1940*
Blissus leucopterus	Chinch bug	Turf-grass	+	F - Damage	KCl	*Pritchett et al., 1966*
Helopeltis theivora	Tea mosquito bug		+	Bug population		*Andrews, 1923 in Aggarwal, 1985*
Species not mentioned		Soybean	+	F - Damage		*França Neto et al., 1985*
Species not mentioned		Tea	+	Attack		*Davidson, 1925 in Fuchs et al., 1972*

Homoptera-Aphids						
Acyrthosiphon pisum	Pea aphid	Broad beans	- (9)	L - Trial I - Number larvae per plant		*El-Tigani, 1962*
Acyrthosiphon pisum	Pea aphid	Broad beans	+ (2)	L - Trial II - Number larvae per plant		*El-Tigani, 1962*
Acyrtosiphon pisum	Pea aphid	Peas	+ (5)	L - Trial with 3 weeks old plants - Fecundity		*Barker et al., 1951b*
Acyrthosiphon pisum	Pea aphid	Peas	+ (31)	L - Trial with 3 weeks old plants - Damage		*Barker, et al., 1951b*
Acyrthosiphon pisum	Pea aphid	Peas	- (39)	L - Trial with 4 weeks old plants - Fecundity		*Barker et al., 1951b*
Acyrthosiphon pisum	Pea aphid	Peas	+ (48)	L - Trial with 4 weeks old plants - Damage		*Barker et al., 1951b*
Acyrthosiphon pisum	Pea aphid	Peas	+ (41)	L - Trial I - Number larvae per plant		*El-Tigani, 1962*
Acyrthosiphon pisum	Pea aphid	Peas	- (21)	L - Trial II - Number larvae per plant		*El-Tigani 1962*
Acyrthosiphon pisum	Pea aphid	Peas	+ (19)	L - Trial III - Number larvae per plant		*El-Tigani, 1962*
Acyrthosiphon pisum	Pea aphid	Peas	0	L - Number progeny per female	K_2SO_4	*Markkula et al., 1969*
Acyrthosiphon pisum	Pea aphid	Peas	+ (27)	F - Trial 1950 - Number aphids per plant in cages		*Taylor et al., 1952*
Acyrthosiphon pisum	Pea aphid	Peas	+ (37)	L - Trial 1950 - Number aphids per plant outside		*Taylor et al., 1952*
Acyrthosiphon pisum	Pea aphid	Peas	- (14)	F - Trial 1951 - Number aphids per plant in cages		*Taylor et al., 1952*
Acyrthosiphon pisum	Pea aphid	Peas	+ (14)	F - Trial 1951 - Number aphids per plant outside		*Taylor et al., 1952*
Aphis craccivora	Groundnut aphid	Ground-nut	-	L - Fecundity		*Waghray et al., 1965*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Aphis fabae	Bean aphid	Beets	+ (63)	L - Number larvae per plant		*El-Tigani, 1962*
Aphis fabae	Bean aphid	Broad beans	-	Attack intensity		*Davidson, 1925 in El-Tigani, 1962*
Aphis fabae	Bean aphid	Broad beans	- (4)	L - Number larvae per plant		*El-Tigani, 1962*
Aphis fabae	Bean aphid	Broad beans	+	L		*Seelhorst, 1906 in El-Tigani, 1962*
Aphis gossypii	Cotton aphid	Cotton	0	Aphids incidence	KCl	*Jayaraj et al., 1964 in Singh et al., 1983*
Aphis gossypii	Cotton aphid	Cotton	+	F - Aphids incidence		*Tandon, 1973*
Aphis pomi	Apple aphid	Apples	0	L - Crop susceptibility		*Jancke, 1933*
Aphis pomi	Apple aphid	Apples	+	F - Number aphids in 1962	K_2SO_4	*Mathys et al., 1968*
Aphis pomi	Apple aphid	Apples	-	F - Number aphids in 1963	K_2SO_4	*Mathys et al., 1968*
Aphis rhamni		Potato	+	F - Number aphids	KCl	*Broadbent et al., 1952*
Brachycolus noxius		Barley	-	F - Number dead plants		*Lymareva, 1970*
Brevicoryne brassicae	Cabbage aphid	Brussels sprouts	+	F - Reproduction rate		*Van Emden, 1966*
Brevicoryne brassicae	Cabbage aphid	Brussels sprouts	+	F - Fecundity		*Van Emden, 1966*
Brevicoryne brassicae	Cabbage aphid	Cabbage	+ (49)	L - Number larvae per plant		*El-Tigani, 1962*
Brevicoryne brassicae	Cabbage aphid	Cabagge	+	F - Attack intenstiy		*Lind et al., 1914 in Stapel, 1958*
Brevicoryne brassicae	Cabbage aphid	Cauli-flower	+	Aphids incidence		*Quanjer, 1928*
Doralis rhamni		Potato	- (15)	F - Number larvae		*Völk et al., 1952*
Eriosoma lanigerum	Woolly apple aphid	Apples	0			*Helbig, 1940 in El-Tigani, 1962*

Eriosoma lanigerum	Woolly apple aphid	Apples	2 +	L - Infestation index - 2 trials		*Jancke, 1933*
Eriosoma lanigerum	Woolly apple aphid	Apples	-	F - Infestation index in 1931	KCl	*Jancke, 1933*
Eriosoma lanigerum	Woolly apple aphid	Apples	+	F - Infestation index in 1932	KCl	*Jancke, 1933*
Eriosoma lanigerum	Woolly apple aphid	Apples	+	Aphids multiplication		*Lambert, 1932 in El-Tigani, 1962*
Eriosoma lanigerum	Woolly apple aphid	Apples	+			*Scheller, 1932 in El-Tigani, 1962*
Eriosoma lanigerum	Woolly apple aphid	Crop un-specified	+	Infestation		*Loewel, 1936 in Eckstein et al., 1937*
Eriosoma lanigerum	Woolly apple aphid	Crop un-specified	+	Infestation		*Ludwigs, 1936 in Eckstein et al., 1937*
Eriosoma lanigerum	Woolly apple aphid	Red currant	+			*Trummer, 1940 in El-Tigani, 1962*
Lipaphis erysimi	Mustard aphid	Mustard	- (1)	L - Susceptible variety - Development velocity		*Kundu et al., 1967*
Lipaphis erysimi	Mustard aphid	Mustard	- (2)	L - Susceptible variety - Reproduction rate		*Kundu et al., 1967*
Macrosiphum euphorbiae	Potato aphid	Lettuce	2+(30)	L - Number larvae per plant - 2 trials		*El-Tigani, 1962*
Macrosiphum euphorbiae	Potato aphid	Potato	+	F - Number aphids	KCl	*Broadbent et al., 1952*
Macrosiphum euphorbiae	Potato aphid	Potato	+ (7)	L - Trial I - Number larvae per plant		*El-Tigani, 1962*
Macrosiphum euphorbiae	Potato aphid	Potato	- (52)	L - Trial II - Number larvae per plant		*El-Tigani, 1962*
Macrosiphum euphorbiae	Potato aphid	Potato	+ (17)	F - Trial 1950 - Number aphids in cage		*Taylor et al., 1952*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Macrosiphum euphorbiae	Potato aphid	Potato	- (27)	F - Trial 1951 - Number aphids in cage		*Taylor et al., 1952*
Macrosiphum euphorbiae	Potato aphid	Potato	- (1)	F - Trial 1951 - Number aphids on 10 feet row		*Taylor et al., 1952*
Macrosiphum euphorbiae	Potato aphid	Potato	- (16)	L - Number nymphs per adult		*Taylor et al., 1952*
Macrosiphum euphorbiae	Potato aphid	Potato	- (15)	L - Number adults per plant		*Taylor et al., 1952*
Myzus persicae	Green peach aphid	Beets	0	L - Number progeny per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Broad beans	+	L - Number progeny per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Brussels sprouts	+	L - Reproduction rate		*Van Emden, 1966*
Myzus persicae	Green peach aphid	Brussels sprouts	+	L - Fecundity		*Van Emden, 1966*
Myzus persicae	Green peach aphid	Chrysan-themum	+	L - Number progeny per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Chrysan-themum	10 +	L - Trial I - Number descendants per female - 10 varieties		*Markkula , Roukka and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Chrysan-themum	6 +	L - Trial II - Number descendants per female - 6 varieties		*Markkula, Roukka and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Chrysan-themum	10 +	L - Trial I - Aphids life span - 10 varieties		*Markkula, Roukka and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Chrysan-themum	6 +	L - Trial II - Aphids life span - 6 varieties		*Markkula, Roukka and Tiittanen, 1969*
Myzus persicae	Green peach aphid	Nastur-rium	+ (3)	L - Development period		*Barker et al., 1951a*
Myzus persicae	Green peach aphid	Potato	+	F - Number aphids	KCl	*Broadbent et al., 1952*

Myzus persicae	Green peach aphid	Potato	+ (53)	L - Number larvae per plant		*El-Tigani, 1962*
Myzus persicae	Green peach aphid	Potato	-	L - Preference for leaves	KCl	*Hofferbert et al.,1948*
Myzus persicae	Green peach aphid	Potato	+ (44)	L - Aphid development		*Janssen, 1929b in Jancke, 1933*
Myzus persicae	Green peach aphid	Potato	+ (8)	F - Long-term trial - Number aphids per plant in 1938	KCl	*Klapp, 1951*
Myzus persicae	Green peach aphid	Potato	+ (31)	F - Long-term trial - Number aphids per plant in 1938	K_2SO_4	*Klapp, 1951*
Myzus persicae	Green peach aphid	Potato	+ (45)	F - Long-term trial - Number aphids per 100 leaves in 1951	KCl	*Klapp, 1951*
Myzus persicae	Green peach aphid	Potato	+ (40)	F - Long-term trial - Number aphids per 100 leaves in 1951	K_2SO_4	*Klapp, 1951*
Myzus persicae	Green peach aphid	Potato	+	Aphid multiplication		*Vijverberg, 1965 in Fuchs et al., 1972*
Myzus persicae	Green peach aphid	Potato	+ (8)	F - Number larvae	KCl	*Völk et al., 1952*
Myzus persicae	Green peach aphid	Potato	+ (30)	L - Number aphids		*Völk et al., 1952*
Myzus persicae	Green peach aphid	Potato	+ (43)	L - Number descendant larvae		*Völk et al., 1952*
Myzus persicae	Green peach aphid	Potato	+ (21)	L - Number larvae		*Völk et al., 1952*
Myzus persicae	Green peach aphid	Potato	-			*Völk et al., 1954*
Myzus persicae	Green peach aphid	Potato	+ (49)	L - Number aphids 1949	KCl	*Wünscher, 1952*
Myzus persicae	Green peach aphid	Potato	+ (49)	L - Number aphids 1949	K_2SO_4	*Wünscher, 1952*
Myzus persicae	Green peach aphid	Potato	- (6)	L - Number aphids 1950	KCl	*Wünscher, 1952*
Myzus persicae	Green peach aphid	Potato	+ (43)	L - Number aphids 1950	K_2SO_4	*Wünscher, 1952*
Myzus persicae	Green peach aphid	Tobacco	- (98)	L - Fecundity		*Michel, 1963*
Myzus persicae	Green peach aphid	Tobacco	- (4)	L - Fecundity		*Michel et al., 1964*
Myzus persicae	Green peach aphid	Tobacco	- (159)	L - Trial in greenhouse - Fecundity		*Wooldridge et al., 1968*
Myzus persicae	Green peach aphid	Tobacco	- (114)	L - Trial in greenhouse - Velocity of adult development		*Wooldridge et al., 1968*
Myzus persicae	Green peach aphid	Tobacco	- (80)	L - Trial in greenhouse - Velocity of nymphal development		*Wooldridge et al., 1968*
Myzus persicae	Green peach aphid	Tobacco	+ (5)	L - Trial in insectary - Fecundity		*Wooldridge et al., 1968*
Myzus persicae	Green peach aphid	Tobacco	+ (20)	L - Trial in insectary - Velocity of adult development		*Wooldridge et al., 1968*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Myzus persicae	Green peach aphid	Tobacco	+ (25)	L - Trial in insectary - Velocity of nymphal development		*Wooldridge et al., 1968*
Rhopalosiphum fitchi	Apple grain aphid	Oats	+ (4)	L - Number aphids - Average of 2 evaluations		*Coon, 1959*
Rhopalosiphum padi	Apple grain aphid	Maize	+ (24)	L - Number larvae per plant		*El-Tigani, 1962*
Rhopalosiphum padi	Apple grain aphid	Oats	- (5)	L - Trial I - Number larvae per plant		*El-Tigani, 1962*
Rhopalosiphum padi	Apple grain aphid	Oats	+ (30)	L - Trial II - Number larvae per plant		*El-Tigani, 1962*
Rhopalosiphum padi	Apple grain aphid	Wheat	+ (50)	L - Number larvae per plant		*El-Tigani, 1962*
Schizaphis graminum	Greenbug	Sorghum	2 +	L - Resistant variety - Number greenbugs - Average for low and medium temperatures		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	-	L - Resistant variety - Number greenbugs - High temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	0	L - Susceptible variety - Number greenbugs - Low temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	+	L - Susceptible variety - Number greenbugs - Medium temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	-	L - Susceptible variety - Number greenbugs - High temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	2 +	L - Resistant variety - Crop tolerance - Average for low and medium temperatures		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	-	L - Resistant variety - Crop tolerance - High temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	3 -	L - Susceptible variety - Crop tolerance - Average for low, medium and high temperatures		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	2 +	L - Resistant variety - Foliage loss - Average for low and medium temperatures		*Schweissing et al., 1979*

Schizaphis graminum	Greenbug	Sorghum	-	L - Resistant variety - Foliage loss - High temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	0	L - Susceptible variety - Foliage loss - Low temperature		*Schweissing et al., 1979*
Schizaphis graminum	Greenbug	Sorghum	2 -	L - Susceptible variety - Foliage loss - Average for medium and high temperatures		*Schweissing et al., 1979*
Therioaphis maculata	Spotted alfalfa aphid	Lucerne	+ (87)	L - Resistant variety - Number aphids		*Kindler et al., 1970*
Therioaphis maculata	Spotted alfalfa aphid	Lucerne	- (3)	L - Susceptible variety - Number aphids		*Kindler et al., 1970*
Therioaphis maculata	Spotted alfalfa aphid	Lucerne	+ (87)	L - Resistant clone C-84 - Number aphids		*Mc Murtry, 1962 in Leath et al., 1974*
Therioaphis maculata	Spotted alfalfa aphid	Lucerne	+ (51)	L - Resistant clone C-902 - Number aphids		*Mc Murtry, 1962 in Leath et al., 1974*
Therioaphis maculata	Spotted alfalfa aphid	Lucerne	- (2)	L - Susceptible clone Caliverde - Number aphids		*Mc Murtry, 1962 in Leath et al., 1974*
Toxoptera graminum	Greenbug	Cereals	+	L - Aphid development		*Hasemann, 1946 in El-Tigani, 1962*
Toxoptera graminum	Greenbug	Wheat	2-(12)	L - Artificial infestation - Number aphids - 2 trials		*Daniels, 1957*
Species not mentioned		Broad beans	+	F - Soil poor in K - No. aphids - Long term trial		*Jentsch, 1933*
Species not mentioned		Broad beans	+	F		*Quanjer, 1929*
Species not mentioned		Buck-wheat	+	L	K_2SO_4	*Loew, 1924*
Species not mentioned		Parsnip	+	F		*Quanjer, 1929*
Species not mentioned		Peppers	+ (32)	F - Number aphids		*Balasubramanian* et *al., 1981*
Species not mentioned		Potato	+	F - Number aphids	KCl	*Broadbent et al., 1952*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Species not mentioned		Potato	+ (69)	L - Number descendants		*Janssen, 1929a*
Species not mentioned		Potato	0	F - Trial I	KCl	*Krüger, 1951*
Species not mentioned		Potato	0	F - Trial I	K_2SO_4	*Krüger, 1951*
Species not mentioned		Potato	0	F - Trial II	KCl	*Krüger, 1951*
Species not mentioned		Potato	0	F - Trial II	K_2SO_4	*Krüger, 1951*
Species not mentioned		Potato	+ (28)	F - Long-term trial - Number aphids in 1948 - Average of 3 evaluations		*Krüger, 1951*
Species not mentioned		Potato	+ (39)	F - Long-term trial - Variety Mittelfrühe - Number aphids in 1949		*Krüger, 1951*
Species not mentioned		Potato	+ (18)	F - Long-term trial - Variety Ackersegen - Number aphids in 1949 - Average of 2 evaluations		*Krüger, 1951*
Species not mentioned		Potato	30	F - 3 trials	KCl	*Münster, 1964*
Species not mentioned		Potato	30	F - 3 trials	K_2SO_4	*Münster, 1964*
Species not mentioned		Potato	0	F		*Ross et al., 1947 in El-Tigani, 1962*
Species not mentioned		Potato	0	F - Trial 1948 - Number aphids	KCl	*Völk et al., 1952*
Species not mentioned		Rye	-	L - Aphid incidence	K_2SO_4	*Eglits, 1934*
Species not mentioned		Sugar-beet	+	F - Soil poor in K-No. aphids - Long term trial		*Jentsch, 1933*
Species not mentioned		Sugar-beet	+	F		*Quanjer, 1929*

Species not mentioned		White mustard	+			*Wilfarth et al., 1909 in El-Tigani, 1962*
Homoptera-Leaf-hoppers						
Empoasca devastans	Cotton jassid	Cotton	0	Insect incidence		*Jayaraj et al., 1964 in Singh et al., 1983*
Empoasca devastans	Cotton jassid	Cotton	0	F - Number insects		*Tandon, 1973*
Empoasca fabae	Potato leafhopper	Lucerne	+	F - Insect multiplication		*Smith et al., 1959 in El-Tigani, 1962*
Nephotettix virescens	Green leafhopper	Rice	+ (35)	F - Number leafhoppers	KCl	*Subramanian et al. 1976*
Nephotettix virescens	Green leafhopper	Rice	+	F - Variety Kannagi - Insect incidence		*Vaithilingam et al. 1976*
Nephotettix virescens	Green leafhopper	Rice	+	F - Variety IR 20 - Insect incidence		*Vaithilingham et al., 1976*
Zygina maculifrons	Blue jassid	Rice	+	F - Variety Kannagi - Insect incidence		*Vaithilingam et al. 1976*
Zygina maculifrons	Blue jassid	Rice	+	F - Variety IR 20 - Insect incidence		*Vaithilingam et al., 1976*
	Green leafhopper	Rice	2 +(14)	F - Leafhopper population - 2 varieties		*PRII, 1986*
Species not mentioned		Lucerne	+	Leafhoppers multiplication		*Rohde, 1948 in El-Tigani, 1962*
Species not mentioned		Eggplant	+ (13)	F - Number leafhoppers - Average of 2 evaluations		*Sinha et al., 1976*
Homoptera-Mealybugs						
Phenacoccus manihoti	Cassava mealybug	Cassava	- (14)	L - Number eggs per female - Variety TMS 30001		*Lema et al., 1983*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Phenacoccus manihoti	Cassava mealybug	Cassava	+ (9)	L - Number eggs per female - Variety TMS 30572		*Lema et al., 1983*
Planococcus citri	Citrus mealybug	Cocoa	+			*Fennah, 1957 in El-Tigani, 1962*
Pseudococcus comstocki	Comstock mealybug	Apples	+	F		*Schoene, 1941 in Leath et al., 1974*
Homoptera-Planthoppers						
Nilaparvata lugens	Brown planthopper	Rice	- (17)	F - Long-term trial - Planthopper population - Average of 3 evaluations		*Abraham, 1957*
Nilaparvata lugens	Brown planthopper	Rice	+ (62)	F - Number planthoppers	KCl	*Ittyavirah et al., 1979*
Nilaparavata lugens	Brown planthopper	Rice	+ (15)	F - Number planthoppers	KCl	*Subramanian et al. 1976*
Nilaparvata lugens	Brown planthopper	Rice	+	F - Number insects		*Tandon, 1973*
Nilaparvata lugens	Brown planthopper	Rice	+	F - Variety Kannagi - Insect incidence		*Vaithilingam et al., 1976*
Nilaparvata lugens	Brown planthopper	Rice	+	F - Variety IR 20 - Insect incidence		*Vaithilingam et al., 1976*
Nilaparvata lugens	Brown planthopper	Rice	+	L - Variety Kannagi - Feeding		*Vaithlingam et al., 1976*
Nilaparvata lugens	Brown planthopper	Rice	+	L - Variety IR 20 - Feeding		*Vaithilingam et al., 1976*
Nilaparvata lugens	Brown planthopper	Rice	5 +	L - Insect preference - 5 varieties		*Vaithilingam et al., 1985*
Pyrilla pusana	Sugarcane leafhopper	Sugar-cane	- (10)	Number adults		*Khan et al., 1966*

Pyrilla pusana	Sugarcane leafhopper	Sugar-cane	+ (44)	Number nymphs		*Khan et al., 1966*
Pyrilla pusana	Sugarcane leafhopper	Sugar-cane	- (6)	Number egg clusters		*Khan et al., 1966*
Pyrilla pusana	Sugarcane leafhopper	Sugar-cane	+ (12)	Number eggs per cluster		*Khan et al., 1966*
Pyrilla spp.		Sugar-cane	- (3)	F - Number eggmasses in 1952	KCl	*Srivastava, 1957*
Pyrilla spp.		Sugar-cane	+ (11)	F - Number eggmasses in 1953	KCl	*Srivastava, 1957*
Saccharosydne saccharivora		Sugar-cane	0	L - Trial with young cane - Number eggs per female		*Metcalf, 1970*
Saccharosydne saccharivora		Sugar-cane	0	L - Trial with ratoon cane - Number eggs per female		*Metcalf, 1970*
	Brown planthopper	Rice	2+(18)	F - Planthopper population - 2 varieties		*PRII, 1986*
	Brown planthopper	Rice	2+(12)	L - Number eggs - 2 varieties		*PRII, 1986*
	Brwon planthopper	Rice	2+(18)	L - Number nymphs hatched - 2 varieties		*PRII, 1986*
	Brown planthopper	Rice	2+(26)	L - Nymphal duration - 2 varieties		*PRII, 1986*
	Brown planthopper	Rice	2+(24)	L - Nymphal survival - 2 varieties		*PRII, 1986*
	Brown planthopper	Rice	2+(25)	L - Nymph population - 2 varieties		*PRII, 1986*
	Brown planthopper	Rice	2+(46)	L - Adult feeding extent - 2 varieties		*PRII, 1986*
Homoptera-Scales						
Eulecanium corni	Robinia scale	Robinia	+(97)	F - Soil low in K - Number insects		*Brüning et al., 1971*
Eulecanium corni	Robinia scale	Robinia	+(43)	F - Soil low in K - Number dead trees		*Brüning et al., 1971*
Eulecanium rufulum	Oak scale	Oak	0	F - Soil low in K - Artificial infestation - Number adults in 1967		*Brüning et al., 1971*
Eulecanium rufulum	Oak scale	Oak	+	F - Soil low in K - Artificial infestation - Number adults in 1968		*Brüning et al., 1971*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Eulecanium rufulum	Oak scale	Oak	+ (93)	F - Soil low in K - Natural infestation - Number insects		*Brüning et al., 1971*
Eulecanium rufulum	Oak scale	Oak	+ (33)	L - Preference for leaves		*Brüning et al., 1971*
Lepidosaphes beckii	Purple scale	Citrus	+ (45)	F - Number scales on fruits 1970	K_2SO_4	*Chaboussou, 1974*
Lepidosaphes beckii	Purple scale	Citrus	+ (58)	F - Number scales on twigs 1970	K_2SO_4	*Chaboussou, 1974*
Lepidosaphes beckii	Purple scale	Citrus	+ (65)	F - Number scales on leaves in October 1970	K_2SO_4	*Chaboussou, 1974*
Lepidosaphes beckii	Purple scale	Citrus	+ (65)	F - Number scales on leaves in April 1971	K_2SO_4	*Chaboussou, 1974*
Melanaspis glomerata	Sugarcane scale	Sugar-cane	+ (27)	F - % infested nodes		*Raghunath, 1983*
Parlatoria ziziphi		Citrus	+ (59)	F - Number scales on leaves	K_2SO_4	*Chaboussou, 1971*
Parlatoria ziziphi		Citrus	+ (81)	F - Number scales on twigs	K_2SO_4	*Chaboussou, 1971*
Saissetia oleae	Black scale	Citrus	+ (31)	F - Number scales on leaves in 1970 - Average of 2 evaluations	K_2SO_4	*Chaboussou, 1971*
Saissetia oleae	Black scale	Citrus	+ (28)	F - Number scales on leaves in April 1971	K_2SO_4	*Chaboussou, 1971*
Saissetia oleae	Black scale	Citrus	+ (49)	F - Number scales on fruits	K_2SO_4	*Chaboussou, 1971*
Saissetia oleae	Black scale	Citrus	+ (13)	F - Number scales on twigs	K_2SO_4	*Chaboussou, 1971*
Homoptera - White-flies						
Bemisia tabaci	Sweet potato whitefly	Squash	- (2)	F - Number eggs	K_2SO_4	*El-Bebeidi et al., 1951*
Bemisia tabaci	Sweet potato whitefly	Squash	- (13)	F - Number nymphs	K_2SO_4	*El-Bebeidi et al., 1951*

Lepidoptera						
Chilo auricilus	Stalk borer	Sugar-cane	0 (0)	F - Stalk borer incidence		*Pandey, 1975*
Chilo infusca-tellus	Sugarcane shoot borer	Sugar-cane	+ (6)	F - Attack intensity		*Sithananthan and Daniel, 1972*
Chilo infusca-tellus	Sugarcane shoot borer	Sugar-cane	+ (2)	F - Infestation intensity		*Shitananthan and Srinivasan, 1972*
Chilo infusca-tellus	Sugarcane shoot borer	Sugar-cane	+ (21)	F - Number surviving mother shoots		*Sithananthan and Srinivasan, 1972*
Chilo sacchari-phagus	Internode borer	Sugar-cane	- (1)	Wet season - Insect incidence		*Hatmosoewarno, 1970, in David et al., 1985*
Chilo sacchari-phagus	Internode borer	Sugar-cane	+ (13)	Dry season - Insect incidence		*Hatmosoeowarno, 1970 in David et al., 1985*
Chilo suppress-alis	Rice stem borer	Rice	+ (19)	L - Trial I - Percentage surviving larvae		*Hirano et al., 1961*
Chilo suppress-alis	Rice stem borer	Rice	+ (7)	L - Trial I - Weight of larvae		*Hirano et al., 1961*
Chilo suppress-alis	Rice stem borer	Rice	+ (17)	L - Trial II - Percentage surviving larvae		*Hirano et al., 1961*
Chilo suppress-alis	Rice stem borer	Rice	- (10)	L - Trial II - Weight of larvae		*Hirano et al., 1961*
Chilo suppress-alis	Rice stem borer	Rice	- (5)	L - Trial III - Percentage surviving larvae		*Hirano et al., 1961*
Chilo suppress-alis	Rice stem borer	Rice	0 (0)	L - Trial III - Weight of larvae		*Hirano et al., 1961*
Choristoneura occidentalis	Western spruce budworm	Larch	2+(23)	F - % injured fascicles - 2 trials	KCl	*Schmidt et al., 1983*
Choristoneura occidentalis	Western spruce budworm	Larch	2+(7)	F - % damaged lateral shoots - 2 trials	KCl	*Schmidt et al., 1983*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Choristoneura occidentalis	Western spruce budworm	Larch	- (13)	F - Trial Lower Cottonwood - % damaged terminal shoots	KCl	*Schmidt et al., 1983*
Choristoneura occidentalis	Western spruce budworm	Larch	+ (23)	F - Trial Rice Ridge - % damaged terminal shoots	KCl	*Schmidt et al., 1983*
Cnaphalocrocis medinalis	Leaf roller	Rice	+ (6)	F - Damage	KCl	*Subramanian et al., 1976*
Cnaphalocrocis medinalis	Leaf roller	Rice	+ (89)	F - Variety Kannagi - Insect incidence	KCl	*Vaithilingam et al., 1976*
Cnaphalocrocis medinalis	Leaf roller	Rice	+ (89)	F - Variety IR 8 - Insect incidence		*Vaithilingam et al., 1976*
Cnaphalocrocis medinalis	Leaf roller	Rice	2+(25)	F - Damage - 2 varieties	KCl	*Vaithilingam et al., 1982*
Dioryctria splendidella		Pine	- (32)	F - Number attacked trees		*Guinaudeau, 1969*
Heliothis armigera	Capitulum borer	Sun-flower	+ (13)	F - Damage	KCl	*Rangarajan et al., 1974*
Heliothis zea	Corn earworm	Maize	- (6)	L - Damage		*Wisemann et al., 1973*
Heliothis zea	Corn earworm	Maize	- (22)	L - Weight of larvae		*Wisemann et al., 1973*
Heliothis zea	Corn earworm	Maize	+ (3)	L - Life span of larvae		*Wisemann et al., 1973*
Leucinodes orbonalis	Fruit borer	Eggplant	+ (14)	F - % affected fruits		*Sinha et al., 1976*
Lymantria dispar		Spruce	+ (33)	L - Development of larvae		*Merker, 1958*
Lymantria monacha		Spruce	- (19)	L - Development of larvae		*Merker, 1958*
Manduca sexta	Tobacco hornworm	Tobacco	4-(47)	F - Soil low in K - Number hornworms - 4 varieties	K_2SO_4	*Semtner et al., 1980*
Pieris brassicae	Large cabbage white	Cruci-ferae	0 (0)	Number dead larvae		*Allen et al., 1957*
Pieris brassicae	Large cabbage white	Cruci-ferae	-	Weight of larvae		*Allen et al., 1957*
Pieris brassicae	Large cabbage white	Cruci-ferae	-	Velocity of larval development		*Allen et al., 1957*

Pyrausta nubilalis	European corn borer	Maize	+ (2)	L - % surviving larvae		*Taylor et al., 1952*
Pyrausta nubilalis	European corn borer	Maize	- (11)	L - Velocity of larval growth		*Taylor et al., 1952*
Pyrausta nubilalis	European corn borer	Maize	- (19)	F - Artificial infestation - Number borers per plant		*Taylor et al., 1952*
Pyrausta nubilalis	European corn borer	Maize	- (2)	F - Artificial infestation - Velocity of larval growth		*Taylor et al., 1952*
Rhyacionia buoliana	European pine shoot moth	Pine	2+(40)	F - Soil low in K - Number larvae - Average for 2 years		*Nef, 1967*
Rhyacionia buoliana	European pine shoot moth	Pine	- (15)	F - Long-term trial - % shoot-ends attacked - 3 years after fertilization		*Schindler et al., 1964*
Rhyacionia buoliana	European pine shoot moth	Pine	+ (7)	F - Long-term trial - % shoot-ends attacked - 6 years after fertilization		*Schindler et al., 1964*
Rhyacionia buoliana	European pine shoot moth	Pine	- (40)	F - Long-term trial - % shoot-ends attacked - 7 years after fertilization		*Schindler et al., 1964*
Rhyacionia spp.		Pine	2+(31)	F - Soils poor in K - % attacked trees - 2 trials	KCl	*Pritchett et al., 1972*
Spodoptera frugiperda	Fall armyworm	Maize	- (11)	L - Damage on early maize		*Wiseman et al., 1973a*
Spodoptera frugiperda	Fall armyworm	Maize	- (32)	L - Damage on late maize		*Wiseman et al., 1973a*
Spodoptera frugiperda	Fall armyworm	Maize	- (4)	L - Weight of larvae		*Wiseman et al., 1973a*
Spodoptera frugiperda	Fall armyworm	Maize	+ (15)	L - % surviving larvae		*Wiseman et al., 1973a*
Spodoptera frugiperda	Fall armyworm	Maize	0 (0)	L - Velocity of pupation		*Wiseman et al.,1973a*
Spodoptera frugiperda	Fall armyworm	Maize	- (2)	L - Weight of pupae		*Wiseman et al.,1973a*
Spodoptera frugiperda	Fall armyworm	Maize	+	F - Damage index		*Wiseman et al.,1973b*
Spodoptera frugiperda	Fall armyworm	Maize	- (28)	L - Weight of larvae		*Leuck, 1972*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Spodoptera frugiperda	Fall armyworm	Pearl millet	- (67)	L - Mortality of larvae		*Leuck, 1972*
Spodoptera frugiperda	Fall armyworm	Pearl millet	- (1)	L - Velocity of population		*Leuck, 1972*
Spodoptera frugiperda	Fall armyworm	Pearl millet	+ (8)	L - Weight of pupae		*Leuck, 1972*
Spodoptera frugiperda	Fall armyworm	Pearl millet	- (3)	L - Velocity of adult emergence		*Leuck, 1972*
Spodoptera frugiperda	Fall armyworm	Pearl millet	+	L - Larval feeding index		*Leuck, 1972*
Spodoptera frugiperda	Fall armyworm	Pearl millet	+ (6)	L - % emerged moths		*Leuck, 1972*
Spodoptera litura	Leaf caterpillar	Sunflower	+ (24)	F - Number larvae	KCl	*Rangarajan et al., 1974*
Tryporyza incertulas	Yellow borer	Rice	+ (15)	F - % white earheads		*John et al., 1980*
Tryporyza incertulas	Yellow borer	Rice	3-(7)	F - % deadhearts - Average for 3 nitrogen forms		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Tryporyza incertulas	Yellow borer	Rice	3-(13)	F - % white earheads - Average for 3 nitrogen forms		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Tryporyza incertulas	Yellow borer	Rice	2-(7)	F - % deadhearts - Average for 2 row spacings		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Tryporyza incertulas	Yellow borer	Rice	- (32)	F - % white earheads - Narrow row spacing		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Tryporyza incertulas	Yellow borer	Rice	+ (12)	F - % white earheads - Wide row spacing		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Tryporyza incertulas	Yellow borer	Rice	+	F - Insect incidence		*Tandon, 1973*
	Cotton leaf roller	Cotton	+ (29)	F - Insect incidence	KCl	*Muthuvel et al., 1982*

	Leaf roller	Rice	2+(45)	F - Damage - 2 varieties		*PRII, 1986*
	Stem borer	Rice	2+(27)	F - % dead hearts - 2 varieties		*PRII, 1986*
	Top borer	Sugar-cane	0 (0)	Wet season - Borer incidence		*Hatmosoewarno, 1970 in David et al., 1985*
	Top borer	Sugar-cane	- (70)	Dry season - Borer incidence		*Hatmosoewarno, 1970 in David et al., 1985*
Coleoptera						
Brachyrhinus sulcatus	Black vine weevil	Straw-berries	+ (21)	L - Trial 1960 - Weewil fecundity		*Cram, 1965*
Brachyrhinus sulcatus	Black vine weevil	Straw-berries	- (5)	L - Trial 1961 - Weewil fecundity		*Cram, 1965*
Brachyrhinus sulcatus	Black vine weevil	Straw-berries	- (3)	L - Trial 1962 - Weewil fecundity		*Cam, 1965*
Cylas formi-carius	Sweet potato weevil	Sweet potato	4+(18)	F - % infested tubers - 4 varieties		*Das et al., 1985*
Cylas formi-carius	Sweet potato weevil	Sweet potato	+ (35)	Attack intensity		*Nair et al., 1975 in Das et al., 1985*
Diabrotica spp.	Corn rootworm	Maize	+ (31)	F - Damage		*Hill et al., 1948*
Epitrix hirti-pennis	Tobacco flea beetle	Tobacco	4-(47)	F - Soil low in K - Number insects - 4 varieties - Average of 4 evaluations		*Semtner et al., 1980*
Lema melanopus	Cereal leaf beetle	Cereals	+	Attack intensity		*Ljubenov, 1956 in El-Tigani, 1962*
Lema sp.		Cereals	+			*Bussler, 1964 in Krauss, 1969*
Lissorhoptrus brevirostris		Rice	+	F - Number larvae	KCl	*Meneses et al., 1980*
Lissorhoptrus brevirostris		Rice	+	F - Number pupae	KCl	*Meneses et al., 1980*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 188 **K-effect on insects** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Lissorhoptrus brevirostris		Rice	+	F - Number adults	KCl	*Meneses et al., 1980*
Lissorhoptrus brevirostris		Rice	+ (18)	F - Damage on leaves - Average of 4 evaluations	KCl	*Meneses et al., 1980*
Phaedon cochleariae	Mustard beetle	Water-cress	-(236)	L - Egg production		*Allen et al., 1956*
Pempheres offinis	Stem weevil	Cotton	2+(4)	F - Long-term trials - Attack intensity - 2 trials		*Nath, 1936*
Pempheres offinis	Stem weevil	Cotton	2+36)	F - Long-term trials - % dead plants - 2 trials		*Nath, 1936*
Pissodes strobu	White pine weevil	Pine	- (36)	F - Soil low in K - % weeviled trees		*Xydias et al., 1964*
Pissodes strobu	White pine weevil	Pine	- (64)	F - Soil low in K - Number weevils		*Xydias et al., 1964*
Sciopithes obscurus	Obscure root weevil	Straw-berries	+ (2)	L - Weevil fecundity		*Cram, 1965*
Scolytus rugolosus	Shot-hole borer	Tea	+ (14)	F - Damage		*Gadd, 1943*
Sitona lineatus	Pea weevil	Pea	0			*Tulisalo et al., 1970 in Jones, 1976*
Sitophilus oryzae	Rice weevil	Maize	-	Damage		*Eden, 1953*
	Cotton stem weevil	Cotton	+ (17)	F - Insect incidence	KCl	*Muthuvel et al., 1982*
	Flea beetles	Flax	+	Attack intensity		*Steigerwald, 1938 in Scharrer et al., 1956*
	Wireworms	Cereals	+	Wireworm development		*Anonym, 1923 in El-Tigani, 1962*
	Wireworms	Potato	+	Wireworm development		*Anonym, 1924 in El-Tigani, 1962*
Hymenoptera						
Cephus cinctus	Wheat stem sawfly	Wheat	+ (13)	F - % infested stems	KCl	*Luginbill et al., 1954*
Cephus cinctus	Wheat stem sawfly	Wheat	+ (34)	F - % cut stems	KCl	*Luginbill et al., 1954*

Diprion piri	Pine sawfly	Pine	0	L - Trial 1962 - Number larvae		*Nef, 1966 in Merker, 1969*
Diprion pini	Pine sawfly	Pine	+	L - Trial 1963 - Number larvae		*Nef, 1966 in Merker 1969*
Pristiphora abietina	Small pine sawly	Spruce	-	L - Development of larvae		*Merker, 1958*
Diptera						
Chlorops taeniopus	Goutfly	Barley	+	Insect population		*Frew, 1924 in Aggarwal, 1985*
Hydrellia sasakii	Rice whorl maggot	Rice	- (1)	F - % damaged tillers		*Saroja et al., 1981*
Hydrellia sasakii	Rice whorl maggot	Rice	+ (35)	Damage	KCl	*Subramanian et al., 1976*
Oscinella frit	Frit fly	Barley	0	F - Long-term trial - % dead plants		*Lymareva, 1969*
Oscinella frit	Frit fly	Oats	+	F - Number eggs		*Trolldenier, 1969*
Pachydiplosis oryzae	Rice gall fly	Rice	-	L - Insect incidence		*Israel et al., 1967*
Pachydiplosis oryzae	Rice gall fly	Rice	- (12)	F - Trial 1968 - N applied as ammonium sulphate - Insect incidence - Average of 2 evaluations		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Pachydiplosis oryzae	Rice gall fly	Rice	+ (13)	F - Trial 1968 - N applied as urea - Insect incidence - Average of 2 evaluations		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Pachydiplosis oryzae	Rice gall fly	Rice	+ (1)	F - Trial 1968 - N applied as calcium ammonium nitrate - Insect incidence - Average of 2 evaluations		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Pachydiplosis oryzae	Rice gall fly	Rice	- (1)	F - Trial 1969 - Insect incidence - Average of 2 evaluations		*Prakasa Rao, 1972 in Prakasa Rao, 1985*
Phorbia coarctata	Wheat bulb fly	Wheat	+	F		*Johnson et al., 1969 in Jones, 1976*
Tipula sp.		Grass-land	+		Kai-nite	*Sommerkamp, 1929*
	Whorl maggot	Rice	2+(39)	F - Damage - 2 varieties		*PRII, 1986*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 189 **K-effect on mites** (Mites ordered alphabetically according to Latin name)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Aceria sheldoni	Citrus bud mite	Citrus	5 +	L - Number mites - 5 trials		*Sternlicht et al., 1975*
Aceria sheldoni	Citrus bud mite	Lemon	+ (16)	L - Number mites		*Sternlicht et al.,1975*
Brevipalpus sp.		Citrus	+ (67)	F - Foliar spray - Number insects	KNO_3	*Chaboussou, 1976*
Bryobia praetiosa	Clover mite	Beans	-	L - Mite population		*Morris, 1961*
Bryobia praetiosa	Clover mite	Beans	+ (6)	L - Longevity		*Morris, 1961*
Bryobia praetiosa	Clover mite	Beans	+ (19)	L - Number eggs		*Morris, 1961*
Bryobia praetiosa	Clover mite	Beans	- (3)	L - Hatching percentage		*Morris, 1961*
Mononychellus sp.		Cassava	+	Mite incidence		*Howeler, 1985*
Mononychellus tanajoa		Cassava	0	Attack intensity	KCl	*Farias et al., 1982*
Mononychellus tanajoa		Cassava	-	Number mites	KCl	*Farias et al., 1982*
Panonychus ulmi	European red mite	Apples	2 -	F - Mite population - 2 years		*Mathys et al., 1968*
Panonychus ulmi	European red mite	Grapes	+	Number eggs		*Besse et al., 1963 in Fuchs et al., 1972*
Tetranychus atlanticus		Soybeans	4+(14)	L - Progeny per female - 4 trials		*Cannon et al., 1965*
Tetranychus bimaculatus		Tomato	- (20)	L - Mite population		*Rodriguez, 1951*
Tetranychus spp.		Apples	0	F		*Hamstead et al., 1953 in El-Tigani, 1962*
Tetranychus spp.		Beans	-	Life length		*Watson, 1964 in Fuchs et al., 1972*
Tetranychus spp.		Beans	-	Fecundity		*Watson, 1964 in Fuchs et al., 1972*

Tetranychus telarius	Carmine mite	Beans	+ (8)	L - OP-susceptible mites		*Henneberry, 1962*
Tetranychus telarius	Carmine mite	Beans	- (16)	L - OP-resistant mites		*Henneberry, 1962*
Tetranychus telarius	Carmine mite	Beets	0	L - Number descendants per female		*Markkula and Tiittanen, 1969*
Tetranychus telarius	Carmine mite	Broad beans	-	L - Number descendants per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Tetranychus telarius	Carmine mite	Chrysan-themum	+	L - Number descendants per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Tetranychus telarius	Carmine mite	Chrysan-themum	5 +	L - Number descendants per female - 5 varieties		*Markkula, Roukka and Tiittanen, 1969*
Tetranychus telarius	Carmine mite	Chrysan-themum	5 -	L - Number descendants per female - 5 varieties		*Markkula, Roukka and Tiittanen, 1969*
Tetranychus telarius	Carmine mite	Cucum-ber	-	L - Number descendants per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Tetranychus telarius	Carmine mite	Tomato	0	L - Number descendants per female	K_2SO_4	*Markkula and Tiittanen, 1969*
Tetranychus urticae	Twospotted spider mite	Apples	- (23)	L - Number eggs per mite		*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Apples	- (16)	L - Mortality of adults		*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Apples	0	L - Fecundity		*Storms, 1969*
Tetranychus urticae	Twospotted spider mite	Beans	3 +	L - Number mites - 3 trials		*Fritsche et al., 1957*
Tetranychus urticae	Twospotted spider mite	Beans	+	Rate of multiplication		*Fritsche, 1961*
Tetranychus urticae	Twospotted spider mite	Cherry	+ (1)	L - Number eggs per mite		*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Cherry	+ (22)	L - Mortality of adults		*Harries, 1966*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 189 **K-effect on mites** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Tetranychus urticae	Twospotted spider mite	Cucumber	0	L - Number eggs per female		*Tulisalo, 1971*
Tetranychus urticae	Twospotted spider mite	Grapes	+	L - Fecundity	KNO_3	*Chaboussou, 1972*
Tetranychus urticae	Twospotted spider mite	Grapes	2-(103)	L - descendants per female - 2 varieties		*Schreiner, 1984*
Tetranychus urticae	Twospotted spider mite	Peach	- (10)	L - Number eggs per mite		*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Peach	- (7)	L - Mortality of adults		*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Peach	- (16)	F - Number eggs per mite	KCl	*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Peach	- (25)	F - Mortality of adults	KCl	*Harries, 1966*
Tetranychus urticae	Twospotted spider mite	Raspberry	2-(50)	F - Long-term trial - Number mites - Average for 2 years		*Badowska-Czubik et al., 1977*
Tetranychus urticae	Twospotted spider	Sorghum mite	-	L - Infestation intensity		*Flechtmann et al., 1976*
Species not mentioned		Cassava	2+(55)	F - % infested leaves - 2 varieties		*Aiyer et al., 1985*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 190 **K-effect on nematodes** ((Nematodes ordered according to Latin name)

Latin name	English name		K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Aphelenchoides oryzae	Rice nematode	Rice	-	L - Damage index		*Orsenigo, 1956*
Aphelenchoides oryzae	Rice nematode	Rice	+ (40)	L - % sterile spikes		*Orsenigo, 1956*
Aphelenchoides spp.		Soil	0	F - Long-term trial - Number nematodes in soil		*Corbett et al., 1969 in Jones, 1976*
Heterodera avenae		Cereals	+	L - Number cysts		*Mukhopadaya, 1972 in Ritter, 1976*
Heterodera glycines	Soybean cyst nematode	Soybean	- (9)	L - Soil low in K - Number cysts in soil	KCl	*Luedders et al.,1979*
Heterodera glycines	Soybean cyst nematode	Soybean	- (56)	L - Soil low in K - Number cysts per plant	KCl	*Luedders et al.,1979*
Heterodera glycines	Soybean cyst nematode	Soybean	- (27)	L - Soil low in K - Number cysts in soil	K_2SO_4	*Luedders et al.,1979*
Heterodera glycines	Soybean cyst nematode	Soybean	- (33)	L - Soil low in K - Number cysts per plant	K_2SO_4	*Luedders et al.,1979*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	+ (2)	L - Number larvae	KCl	*Curtis, 1964*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	+ (39)	L - Number cysts	KCl	*Curtis, 1964*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	- (460)	L - Number larvae	KCl	*Curtis, 1964*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	+ (69)	L - Number cysts	KCl	*Curtis, 1964*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	+	L - Effect of plant filtrate on cysts hatching	KCl	*Curtis, 1964*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	+	L - Number cysts in soil	KCl	*Curtis, 1964*
Heterodera schachtii	Sugarbeet nematode	Sugarbeet	+			*Skarbilovic, 1960 in Kirpatrick et. al., 1964*

Meloidogyne exigua		Coffee	0	L - Hatching of larvae	KCl	*Dos Santos and Ferraz, 1981*
Meloidogyne exigua		Coffee	+	L - Number galls	KCl	*Dos Santos, Ferraz and De Oliveira, 1981*
Meloidogyne exigua		Coffee	+	L - Number eggs	KCl	*Dos Santos, Ferraz and De Oliveira, 1981*
Meloidogyne hapla	Northern root-knot nematode	Cucum-ber	- (72)	Total number of nematodes in roots		*Marks et al., 1964*
Meloidogyne incognita	Root-knot nematode	Beans	+	L - Root-gall index - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (30)	L - Number females per g root - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (155)	L - Number females per plant - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (205)	L - Number females per unit inoculum - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (143)	L - Number eggmasses per g root - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (336)	L - Number eggmasses per plant - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (500)	L - Number eggmasses per unit inoculum - Average for 50 and 200 eggmasses inoculated		*Oteifa, 1951*
Meloidogyne incognita	Root-knot nematode	Beans	- (67)	L - Velocity of development		*Oteifa, 1953*
Meloidogyne incognita	Root-knot nematode	Castor	- (43)	L - Nematodes population - Average for 10, 100 and 1000 larvae inoculated		*Ismail et al., 1980*
Meloidogyne incognita	Root-knot nematode	Castor	-	L - Root knot index - Average for 10, 100 and 1000 larvae inoculated		*Ismail et al., 1980*
Meloidogyne incognita	Root-knot nematode	Coffee	-	L - Velocity of nematodes development		*Jaehn et al., 1983*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 190 **K-effect on nematodes** (continued)

Latin name	English name		K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Meloidogyne incognita	Root-knot nematode	Coffee	- (40)	L - Number nematodes per plant		*Jaehn et al., 1983*
Meloidogyne incognita	Root-knot nematode	Coffee	- (109)	L - Number eggs per oothea		*Jaehn et al., 1983*
Meloidogyne incognita	Root-knot nematode	Coffee	- (629)	L - Number eggs per plant		*Jaehn et al., 1983*
Meloidogyne incognita	Root-knot nematode	Cotton	+ (17)	L - Number eggmasses per g root		*Oteifa, 1976*
Meloidogyne incognita	Root-knot nematode	Cotton	- (235)	L - Number eggmasses per root		*Oteifa, 1976*
Meloidogyne incognita	Root-knot nematode	Cotton	- (18)	L - Number hatch per root		*Oteifa, 1976*
Meloidogyne incognita	Root-knot nematode	Cotton	- (93)	L - Number penetrates per root		*Oteifa, 1976*
Meloidogyne incognita	Root-knot nematode	Cucumber	- (87)	L - Number eggs per eggmass		*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Cucumber	+ (66)	L - Number eggs spawned in solution		*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Cucumber	- (15)	L - Number mature egg-laying females		*Marks et al., 1964*
Meloidogyne incognita	Root-knot nematode	Cucumber	- (43)	L - Total number of nematodes of all stages		*Marks et al., 1964*
Meloidogyne incognita	Root-knot nematode	Cucurbits	2-(37)	L - Total number of nematodes - 2 trials - Average for 10, 100 and 1000 larvae inoculated		*Ismail, 1980*
Meloidogyne incognita	Root-knot nematode	Cucurbits	2 -	L - Root-knot index - 2 trials - Average for 10, 100 and 1000 larvae inoculated		*Ismail, 1980*
Meloidogyne incognita	Root-knot nematode	Eggplant	-	L - Root-knot index - Average for 5, 50, 500 and 1000 larvae inoculated		*Haque et al., 1974*
Meloidogyne incognita	Root-knot nematode	Okra	-	L - Root-knot index - 1000 larvae inoculated		*Haque et al., 1972*

Meloidogyne incognita	Root-knot nematode	Okra	-	L - Root-knot index - Average for 5, 50, 500 and 1000 larvae inoculated	*Haque et al., 1974*
Meloidogyne incognita	Root-knot nematode	Soybeans	-	Susceptible variety - Number galls	*Shands et al., 1957*
Meloidogyne incognita	Root-knot nematode	Soybeans	-	Moderately susceptible variety - Number galls	*Shands et al., 1957*
Meloidogyne incognita	Root-knot nematode	Soybeans	-	Resistant variety - Nematode penetration	*Shands et al., 1957*
Meloidogyne incognita	Root-knot nematode	Sweet potato	3+(22)	L - Number eggs per eggmass - 3 trials	*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Sweet potato	3-(34)	L - Number eggs spawned in solution - 3 trials	*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Sweet potato	- (14)	L - Cross sectional area of nematodes - Average of 2 evaluations	*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Tomato	-(782)	L - Number adults	*Davide et al., 1967*
Meloidogyne incognita	Root-knot nematode	Tomato	- (28)	L - Number eggs per female	*De Guiran et al.,1980*
Meloidogyne incognita	Root-knot nematode	Tomato	-	L - Root-knot index - Average for 5, 50, 500, and 1000 larvae inoculated	*Haque et al., 1974*
Meloidogyne incognita	Root-knot nematode	Tomato	2 +	L - Number eggs per eggmass - 2 trials	*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Tomato	2-(17)	L - Number eggs spawned in solution - 2 trials	*Ishibashi et al., 1964*
Meloidogyne incognita	Root-knot nematode	Tomato	- (86)	L - Susceptible variety - Total number of nematodes - Average for 10, 100, and 1000 larvae inoculated	*Ismail et al., 1976*
Meloidogyne incognita	Root-knot nematode	Tomato	- (39)	L - Resistant variety - Total number of nematodes - Average for 10, 100 and 1000 larvae inoculated	*Ismail et al., 1976*
Meloidogyne incognita	Root-knot nematode	Tomato	2 -	L - 1 susceptible and 1 resistant variety - Root-knot index - Average for 10, 100 and 1000 larvae inoculated	*Ismail et al., 1976*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 190 **K-effect on nematodes** (continued)

Latin name	English name		K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Meloidogyne incognita	Root-knot nematode	Tomato	- (17)	L - Cross sectional area of nematodes		*Ismail et al., 1977*
Meloidogyne incognita	Root-knot nematode	Tomato	- (3)	Number galls per plant	KCl	*Johnson, 1971*
Meloidogyne incognita	Root-knot nematode	Tomato	+ (11)	Number galls per root	KCl	*Johnson, 1971*
Meloidogyne javanica	Javanese root-knot nematode	Cucumber	- (22)	L - Velocity of development		*Marks et al., 1964*
Meloidogyne javanica	Javanese root-knot nematode	Cucumber	+ (2)	L - Number nematodes of all stages in roots		*Marks et al., 1964*
Meloidogyne javanica	Javanese root-knot nematode	Muskmelon	-	L - Galling		*Spiegel et al., 1984*
Meloidogyne javanica	Javanese root-knot nematode	Tomato	0	L - Galling index		*Spiegel et al., 1982*
Meloidogyne javanica	Javanese root-knot nematode	Tomato	-(264)	L - Nematodes population		*Spiegel et al., 1982*
Meloidogyne javanica	Javanese root-knot nematode	Tomato	+ (29)	L - Rapidity of nematode growth - Average of 2 evaluations	KNO_3	*Bird, 1960*
Meloidogyne javanica	Javanese root-knot nematode	Tomato	+	L - Number galls		*Gupta et al., 1971*
Meloidogyne sp.		Tomato	+ (57)	L - Number galls		*Birat, 1963*
Meloidogyne sp.		Tomato	- (152)	L - Number eggs	KCl	*Dropkin et al., 1966*
Meloidogyne sp.		Tomato	- (50)	L - Number egg masses	KCl	*Dropkin et al., 1966*
Meloidogyne spp.		Unspecified	+	Damage		*Tyler, 1944 in Kincaid, 1946*
Pratylenchus penetrans	Cobb's meadow nematode	Lucerne	0	Reproduction		*Willis, 1973*
Pratylenchus penetrans	Cobb's meadow nematode	Lucerne	+ (61)	L - Trial I - Number nematodes	KCl	*Willis, 1976*
Pratylenchus penetrans	Cobb's meadow nematode	Lucerne	- (8)	L - Trial II - Number nematodes	KCl	*Willis, 1976*

Pratylenchus penetrans	Cobb's meadow nematode	Cherries	+ (1)	F - Orchard I - Number nematodes in soil		*Kirpatrick et al., 1964*
Pratylenchus penetrans	Cobb's meadow nematode	Cherries	+ (54)	F - Orchard II - Number nematodes in soil		*Kirpatrick et al., 1964*
Pratylenchus penetrans	Cobb's meadow nematode	Cherries	+	F - Orchard III - Number nematodes in soil		*Kirpatrick et al., 1964*
Pratylenchus penetrans	Cobb's meadow nematode	Clover	- (21)	L - Number nematodes	KCl	*Willis, 1976*
Rotylenchus reniformis	Reniform nematode	Castor	- (57)	L - Nematodes population - Average for 10, 100, and 1000 females inoculated		*Ismail et al., 1980*
Rotylenchus reniformis	Reniform nematode	Cotton	+ (43)	L - Number eggmasses per g root		*Oteifa, 1976*
Rotylenchus reniformis	Reniform nematode	Cotton	- (77)	L - Number eggmasses per root		*Oteifa, 1976*
Rotylenchus reniformis	Reniform nematode	Cotton	- (12)	L - Number hatches per root		*Oteifa, 1976*
Rotylenchus reniformis	Reniform nematode	Cotton	- (49)	L - Number penetrates per root		*Oteifa, 1976*
Rotylenchus reniformis	Reniform nematode	Cowpeas	- (561)	L - Nematodes population in roots	K_2SO_4	*Badra et al., 1979*
Rotylenchus reniformis	Reniform nematode	Cowpeas	+ (44)	L - Nematodes population in soil	K_2SO_4	*Badra et al., 1979*
Rotylenchus reniformis	Reniform nematode	Garlic	+ (100)	L - Number nematodes in roots	KCl	*Rodriguez Fuentes et al., 1981*
Rotylenchus reniformis	Reniform nematode	Garlic	+ (91)	L - Number nematodes in soil	KCl	*Rodriguez Fuentes et al., 1981*
Rotylenchus reniformis	Reniform nematode	Okra	- (32)	L - Nematode population in soil	K_2SO_4	*Sivakumar et al., 1974*
Rotylenchus reniformis	Reniform nematode	Pepper	+(100)	L - Number nematodes in roots	KCl	*Rodriguez Fuentes et al., 1981*
Rotylenchus reniformis	Reniform nematode	Pepper	+ (68)	L - Number nematodes in soil	KCl	*Rodriguez Fuentes et al., 1981*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 190 **K-effect on nematodes** (continued)

Latin name	English name		K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Rotylenchus reniformis	Reniform nematode	Tomato	- (452)	L - Number nematodes in roots	KCl	*Rodriguez Fuentes et al., 1981*
Rotylenchus reniformis	Reniform nematode	Tomato	- (100)	L - Number nematodes in soil	KCl	*Rodriguez Fuentes et al., 1981*
Tylenchorhyncchus latus	Stunt nematode	Cotton	- (7)	F - Population levels	K_2SO_4	*Oteifa, 1965*
Tylenchorhynchus sp.		Cherries	- (888)	F - Number nematodes in soil	K_2SO_4	*Kirpatrick et al., 1964*
Tylenchulus semipenetrans		Orange	- (15)	L - Nematodes population in soil	K_2SO_4	*Badra et al., 1979*
Tylenchulus semipenetrans		Orange	- (367)	L - Nematodes population in soil	K_2SO_4	*Badra et al., 1979*
Xiphinema americanum	American dagger nematode	Cherries	3 +	F - Number nematodes in soil - Average for 3 orchards		*Kirpatrick et al., 1964*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 191 **K-effect on viruses** (Viruses ordered alphabetically according to English name)

English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Leafroll viruses					
Leafroll	Potato	-	Virus symptoms		*Arenz, 1949 in Fuchs et al., 1972*
Leafroll	Potato	3-(271)	F - Long-term trial - Variety Mittelfrühe- % infected plants - Average for 3 years	KCl	*Bode, 1949*
Leafroll	Potato	- (81)	F - Variety Ackersegen - % infected plants	KCl	*Bode, 1949*
Leafroll	Potato	- (163)	F - Variety Flava - % infected plants	KCl	*Bode, 1949*
Leafroll	Potato	-	Virus symptoms		*Bröning et al., 1955 in Fuchs et al., 1972*
Leafroll	Potato	3 -	F - 1st planting date - Virus incidence - 3 trials	KCl	*Broadbent et al., 1952*
Leafroll	Potato	2 +	F - 1st planting date - Virus incidence - 2 trials	KCl	*Broadbent et al., 1952*
Leafroll	Potato	4 -	F - 2nd planting date - Virus incidence - 4 trials	KCl	*Broadbent et al., 1952*
Leafroll	Potato	+	F - 2nd planting date - Virus incidence - 1 trial	KCl	*Broadbent et al., 1952*
Leafroll	Potato	4 -	F - 3rd planting date - Virus incidence - 4 trials	KCl	*Broadbent et al., 1952*
Leafroll	Potato	2 -	F - 4th planting date - Virus incidence - 2 trials	KCl	*Broadbent et al., 1952*
Leafroll	Potato	2 +	F - 4th planting date - Virus incidence - 2 trials	KCl	*Broadbent et al., 1952*
Leafroll	Potato	-	% infected descendants	KCl	*Hofferbert et al., 1948, in Völk et al., 1952*
Leafroll	Potato	- (169)	F - Long-term trial - Eye cutting test 1946 - % descendants with leafroll		*Krüger, 1951*
Leafroll	Potato	- (142)	F - Long-term trial - Eye cutting test 1947 - % descendants with leafroll		*Krüger, 1951*

Leafroll	Potato	- (134)	F - Long-term trial - Eye cutting test 1948 - % descendants with leafroll		*Krüger, 1951*
Leafroll	Potato	- (40)	F - Long-term trial Göttingen - % descendants with leafroll in 1948		*Krüger, 1951*
Leafroll	Potato	- (69)	F - Long-term trial Göttingen - % descendants with leafroll in 1949		*Krüger, 1951*
Leafroll	Potato	- (61)	F - Long-term trial Ebstorf - % descendants with leafroll in 1948		*Krüger, 1951*
Leafroll	Potato	- (88)	F - Long-term trial Ebstorf - % desccendants with leafroll in 1949		*Krüger, 1951*
Leafroll	Potato	+ (10)	F - Trial Ependes - Autumn application - % descendants with heavy viroses	KCl	*Münster, 1964*
Leafroll	Potato	+ (33)	F - Trial Ependes - Spring application - % descendants with heavy viroses	KCl	*Münster, 1964*
Leafroll	Potato	- (53)	F - Trial Ependes - Spring application - % descendants with heavy viroses	K_2SO_4	*Münster, 1964*
Leafroll	Potato	+ (64)	F - Trial Senarclens - Autumn application - % descendants with heavy viroses	KCl	*Münster, 1964*
Leafroll	Potato	+ (79)	F - Trial Senarclens - Spring application - % descendants with heavy viroses	KCl	*Münster, 1964*
Leafroll	Potato	+ (58)	F - Trial Senarclens - Spring application - % descendants with heavy viroses	K_2SO_4	*Münster, 1964*
Leafroll	Potato	+ (51)	F - Trial Payerne - Autumn application - % descendants with heavy viroses	KCl	*Münster, 1964*
Leafroll	Potato	+ (60)	F - Trial Payerne - Spring application - % descendants with heavy viroses	KCl	*Münster, 1964*
Leafroll	Potato	+ (41)	F - Trial Payerne - Spring application - % descendants with heavy viroses	K_2SO_4	*Münster, 1964*
Leafroll	Potato	+	F - Soil rich in K - Leafroll symptoms		*Quelhas dos Santos, 1979*
Leafroll	Potato	- (29)	F - Soil low in K - Trial Fuchsenbigl 1959 - % diseased descendants	KCl	*Reichard, 1964*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 191 **K-effect on viruses** (continued)

English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Leafroll	Potato	- (22)	F - Soil low in K - Trial Fuchsenbigl 1960 - % diseased descendants	KCl	*Reichard, 1964*
Leafroll	Potato	+ (2)	F - Trial Rottenhaus 1959 - % diseased descendants	KCl	*Reichard, 1964*
Leafroll	Potato	- (2)	F - Trial Rottenhaus 1960 - % diseased descendants	KCl	*Reichard, 1964*
Leafroll	Potato	- (19)	F - Trial Stift. Swettl. 1959 - % diseased descendants	KCl	*Reichard, 1964*
Leafroll	Potato	- (13)	F - Trial Stift. Swettl. 1960 - % diseased descendants	KCl	*Reichard, 1964*
Leafroll	Potato	-	F - Crop susceptibility	KCl	*Ross, 1946 in Völk et al., 1952*
Leafroll	Potato	0	F - Crop susceptibility	K_2SO_4	*Ross, 1946 in Völk et al., 1952*
Leafroll	Potato	- (46)	F - Trial 1947 - % infected tubers	KCl	*Völk et al., 1952*
Leafroll	Potato	- (92)	F - Trial 1948 - % infected tubers	KCl	*Völk et al., 1952*
Leafroll	Potato	- (46)	F - Trial 1949 - % infected tubers	KCl	*Völk et al., 1952*
Leafroll	Potato	-	Virus symptoms		*Wilson, 1955 in Last, 1956*
Leafroll	Potato	+	Phloem necrosis		*Wilson, 1955 in Last, 1956*
Leafroll	Potato	0 (0)	F - Eye cutting test - % descendants with leafroll	KCl	*Wünscher, 1952*
Leafroll	Potato	+ (46)	F - Eye cutting test - % descendants with leafroll	K_2SO_4	*Wünscher, 1952*
Leafroll	Potato	+ (17)	F - Variety Mittelfrühe - % descendants with leafroll	KCl	*Wünscher, 1952*
Leafroll	Potato	+ (7)	F - Variety Mittelfrühe - % descendants with leafroll	K_2SO_4	*Wünscher, 1952*
Leafroll	Potato	+ (71)	F - Variety Ackersegen - % descendants with leafroll	KCl	*Wünscher, 1952*
Leafroll	Potato	+ (71)	F - Variety Ackersegen - % descendants with leafroll	K_2SO_4	*Wünscher, 1952*
Mosaic viruses					
Cauliflower mosaic	Cauli-flower	0	Virus symptoms		*Broadbent et al.,1953 in Fuchs et al., 1972*
Cauliflower mosaic	Turnip	+	Virus symptoms		*Hamlyn, 1955 in Fuchs et al., 1972*

Cucumber mosaic	Cheno-podium	+			*Foster, 1967 in Fuchs et al., 1972*
Maize dwarf mosaic	Maize	-	L - Virus content		*Tu et al., 1968*
Maize mosaic	Sorghum	+	Virus severity		*Raychaudhuri, 1966 in Leath et al., 1974*
Peppers mosaic	Peppers	+	L - Virus symptoms	KCl	*Alagianagalingam et al., 1977*
Peppers mosaic	Peppers	4+(15)	F - % mosaic - 4 trials	KCl	*Narasimhan et al., 1976*
Peppers mosaic	Peppers	+	L - Disease index	KCl	*Narasimhan et al., 1976*
Spot mosaic of tomato	Tobacco	0 (0)	L - Velocity of incubation		*Volk, 1931*
Spot mosaic of tomato	Tobacco	0 (0)	L - Number successful infections		*Volk, 1931*
Spot mosaic of tomato	Tomato	- (4)	L - Trial I - Rate of appearance of spots		*Volk, 1931*
Spot mosaic of tomato	Tomato	- (50)	L - Trial I - Number successful infections		*Volk, 1931*
Spot mosaic of tomato	Tomato	- (14)	L - Trial II - Rate of appearance of spots		*Volk, 1931*
Spot mosaic of tomato	Tomato	- (9)	L - Trial II - Number successful infections		*Volk, 1931*
Sunnhemp mosaic virus	Cowpea	- (32)	L - Virus concentration		*Chant et al., 1984*
Sunnhemp mosaic virus	Crotalaria juncea	+	Virus dissemination		*Sastry et al., 1963 in Fuchs et al., 1972*
Tobacco mosaic virus	Beans	2-(196)	L - Number lesions on leaves - 2 trials		*Panzer, 1957*
Tobacco mosaic virus	Nicotiana glutinosa	4+(61)	L - Number lesions on leaves - 4 trials		*Allington et al., 1974*

* K-effect: + Positive i.e. parasite development or damage decreased; ( ) = decrease expressed in %
- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 191 **K-effect on viruses** (continued)

English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Tobacco mosaic virus	Tobacco	3+(17)	L - Virus concentration in sap - 3 trials		*Bawden et al., 1950b*
Tobacco mosaic virus	Tobacco	- (42)	L - Virus concentration in sap - 1 trial		*Bawden et al., 1950b*
Tobacco mosaic virus	Tobacco	2-(25)	L - Total virus in sap - 2 trials		*Bawden et al., 1950b*
Tobacco mosaic virus	Tobacco	4-(5)	L - Infectivity of virus - 4 trials		*Bawden et al., 1950b*
Tobacco mosaic virus	Tobacco	0	L - Number lesions	KCl	*Hildebrandt et al., 1953*
Tobacco mosaic virus	Tobacco	3-(44)	L - Number lesions - Average of 3 trials	K_2SO_4	*Spencer, 1935*
Tobacco mosaic virus	Tobacco	+ (32)	L - Velocity of virus spread within plant		*Spencer, 1937*
Tobacco mosaic virus	Tobacco	0 (0)	L - % infected plants		*Spencer, 1937*
Tobacco mosaic virus	Tobacco	- (14)	L - Number lesions caused on Nicotiana leaves by inocula from tobacco plants		*Weathers et al., 1954*
Tobacco mosaic virus	Tomato	0	Virus content of roots		*Papasolomontos et al., 1959*
Tobacco mosaic virus	Tomato	- (91)	L - Trial V - Number necrotic spots on Nicotiana		*Rebowska, 1965*
Tobacco mosaic virus	Tomato	+ (23)	L - Trial VII - Number necrotic spots on Nicotiana		*Rebowska, 1965*
Tobacco mosaic virus	Tomato	- (380)	L - Trial VIII - Number necrotic spots on Nicotiana		*Rebowska, 1965*
Tomato mosaic virus	Tomato	- (119)	L - Without *Fusarium* inoculation - Virus concentration		*Chant et al., 1985*
Tomato mosaic virus	Tomato	+ (21)	L - With *Fusarium* inoculation - Virus concentration		*Chant et al., 1985*

Tomato stripe	Tomato	+	F - Long-term trial		*Ainsworth, 1932 in Spencer 1935*
Watermelon mosaic virus	Water-melon	0	Virus multiplication		*Singh et al., 1966 in Fuchs et al., 1972*
Wheat streak mosaic	Wheat	0	Virus content		*Hounold, 1958 in Fuchs et al., 1972*
Mosaic un-specified	Peppers	+ (46)	F - % infected plants		*Balasubramanian et al., 1981*
Mosaic un-specified	Potato	2+(20)	F - Soils low in K - % descendants with mosaic - 2 trials		*Janssen, 1929a*
Mosaic un-specified	Potato	- (24)	F - Autumn application - % descendants with heavy viroses	KCl	*Münster, 1964*
Mosaic un-specified	Potato	- (6)	F - Spring application - % descendants with heavy viroses	KCl	*Münster, 1964*
Mosaic un-specified	Potato	+ (41)	F - Spring application - % descendants with heavy viroses	K_2SO_4	*Münster, 1964*
Mosaic un-specified	Tobacco	+	Crop susceptibility		*Bröning, 1929 in Eckstein et al., 1937*
Other viruses					
Beet yellows	Beets	+	Symptoms		*Helling, 1953 in Fuchs et al., 1972*
Beta virus 4	Beets	+	L - Severity of symptoms		*Warchalowa, 1970*
Beta virus 4	Beets	+	L - Rate of appearance of symptoms		*Warchalowa, 1970*
Cucumber virus I	Spinach	- (187)	L - Trial I - Virus concentration		*Cheo et al., 1972*
Cucumber virus I	Spinach	- (458)	L - Trial II - Virus concentration		*Cheo et al., 1972*
Potato virus X	Potato	2 +	L - Virus concentration - 2 trials		*Bawden et al., 1950b*
Potato virus X	Potato	0	L - Virus concentration - 1 trial		*Bawden et al., 1950b*
Potato virus X	Potato	+	Velocity of virus spread within plant		*Diercks, 1953 in Proeseler, 1963*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 191 **K-effect on viruses** (continued)

English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Potato virus Y	Potato	4+(5)	L - Number diseased plants - 4 trials		*Bawden et al., 1950a*
Potato virus Y	Potato	2 +	F - 1st planting date - Virus incidence - 2 trials	KCl	*Broadbent et al.,1952*
Potato virus Y	Potato	3 -	F - 1st planting date - Virus incidence - 3 trials	KCl	*Boradbent et al.,1952*
Potato virus Y	Potato	2 +	F - 2nd planting date - Virus incidence - 2 trials	KCl	*Boradbent et al.,1952*
Potato virus Y	Potato	3 -	F - 2nd planting date - Virus incidence - 3 trials	KCl	*Broadbent et al.,1952*
Potato virus Y	Potato	+	F - 3rd planting date - Virus incidence - 1 trial	KCl	*Broadbent et al.,1952*
Potato virus Y	Potato	3 -	F - 3rd planting date - Virus incidence - 3 trials	KCl	*Broadbent et al.,1952*
Potato virus Y	Potato	4 -	F - 4th planting date - Virus incidence - 4 trials	KCl	*Broadbent et al.,1952*
Potato virus Y	Tobacco	0 (0)	L - Trial I - Number infected plants		*Bawden et al., 1950a*
Potato virus Y	Tobacco	+ (16)	L - Trial II - Number infected plants		*Bawden et al., 1950a*
Potato virus Y	Tobacco	- (11)	L - Trial III - Number infected plants		*Bawden et al., 1950a*
Potato virus Y	Tobacco	+ (23)	L - Trial IV - Number infected plants		*Bawden et al., 1950a*
Potato virus Y	Tobacco	3+(11)	L - Number infected plants - Average of 3 trials		*Bawden et al., 1950a*
Potato virus Y^N	Potato	2+(4)	F - Artificial inoculation - 2 trials		*Scheppers et al., 1976*
Pseudonet-necrose	Potato	2 +	F - Crop susceptibility - 2 trials		*Quanjer, 1931*
Rice stripe disease	Rice	+ (22)	F - % damaged hills	KCl	*Kim et al., 1973*
Rice stripe disease	Rice	+			*Cho, 1966 in Lee, 1967*
Streak of tomato	Tomato	- (16)	L - Velocity of incubation		*Volk, 1931*
Streak of tomato	Tomato	0 (0)	L - Velocitiy of appearance of necroses		*Volk, 1931*
Streak of tomato	Tomato	- (10)	L - Number successful infections		*Volk, 1931*
Tomato bushy stunt virus	Tomato	- (7)	L - Without *Fusarium* inoculation - Virus concentration		*Chant et al., 1985*
Tomato bushy stunt virus	Tomato	+ (3)	L - With *Fusarium* inoculation - Virus concentration		*Chant et al., 1985*
Tomato spotted wilt	Unspecified	-	Formation of necroses		*Klinkowski et al., 1952 in Fuchs et al., 1972*

Turnip virus No. 1	Nicotiana sp.	0	L - Virus biosynthesis		*Dufrenoy, 1955*
Turnip virus No. 1	Nicotiana glutinosa	3 -	L - Number lesions on leaves - 3 trials		*Pound et al., 1953*
Turnip virus No. 1	Nicotiana multivalis	2 -	L - Number lesions on leaves - 2 trials		*Pound et al., 1953*
Viruses unspecified	Potato	- (8)	L - % infected descendants	KCl	*Klapp, 1951*
Viruses unspecified	Potato	- (108)	L - % infected descendants	K_2SO_4	*Klapp, 1951*
Viruses unspecified	Potato	- (23)	F - Trial 1954 - Variety Ackersegen - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	- (23)	F - Trial 1955 - Variety Ackersegen - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	- (471)	F - Trial 1956 - Variety Ackersegen - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	+ (19)	F - Trial 1957 - Variety Ackersegen - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	- (46)	F - Trial 1954 - Variety Capella - Low infestation - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	+ (19)	F - Trial 1955 - Variety Capella - Low infestation - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	- (367)	F - Trial 1957 - Variety Capella - Low infestation - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	- (66)	F - Trial 1956 - Variety Capella - Heavy infestation - % plants with heavy viroses	KCl	*Stricker, 1958*
Viruses unspecified	Potato	- (71)	F - Trial 1957 - Variety Capella - Heavy infestation - % plants with heavy viroses	KCl	*Stricker, 1958*

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- Negative i.e. parasite development or damage increased; ( ) = increase expressed in %
0 No effect i.e. parasite development or damage unchanged

Table 192 **K-effect on bacteria** (Bacteria ordered alphabetically according to Latin name)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Agrobacterium tumefaciens		Grapes	+ (25)	F - % attack		*Condei et al., 1980*
Bacillus betae		Fodder beets	+ (80)	F - % attack		*Niklas et al., 1927 in Scharrer et al., 1956*
Bacillus phytophthorus		Potato	0 (0)	F - Length of blackening on shoots	KCl	*Fehmi, 1933*
Bacillus spp.		Potato	+ (6)	F - % rotten tubers after storage	KCl	*Fehmi, 1933*
Bacterium lathyri	Streak disease of tomato	Tomato	+			*Bewley et al., 1919 in Martin, 1973*
Corynebacterium insidiosum	Bacterial wilt of alfalfa	Alfalfa	2 +	L - Crop susceptibility - 2 varieties		*Walters et al., 1959*
Corynebacterium michiganense	Bacterial canker of tomato	Tomato	+	L - Disease index - Average of 4 evaluations		*Walker et al., 1948*
Corynebacterium sepedonicum	Tomato ring rot	Tomato	2 0	L - Disease index - 2 trials		*Walker et al., 1951*
Erwinia amylovora	Fire blight	Pear	+ (3)	L - Trial 1957 - % of shoot infected		*Fisher et al., 1959*
Erwinia amylovora	Fire blight	Pear	- (17)	L - Trial 1958 - % of shoot infected		*Fisher et al., 1959*
Erwinia amylovora	Fire blight	Pear	2+(20)	L - Length of blight invasion - Average for 2 years		*Fisher et al., 1959*
Erwinia amylovora	Fire blight	Pear	2+(26)	L - Fire blight extent - Average for 2 years		*Keil et al., 1972*
Erwinia amylovora	Fire blight	Pear	+ (5)	L - % successful inoculations		*Lewis et al., 1962*
Erwinia amylovora	Fire blight	Pear	+ (24)	L - % infected wood		*Lewis et al., 1962*
Erwinia amylovora	Fire blight	Pear	- (29)	F - Disease index		*Parker et al., 1961*

Erwinia amylovora	Fire blight	Pear	- (63)	L - % shoot length infected 1955		*Parker et al., 1961*
Erwinia amylovora	Fire blight	Pear	+ (3)	L - % shoot length infected 1956		*Parker et al., 1961*
Erwinia carotovora	Soft rot	Cabbage	+			*Upit, 1970 in Huber et al., 1985*
Erwinia chrysanthemi	Bacterial leaf blight	Philodendron	2 -	L - Disease severity - 2 trials	K_2SO_4	*Haygood et al., 1982*
Erwinia herbicola	Tomato graywall	Tomato	6 +	F - Disease index - 6 trials	K_2SO_4	*Picha et al., 1983*
Erwinia herbicola	Tomato graywall	Tomato	0	F - Disease index - 1 trial	K_2SO_4	*Picha et al., 1983*
Erwinia herbicola	Tomato graywall	Tomato	-	F - Disease index - 1 trial	K_2SO_4	*Picha et al., 1983*
Erwinia herbicola	Tomato graywall	Tomato	2 +	L - Disease index - 2 varieties	K_2SO_4	*Picha et al., 1983*
Erwinia herbicola	Tomato graywall	Tomato	0	L - Disease index - 1 variety	K_2SO_4	*Picha et al., 1983*
Erwinia herbicola	Tomato graywall	Tomato	-	L - Disease index - 1 variety	K_2SO_4	*Picha et al., 1983*
Phytomonas stewartii	Bacterial wilt of maize	Maize	+	L - Infection index	K_2SO_4	*Spencer et al., 1938*
Phytomonas stewartii	Bacterial wilt of maize	Maize	- (8)	L - Number dead leaves	K_2SO_4	*Spencer et al., 1938*
Phytomonas stewartii	Bacterial wilt of maize	Maize	+ (46)	L - Number lesions	K_2SO_4	*Spencer et al., 1938*
Pseudomonas angulata	Angular leaf spot	Unspecified	+	Disease incidence		*Fromme et al., 1931 in Eckstein, 1937*
Pseudomonas angulata	Blackfire	Tobacco	+			*Johnson, 1940 in Huber et al., 1985*
Pseudomonas angulata	Blackfire	Tobacco	+	Crop susceptibility		*Johnson, 1947 in van Gundy et al., 1957*

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0 No effect i.e. parasite development or damage unchanged

Table 192 **K-effect on bacteria** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Pseudomonas angulata	Blackfire	Tobacco	+	F - Damage		*Moss et al., 1927 in Wingard, 1941*
Pseudomonas lachrymans	Angular leaf spot	Cucumbers	4 +	L - Disease index - 4 trials		*Van Gundy et al., 1957*
Pseudomonas lachrymans	Angular leaf spot	Cucumbers	0	L - Disease index - 1 trial		*Van Gundy et al., 1957*
Pseudomonas phaseolicola	Halo blight	Beans	2-(173)	L - Disease index - 2 trials		*Patel et al., 1963*
Pseudomonas solanacearum	Bacterial wilt of potato	Potato	2-(12)	L - Disease severity - 2 trials		*Mahmoud et al., 1976*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	+	L - Trial midwinter - Disease index		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	-	L - Trial summer - Disease index		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	-	L - Trial autumn - Disease index		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	+	L - Trial with normal light		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	-	L - Trial with low light		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	-	L - Trial with short days		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	+	L - Trial with sand temperature 24° C		*Gallegly et al., 1949*
Pseudomonas solanacearum	Bacterial wilt of tomato	Tomato	+	L - Trial with sand temperature 32° C		*Gallegly et al., 1949*
Pseudomonas syringae	Chocolate spot	Maize	+	L - Infection success	KCl	*Arny et al., 1972*
Pseudomonas syringae	Chocolate spot	Maize	+ (100)	F - Soil low in K - Disease incidence		*Karlen et al., 1973*

Pseudomonas syringae	Bacterial blight	Lima bean	6+(24)	L - Infection success - Average of 6 trials		*Thaung et al., 1957*
Pseudomonas tabaci	Wildfire	Tobacco	+	F - Damage		*Atkinson et al., 1960*
Pseudomonas tabaci	Wildfire	Tobacco	+	Crop susceptibility		*Böning, 1930 in Fuchs et al., 1972*
Pseudomonas tabaci	Wildfire	Tobacco	+	Crop susceptibility		*Johnson, 1947 in van Gundy et al., 1957*
Pseudomonas tabaci	Wildfire	Tobacco	+	F		*Mc New, 1953*
Pseudomonas tabaci	Wildfire	Tobacco	+	F - Damage		*Moss et al., 1927 in Wingard, 1941*
Pseudomonas tabaci	Wildfire	Tobacco	+	Crop susceptibility		*Sacco, 1946 in Fuchs et al., 1972*
Pseudomonas tabaci	Wildfire	Tobacco	0 (0)	L - Velocity of incubation on wounded leaves		*Volk, 1931*
Pseudomonas tabaci	Wildfire	Tobacco	+ (11)	L - Velocity of incubation on unwounded leaves		*Volk, 1931*
Pseudomonas tabaci	Wildfire	Tobacco	+ (13)	L - Number successful inoculations on wounded leaves		*Volk, 1931*
Pseudomonas tabaci	Wildfire	Tobacco	+ (30)	L - Number successful inoculations on unwounded leaves		*Volk, 1931*
Streptomyces scabies	Potato scab	Potato	-	F - Disease intensity	KCl	*Berkner et al., 1932 in Wenzl et al., 1974*
Streptomyces scabies	Potato scab	Potato	+	F - Disease intensity	K_2SO_4	*Berkner et al., 1932 in Wenzl et al., 1974*
Streptomyces scabies	Potato scab	Potato	- (32)	F - Disease severity	KCl	*Davis et al., 1976*
Streptomyces scabies	Potato scab	Potato	-	F - Physiologically acid fertilizer	KCl	*Dhein, 1938 in Wenzl et al., 1974*
Streptomyces scabies	Potato scab	Potato	-	F - Physiologically alkalin fertilizer	KCl	*Dhein, 1938 in Wenzl et al., 1974*

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0 No effect i.e. parasite development or damage unchanged

Table 192 **K-effect on bacteria** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Streptomyces scabies	Potato scab	Potato	+	F - Physiologically acid fertilizer	K_2SO_4	*Dhein, 1938 in Wenzl et al., 1974*
Streptomyces scabies	Potato scab	Potato	+ (59)	L - Without calcium application - Number lesions	KCl	*Doyle et al., 1960*
Streptomyces scabies	Potato scab	Potato	+ (28)	L - Calcium applied as calcium sulphate - Number lesions	KCl	*Doyle et al., 1960*
Streptomyces scabies	Potato scab	Potato	- (20)	L - Calcium applied as calcium hydroxide - Number lesions	KCl	*Doyle et al., 1960*
Streptomyces scabies	Potato scab	Potato	-			*Mc New, 1953*
Streptomyces scabies	Potato scab	Potato	0	F - Disease incidence		*Varis, 1972*
Streptomyces scabies	Potato scab	Potato	+	F - Long-term trial - Disease intensity in 1963		*Wenzl et al., 1974*
Streptomyces scabies	Potato scab	Potato	-	F - Long-term trial - Disease intensity in 1970		*Wenzl et al., 1974*
Xanthomonas axonoperis	Gomosis	Imperial grass	+ (93)	F - % dead plants	KCl	*Castano et al., 1965*
Xanthomonas campestris	Cabbage black rot	Cabbage	+ (8)	L - Lesion size	KCl	*Iza et al., 1986*
Xanthomonas campestris	Cabbage black rot	Cabbage	+ (21)	L - % infection	KCl	*Iza et al., 1986*
Xanthomonas campestris	Cabbage black rot	Cabbage	40	L - Disease index - 4 trials		*Walker et al., 1951*
Xanthomonas campestris	Cassava bacterial blight	Cassava	+ (50)	L - Resistant variety - Number leaf spots	KCl	*Ikotun et al., 1984*
Xanthomonas campestris	Cassava bacterial blight	Cassava	+ (50)	L - Susceptible variety - Number leaf spots	KCl	*Ikotun et al., 1984*
Xanthomonas campestris	Bacterial leaf blight	Rice	+ (18)	L - Susceptible variety - Lesion length	K_2SO_4	*Mohanty et al., 1983*

Xanthomonas campestris	Bacterial leaf blight	Rice	+ (24)	L - Intermediate variety - Lesion length	K_2SO_4	*Mohanty et al., 1983*
Xanthomonas campestris	Bacterial leaf blight	Rice	+ (45)	L - Tolerant variety - Lesion length	K_2SO_4	*Mohanty et al., 1983*
Xanthomonas campestris	Bacterial leaf blight	Rice	+ (50)	L - Lesion length		*Mondal et al., 1985*
Xanthomonas malvacearum	Angular leaf spot	Cotton	+	Disease incidence		*Rolfs, 1915 in Huber et al., 1985*
Xanthomonas manihotis	Cassava bacterial blight	Cassava	+ (29)	F - Tolerant variety - % wilt	KCl	*Adeniji et al., 1978*
Xanthomonas manihotis	Cassava bacterial blight	Cassava	+ (15)	F - Susceptible variety - % wilt	KCl	*Adeniji et al., 1978*
Xanthomonas manihotis	Cassava bacterial blight	Cassava	+ (18)	F - Soil low in K - % infection	KCl	*Odurukwe et al., 1980*
Xanthomonas manihotis	Cassava bacterial blight	Cassava	+	F - Soil low in K - Disease index	KCl	*Odurukwe et al., 1980*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+	% affected leaves		*Devadath et al., 1970 in Ismunadji, 1976*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+ (11)	Lesion length		*Devadath et al., 1970 in Ismunadji, 1976*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+	Disease intensity		*Hashioka, 1951 in Reddy et al., 1975*
Xanthomonas oryzae	Bacterial leaf blight	Rice	0	F - Artificial inoculation - Lesion length	KCl	*Ho et al., 1978*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+	L - Lesion size		*Kim et al., 1970*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+ (64)	Spot size		*Lee, 1966*
Xanthomonas oryzae	Bacterial leaf blight	Rice	3 +	F - Disease index - 3 seasons		*Mondal et al., 1982*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+ (24)	F - Number affected leaves		*Padhi et al., 1972*

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0 No effect i.e. parasite development or damage unchanged

Table 192 **K-effect on bacteria** (continued)

Latin name	English name	Crop	K-effect*	Remarks (F = field trials; L = trials in laboratory, pots, etc)	K-form	Reference
Xanthomonas oryzae	Bacterial leaf blight	Rice	0	L - Highly susceptible variety - Lesion length		*Reddy et al., 1975*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+	L - Less susceptible variety - Lesion length		*Reddy et al., 1975*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+	Disease intensity		*Tagami et al., 1962 in Reddy et al., 1975*
Xanthomonas oryzae	Bacterial leaf blight	Rice	+ (63)	F - Disease incidence		*Tominaga, 1950 in Ono, 1957*
Xanthomonas pelargonii	Bacterial stem rot	Geranium	+	L - Disease index		*Kivilaan et al., 1958*
Xanthomonas phaseoli	Common blight	Beans	4-(169)	L - Disease index - 4 trials		*Patel et al., 1963*
Xanthomonas pruni	Bacterial spot	Peaches	2+(42)	Infection intensity - 2 varieties		*Matthee et al., 1969*
Xanthomonas sp.		Philodendron	+	L - Disease intensity		*Harkness et al., 1970*
Xanthomonas sp.		Philodendron	+	L - Number lesions per leaf		*Harkness et al., 1970*
Xanthomonas sp.		Philodendron	2 -	L - % affected leaves - 2 trials		*Harkness et al., 1970*
Xanthomonas sp.		Philodendron	2 +	L - % affected leaves - 2 trials		*Harkness et al., 1970*
Xanthomonas spp.		Cabbage	+	Crop susceptibility		*Popov, 1957 in Fuchs et al., 1972*
Xanthomonas spp.		Cabbage	+	Crop susceptibility		*Ruizhkova, 1955 in Fuchs et al., 1972*
Xanthomonas vesicatoria		Tomato	2 +	L - Disease index - Average of 2 trials		*Nayudu et al., 1960*
	Bacterial leaf blight	Maize	+	F - Disease index	KCl	*Webb et al., 1968*
	Potato scab	Potato	- (122)	L - Number scabby areas		*Schroeder et al.,1942*

Potato scab	Potato	- (100)	L - Number deep lesions	*Schroeder et al.,1942*
Wildfire	Tobacco	+	Crop susceptibility	*Böning, 1929 in Eckstein et al., 1937*

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0 No effect i.e. parasite development or damage unchanged

15. Index of parasite names

15.1. English names

15.1.1. Fungal diseases

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Brown rust of rye (Rye)	*Puccinia dispersa*	47,248
Brown rust of wheat (Wheat)	*Puccinia triticina*	41,249
Brown spot (Coffee)	*Cercospora coffeicola*	76,77,281

		Page
Brown spot (Tobacco)	*Alternaria longipes*	77,281
Brown stem rot (Soybeans)	*Cephalosporium gregatum*	64,275
Bunt of wheat (Wheat)	*Tilletia foetida, Tilletia* spp.	41,249
Cabbage clubroot (Cabbage)	*Plasmodiophora brassicae*	78,282
Cabbage clubroot (Mustard)	*Plasmodiophora brassicae*	78,286
Cabbage clubroot (Turnip)	*Plasmodiophora brassicae*	79,289
Cabbage yellows (Cabbage)	*Fusarium oxysporum*	78,283
Cercospora (Beets)		73,277
Cercospora leaf spot (Cassava)	*Cercospora henningsii*	73,74,159,278
Cercospora leaf spot (Rice)	*Cercospora oryzae*	30,31,242
Charcoal rot (Maize)	*Sclerotium bataticola*	24,233
Charcoal rot (Soybeans)		64,275
Chocolate spot (Beans)	*Botrytis* sp.	78,282
Chocolate spot (Broad beans)	*Botrytis* spp.	78,282
Coconut heart rot (Coconut)		68,272
Common root rot (Barley)	*Helminthosporium sativum*	19,21,230
Common root rot (Wheat)	*Helminthosporium sativum*	40,41,249
Corn root rot (Maize)	*Gibberella, G. roseum, G. saubinetti, G. zeae*	24,233
Corn rust (Maize)	*Puccinia sorghi*	24,233
Corn smut (Maize)	*Ustilago maydis, U. zeae*	24,234
Coryneum blight (Peaches)	*Clasterosporium carpophilum*	61,272
Cotton wilt (Cotton)	*Fusarium oxysporum, F.* spp.	21,48,256
Crown rust of oats (Oats)	*Puccinia coronifera*	47,239
Currant anthracnose (Black currant)	*Pseudopeziza ribis*	61,269
Cytospora canker (Plums)	*Cytospora leucostoma*	61,272
Damping-off (Beets)	*Pythium debaryanum, P. ultimum*	73,278
Damping-off (Cotton)	*Rhizoctonia solani*	48,259
Damping-off (Cowpea)	*Rhizoctonia solani*	78,284
Dirty panicle disease (Rice)	*Curvularia* spp., *Helminthosporium oryzae, Nigrospora* spp.	30,242
Dollarspot (Bermudagrass)	*Sclerotinia homoeocarpa*	52,53,260
Dollarspot (Turfgrasses)	*Sclerotinia homoeocarpa*	87,291
Downy mildew (Cabbage)	*Peronospora parasitica*	78,283
Downy mildew (Cauliflower)	*Peronospora parasitica*	78,283
Downy mildew (Grapes)	*Plasmospara viticola*	60,61,63,270
Downy mildew (Muskmelon)	*Pseudoperonospora cubensis*	78,284
Downy mildew (Pearl millet)	*Sclerospora graminicola*	47,239
Dry eye rot of apple (Apples)	*Botrytis cinerea*	61,267
Dry rot (Gladiolus)	*Stromatinia gladioli*	87,290

		Page
Dry rot of potato (Potato)	*Fusarium coerulum*	73,74,278
Dryland root rot (Barley)	*Fusarium* spp.	21,230
Early blight of potato (Potato)	*Alternaria solani*	73,74,279
Ergot (Pearl millet)	*Claviceps microcephala*	47,239
Eyespot (Sugarcane)	*Helminthosporium sacchari*	73,280
Eyespot (Wheat)	*Cercosporella herpotrichoides*	40,41,250
Flax rust (Flax)	*Melampsora lini*	51,259
Flag smut (Wheat)	*Urocystis tritici*	40,41,250
Foot rot (Squash)	*Fusarium solani*	79,288
Fruit rot (Peppers)	*Alternaria solani, Colletotrichum capsici*	86,290
Fusarium basal rot (Gladiolus)	*Fusarium* sp.	87,290
Fusarium wilt (Oil palm)	*Fusarium oxysporum*	68,70,273
Fusarium wilt of cantaloupe (Cantaloupe)	*Fusarium oxysporum*	78,283
Fusarium wilt of carnations (Carnations)	*Fusarium oxysporum*	87,289
Fusarium wilt of tomato (Tomato)	*Fusarium oxysporum*	79,85,288
Fusarium yellows (Celery)	*Fusarium oxysporum*	78,163,283
Fusarium yellows (Gladiolus)	*Fusarium oxysporum*	87,290
Gloesporium fruit rot (Apples)	*Gloesporium album*	61,62,267
Glume blotch (Wheat)	*Septoria nodorum*	40,41,42,250
Gooseberry mildew (Gooseberry)	*Sphaerotheca mors*	61,270
Gooseberry mildew (Red currant)	*Sphaerotheca mors*	61,272
Grey mold (Cabbage)	*Botrytis cinerea*	78,283
Grey mold (Grapes)	*Botrytis cinerea*	61,271
Grey mould (Potato)	*Botrytis cinerea*	73,159,161,279
Helminthosporium (Coconut)		68,272
Helminthosporium leaf spot (Bermudagrass)	*Helminthosporium cynodontis*	52,53,261
Helminthosporium red leaf spot (Turfgrasses)	*Helminthosporium erythrospilum*	87,291
Hypoxylon canker (Trembling aspen)	*Hypoxylon mammatum*	57,266
Ink disease (Chestnut)	*Phytophthora cambivora*	61,270
Jute anthracnose (Jute)	*Colletotrichum corchorum*	51,260
Jute stem rot (Jute)	*Macrophomina phaseoli, M. corchori*	51,260
Late blight (Potato)	*Phytophthora infestans*	72,73,74,279
Late wilt (Maize)	*Cephalosporium maydis*	24,234
Leaf blight (Cotton)	*Cercospora + Alternaria*	48,50,259

		Page
Leaf blight (Tomato)		79,289
Leaf blotch (Poplar)	*Marssonina brunea*	57,59,265
Leaf fleck (Cocksfoot)	*Mastigosporium rubricosum*	53,262
Leaf mold of tomato (Tomato)	*Cladosporium fulvum*	79,289
Leaf rust (Coffee)		77,281
Leaf rust (Wheat)	*Puccinia recondita, P. tritici*	41,251
Leafspot (Bermudagrass)		52,53,261
Leafspot (Clover)	*Pseudopeziza trifolii*	53,261
Leaf spot (Coconut)	*Drechslera incurvata, Pestalozzia palmarum*	68,69,159,273
Leaf spot (Cotton)	*Alternaria* spp.	48,259
Leafspot (Cocksfoot)	*Helminthosporium* spp., *Mastigosporium rubricosum, Rhynchosporium orthosporum*	53,262
Leaf spot (Fescue)	*Helminthosporium* spp.	53,262
Leaf spot (Lucerne)	*Pseudopeziza medicaginis*	53,262
Leaf spot (Ryegrass)	*Helminthosporium* spp.	53,263
Leaf spot (Strawberry)	*Micosphaerella fragariae*	87,291
Leafspot (Timothy)	*Cladosporium phlei, Heterosporium phlei*	53,56,263
Leafspot (Wheat)	*Puccinia tritici-repentis, Septoria avenae*	41,252
Leaf stripe of barley (Barley)	*Helminthosporium gramineum*	21,231
Mal secco (Citrus)	*Phoma tracheiphila*	61,270
Mildew (Apples)		61,267
Mildew (Barley)		21,231
Mildew (Grapes)		13,61,271
Mildew (Oak)		57,264
Mildew (Oats)		47,239
Mildew (Potato)		73,75,280
Mildew (Roses)		87,290
Mildew (Wheat)		41,43,252
Mint rust (Mint)	*Puccinia menthae*	87,290
Muskmelon wilt (Muskmelon)	*Fusarium oxysporum, F.* spp.	78,81,285
Needle mildew (Sugi)		57,266
Net-blotch of barley (Barley)	*Helminthosporium teres*	21,22,231
Northern anthracnose (Clover)	*Kabatiella caulivora*	53,261
Northern corn leaf blight (Maize)	*Helminthosporium turcicum*	24,26,235
Northern leaf blight (Maize)	*Exserohilum turcicum*	235
Ophiobolus patch (Turfgrasses)	*Ophiobolus graminis*	87,291
Phoma root rot (Chrysanthemum)	*Phoma chrysanthemicola*	87,289
Phomopsis seed rot (Soybeans)	*Phomopsis* sp.	64,65,275

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Phytophthora blight of pigeon pea (Pigeon pea)	*Phytophthora drechsleri*	79,84,159,288
Phytophtora leaf spot (Philodendron)	*Phytophthora* spp.	87,290
Phytophthora root rot (Avocado)	*Phytophthora cinnamoni*	61,269
Phytophthora root rot (Lucerne)	*Phytophthora megasperma*	53,262
Pine needle cast (Pine)	*Lophodermium pinastri*	57,58,264
Pitch canker (Pine)	*Fusarium moniliforme*	57,58,265
Pod and stem blight (Soybeans)	*Diaporthe phaseolorum, D. sojae*	21,64,65,275
Poplar leaf rust (Poplar)	*Melampsora larici-populina*	57,59,266
Potato stem-end rot (Potato)	*Fusarium* spp.	73,75,280
Powdery mildew (Barley)	*Erysiphe graminis*	19,21,23,175,231
Powdery mildew (Cereals unspecified)	*Erysiphe graminis*	47,232
Powdery mildew (Cocksfoot)	*Erysiphe graminis*	53,262
Powdery mildew (Fescue)	*Erysiphe graminis*	53,262
Powdery mildew (Grapes)	*Uncinula necator*	60,61,271
Powdery mildew (Roses)	*Sphaerotheca pannosa*	87,290
Powdery mildew (Rye)	*Erysiphe graminis*	248
Powdery mildew (Wheat)	*Erysiphe graminis*	21,40,41,43,252
Powdery mildew of tobacco (Tobacco)	*Erysiphe cichoracearum*	77,281
Powdery scab of potato (Potato)	*Spongospora subterranea*	73,75,280
Purple seed stain (Soybeans)	*Cercospora kikuchii*	64,66,276
Ragi blast (Finger millet)	*Pyricularia setariae*	46,47,159,162,233
Red thred disease (Turfgrasses)	*Corticium fuciforme*	86,87,291
Rhizoctonia brown patch (Turfgrasses)		87,292
Rhizoctonia seedling disease (Cotton)		48,50,259
Rice blast (Rice)	*Pyricularia oryzae*	19,21,30,32,159,242
Root rot (Beets)	*Phoma betae, Pythium, Rhizoctonia*	72,73,278
Root rot (Clover)	*Fusarium oxysporum, F. roseum, F. solani*	53,261
Root rot (Jute)		51,260
Root rot (Lucerne)	*Fusarium oxysporum, F. tricinctum, F.* spp.	53,54,262

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Root rot (Maize)	*Fusarium* spp.	24,235
Root rot (Pine)	*Fusarium oxysporum, Macrophomina phaseolina*	57,265
Root rot (Sesame)	*Rhizoctonia solani*	68,275
Rust (Beets)		73,278
Rust (Coffee)	*Hemileia vastatrix*	76,77,281
Rust (Sorghum)	*Puccinia purpurea*	47,248
Rust (Wheat)	*Puccinia* spp.	159,160
Rusts (Wheat)	*Puccinia* spp.	41,44,253
Rust unspecified (Wheat)		253
Rusts unspecified (Cereals unspecified)		47,233
Rye ergot (Rye)	*Claviceps purpurea*	47,248
Scab (Apples)	*Venturia inaequalis*	61,268
Sclerotiniosis (Rice)	*Leptosphaeria salvini*	30,35,245
Septoria (Oats)	*Septoria avenae*	46,47,239
Septoria brown spot (Soybeans)		64,277
Sesame blight (Sesame)	*Helminthosporium* spp.	68,275
Sheath blight (Rice)	*Rhizoctonia solani, Thanatephorus cucumeris*	30,36,159,246
Sheath rot (Rice)	*Sarocladium oryzae*	30,36,246
Shoot rot (Coconut)	*Gloesporium*	68,273
Snow blight (Pine)	*Phacidium infestans*	57,265
Snow blight (Tree unspecified)	*Herpotrichia juniperi*	57,267
Snow mold (Ryegrass)	*Fusarium nivale*	53,55,263
Snow mold (Timothy)	*Fusarium nivale, Sclerotinia borealis, Typhula ishikariensis*	53,57,264
Snow mold (Turfgrasses)	*Fusarium nivale, Typhula itoana*	87,292
Southern anthracnose of alfalfa (Lucerne)		53,263
Speckled leaf blotch (Wheat)	*Septoria tritici*	41,45,253
Stalk rot (Maize)	*Diplodia maydis, D. zeae, D.* spp., *Fusarium* spp., *Gibberella roseum, G.* spp., *G. zeae, Pythium* spp., *Rhizoctonia bataticola*	21,24, 26, 159,161,236
Stem and crown blight (Soybeans)	*Rhizoctonia solani*	64,277
Stem rot (Oil palm)	*Fomes noxious*	68,70,159,274
Stem rot (Rice)	*Helminthosporium sigmoideum, Helminthosporium* spp.	30,38,159,160,246

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Stem rot (Tomato)	*Diplodia lycopersici*	79,289
Stemphylium leaf spot (Lucerne)	*Stemphylium sarciniforme*	53,263
Stem rust (Wheat)	*Puccinia graminis*	41,253
Strawberry fruit rot (Strawberry)	*Botrytis cinerea*	87,291
Stripe rust (Wheat)	*Puccinia glumarum*	41,254
Stripe smut (Turfgrasses)	*Ustilago striiformis*	87,292
Sugary disease of sorghum (Sorghum)	*Sphacelia sorghi*	46,47,248
Take-all (Barley)	*Gaeumannomyces graminis*	21,23,232
Take-all (Wheat)	*Gaeumannomyces graminis*	40,41,45,164, 173,175,255
Tuber blight (Potato)		73,280
Verticillium wilt (Cacao)	*Verticillium dahliae*	77,280
Verticillium wilt (Cotton)	*Verticillium albo-atrum, V.dahliae, V.* sp.	48,50,259
Verticillium wilt (Eggplant)	*Verticillium albo-atrum*	78,284
Verticillium wilt (Lion's mouth)	*Verticillium* spp.	87,290
Verticillium wilt (Lucerne)		53,263
Verticillium wilt (Pistachio)	*Verticillium dahliae*	61,272
Verticillium wilt (Radish)	*Verticillium* sp.	79,288
Verticillium wilt (Tomato)	*Verticillium albo-atrum*	79,289
Walnut anthracnose (Black walnut)	*Gnomonia leptostyla*	57,58,264
White rot (Onions)	*Sclerotium cepivorum*	78,82,286
Wilt (Flax)	*Fusarium lini*	51,259
Yellow spot disease (Sugarcane)	*Cercospora kopkei*	73,76,280
Yellow rust (Barley)		21,232
Yellow rust (Wheat)		41,255

15.1.2. Insects and mites

Apple aphid	*Aphis pomi*	92,296
Apple grain aphid	*Rhopalosiphum fitchi, R. padi*	300
Bean aphid	*Aphis fabae*	92,93,296
Black scale	*Saissetia oleae*	102,105,306
Black vine weevil	*Brachyrhinus sulcatus*	113,114,311
Blue jassid	*Zygina maculifrons*	100,101,303
Brown planthopper	*Nilaparvata lugens*	100,101,304
Cabbage aphid	*Brevicoryne brassicae*	92,94,296
Capitulum borer	*Heliothis armigera*	106,109,308

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Carmine mite	*Tetranychus telarius*	118,119,315
Cassava mealybug	*Phenacoccus manihoti*	100,101,303
Cereal leaf beetle	*Lema melanopus*	114,311
Chinch bug	*Blissus leucopterus*	90,91,294
Citrus bud mite	*Aceria sheldoni*	117,118,314
Citrus mealybug	*Planococcus citri*	101,304
Clover mite	*Bryobia praetiosa*	118,314
Comstock mealybug	*Pseudococcus comstocki*	101,304
Corn earworm	*Heliothis zea*	106,109,308
Corn rootworm	*Diabrotica* spp.	114,311
Cotton aphid	*Aphis gossypii*	92,296
Cotton jassid	*Empoasca devastans*	101,303
Cotton leaf roller		107,113,310
Cotton stem weevil		114,115,312
European corn borer	*Pyrausta nubilalis*	107,111,309
European pine shoot moth	*Rhyacionia buoliana*	107,111,309
European red mite	*Panonychus ulmi*	118,314
Fall armyworm	*Spodoptera frugiperda*	107,309
Flea beetles		114,312
Frit fly	*Oscinella frit*	117,313
Fruit borer	*Leucinodes orbonalis*	107,110,159,162,308
Goutfly	*Chlorops taeniopus*	117,313
Greenbug	*Schizaphis graminum*	92,300
Greenbug	*Toxoptera graminum*	92,100,301
Green leafhopper	*Nephotettix virescens*	100,101,303
Green peach aphid	*Myzus persicae*	91,92,96,298
Groundnut aphid	*Aphis craccivora*	92,295
Internode borer	*Chilo sacchariphagus*	106,307
Large cabbage white	*Pieris brassicae*	107,111,308
Leaf caterpillar	*Spodoptera litura*	107,112,310
Leaf roller	*Cnaphalocrocis medinalis*	106,108,308
Mustard aphid	*Lipaphis erysimi*	92,95,297
Mustard beetle	*Phaedon cochleariae*	114,312
Oak scale	*Eulecanium rufulum*	102,103,305
Obscure root weevil	*Sciopithes obscurus*	114,312
Pea aphid	*Acyrthosiphon pisum*	91,92,295
Pea weevil	*Sitona lineatus*	114,312
Pine sawfly	*Diprion pini*	115,116,313
Potato aphid	*Macrosiphum euphorbiae*	92,95,297
Potato leafhopper	*Empoasca fabae*	101,103
Purple scale	*Lepidosaphes beckii*	102,104,306
Rice gall fly	*Pachydiplosis oryzae*	117,313

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Rice stem borer	*Chilo suppressalis*	106,307
Rice weevil	*Sitophilus oryzae*	114,312
Rice whorl maggot	*Hydrellia sasakii*	116,117,313
Robinia scale	*Eulecanium corni*	102,305
Shot-hole borer	*Scolytus rugolosus*	114,312
Small pine sawfly	*Pristiphora abietina*	116,313
Spotted alfalfa aphid	*Therioaphis maculata*	92,99,301
Stalk borer	*Chilo auricilus*	106,307
Stem borer		107,311
Stem weevil	*Pempheres officinis*	114,312
Sugarcane leafhopper	*Pyrilla pusana*	101,304
Sugarcane scale	*Melanaspis glomerata*	102,104,306
Sugarcane shoot borer	*Chilo infuscatellus*	106,307
Sweet potato weevil	*Cylas formicarius*	113,114,311
Sweet potato whitefly	*Bemisia tabaci*	101,102,306
Tea mosquito	*Helopeltis theivora*	91,294
Tobacco flea beetle	*Epitrix hirtipennis*	114,115,311
Tobacco hornworm	*Manduca sexta*	107,110,308
Tobacco thrips	*Frankliniella fusca*	90,91,294
Top borer		107,311
Twospotted spider mite	*Tetranychus urticae*	118,120,315
Western spruce budworm	*Choristoneura occidentalis*	106,108,307
Wheat bulb fly	*Phorbia coarctata*	117,313
Wheat stem sawfly	*Cephus cinctus*	116,312
White pine weevil	*Pissodes strobu*	114,312
Wireworms		114,312
Whorl maggot		117,313
Woolly apple aphid	*Eriosoma lanigerum*	92,95,296
Yellow borer	*Tryporyza incertulas*	107,112,310

15.1.3. Nematodes

American dagger nematode	*Xiphinema americanum*	121,324
Cobb's meadow nematode	*Pratylenchus penetrans*	121,127,322
Javanese root-knot nematode	*Meloidogyne javanica*	121,126,322
Northern root-knot nematode	*Meloidogyne hapla*	121,123,319
Reniform nematode	*Rotylenchus reniformis*	121,128,323
Rice nematode	*Aphelenchoides oryzae*	121,318
Root-knot nematode	*Meloidogyne incognita*	121,123,159,173,319
Soybean cyst nematode	*Heterodera glycines*	121,122,318

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Stunt nematode	*Tylenchorhynchus latus*	121,324
Sugarbeet nematode	*Heterodera schachtii*	121,122,318

15.1.4. Viruses

Beet yellows	138,139,331
Beta virus 4	138,139,331
Cauliflower mosaic	134,328
Cucumber mosaic	134,329
Cucumber virus 1	138,139,331
Leafroll	131,326
Maize dwarf mosaic	134,329
Maize mosaic	134,329
Mosaic unspecified	134,138,331
Peppers mosaic	134,135,329
Potato virus X	139,331
Potato virus Y	139,331
Potato virus Y^N	139,140,331
Pseudonetnecrose	139,332
Rice stripe disease	139,140,332
Spot mosaic of tomato	134,135,329
Streak of tomato	139,332
Sunnhemp mosaic virus	134,135,329
Tobacco mosaic virus	134,329
Tomato bushy stunt virus	139,140,332
Tomato mosaic virus	134,135,137,330
Tomato spotted wilt	139,141,332
Tomato stripe	134,137,331
Turnip virus No. 1	139,141,333
Viruses unspecified	139,333
Watermelon mosaic virus	134,331
Wheat streak mosaic	134,138,331

15.1.5. Bacteria

Angular leaf spot	*Pseudomonas angulata*	335
Angular leaf spot (Cotton)	*Xanthomonas malvacearum*	146,339
Angular leaf spot (Cucumbers)	*Pseudomonas lachrymans*	143,336
Bacterial blight (Lima bean)	*Pseudomonas syringae*	145,337

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Bacterial canker of tomato (Tomato)	*Corynebacterium michiganense*	152,334
Bacterial leaf blight (Maize)		159,340
Bacterial leaf blight (Philodendron)	*Erwinia chrysanthemi*	152,159,335
Bacterial leaf blight (Rice)	*Xanthomonas campestris, X. oryzae*	159,162,339
Bacterial spot (Peaches)	*Xanthomonas pruni*	146,149,340
Bacterial stem rot (Geranium)	*Xanthomonas pelargonii*	146,340
Bacterial wilt of alfalfa (Lucerne)	*Corynebacterium insidiosum*	152,334
Bacterial wilt of maize (Maize)	*Phytomonas stewartii*	152,153,335
Bacterial wilt of potato (Potato)	*Pseudomonas solanacearum*	336
Bacterial wilt of tomato (Tomato)	*Pseudomonas solanacearum*	144,336
Blackfire (Tobacco)	*Pseudomonas angulata*	335
Cabbage black rot (Cabbage)	*Xanthomonas campestris*	338
Cassava bacterial blight (Cassava)	*Xanthomonas campestris, X. manihotis*	146,338,339
Chocolate spot (Maize)	*Pseudomonas syringae*	336
Common blight (Beans)	*Xanthomonas phaseoli*	146,340
Fire blight (Pear)	*Erwinia amylovora*	152,334
Gomosis (Imperial grass)	*Xanthomonas axonoperis*	146,338
Halo blight (Beans)	*Pseudomonas phaseolicola*	143,336
Potato scab (Potato)	*Streptomyces scabies*	152,153,337
Soft rot (Cabbage)	*Erwinia carotovora*	152,335
Streak disease of tomato (Tomato)	*Bacterium lathyri*	152,334
Tomato graywall (Tomato)	*Erwinia herbicola*	152,153,335
Tomato ring rot (Tomato)	*Corynebacterium sepedonicum*	152,334
Wildfire (Tobacco)	*Pseudomonas tabaci*	143,337

15.2. Latin names

15.2.1. Fungal diseases

Alternaria (Cotton)		259
Alternaria longipes (Tobacco)	Brown spot	77,281
Alternaria solani (Peppers)		86,87,290

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Alternaria solani (Potato)	Early blight of potato	73,74,279
Alternaria solani (Tomato)	Alternaria leaf spot	79,85,288
Alternaria spp. (Cotton)	Leaf spot	48,259
Aphanomyces euteiches (Peas)	Aphanomyces root rot	79,84,287
Armillaria mellea (Banana)		61,62,269
Ascochyta trifolii (Clover)		53,262
Botrytis cinerea (Apples)	Dry eye rot of apple	61,267
Botrytis cinerea (Cabbage)	Grey mold	78,283
Botrytis cinerea (Grapes)	Grey mold	61,271
Botrytis cinerea (Lettuce)	Botrytis rot	78,284
Botrytis cinerea (Potato)	Grey mould	73,159,161,279
Botrytis cinerea (Strawberry)	Strawberry fruit rot	87,291
Botrytis cinerea (Tomato)		79,289
Botrytis sp. (Beans)	Chocolate spot	78,282
Botrytis spp. (Beans)		78,282
Botrytis spp. (Broad beans)	Chocolate spot	78,282
Botrytis spp. (Peas)		79,288
Botytris spp. (Tree unspecified)		57,266
Cephalosporium gregatum (Soybeans)	Brown stem rot	64,275
Cephalosporium maydis (Maize)	Late wilt	24,234
Cercospora (Cotton)		259
Cercospora coffeicola (Coffee)	Brown spot	76,77,281
Cercospora henningsii (Cassava)	Cercospora leaf spot	73,74,159,278
Cercospora kikuchii (Soybeans)	Purple seed stain	64,66,276
Cercospora kopkei (Sugarcane)	Yellow spot disease	73,76,280
Cercospora oryzae (Rice)	Cercospora leaf spot	30,31,242
Cercosporella herpotrichoides (Wheat)	Eyespot	40,41,250
Cladosporium fulvum (Tomato)	Leaf mold of tomato	79,289
Cladosporium phlei (Timothy)	Leafspot	263
Clasterosporium carpophilum (Peaches)	Coryneum blight	61,272
Claviceps microcephala (Bajra)	Ergot	47,239
Claviceps purpurea (Rye)	Rye ergot	47,248
Colletotrichum (Beans)	Anthracnose	282
Colletotrichum camelliae (Tea)		77,281
Colletotrichum capsici (Peppers)		86,87,290
Colletotrichum corchorum (Jute)	Jute anthracnose	51,260
Colletotrichum dematium (Soybeans)	Anthracnose	64,65,275
Colletotrichum gloesporiodes (Tea)	Anthracnose	281

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Colletotrichum hibisci (Kenaf)	Anthracnose	51,260
Colletotrichum lindemuthianum (Beans)	Anthracnose	282
Colletotrichum lindemuthianum (Peas)	Anthracnose	79,287
Colletotrichum manihotis (Cassava)	Anthracnose	73,278
Corticium fuciforme (Turfgrasses)	Red thred disease	86,87,291
Coryneum cardinale (Cupressus)		57,264
Curvularia spp. (Rice)	Dirty panicle disease	242
Cytospora leucostoma (Plums)	Cytospora canker	61,272
Cytosporina ludibunda (Apples)		61,268
Diaporthe phaseolorum (Soybeans)	Pod and stem blight	64,65,275,277
Diaporthe sojae (Soybeans)	Pod and stem blight	64,65,275
Diplodia lycopersici (Tomato)	Stem rot	79,289
Diplodia maydis (Maize)	Stalk rot	238
Diplodia zeae (Maize)	Stalk rot	236,237,238
Drechslera incurvata (Coconut)	Leaf spot	69,159,273
Drechslera oryzae (Rice)	Brown leaf spot	240
Epichloe (Grassland)		53,262
Erysiphe cichoracearum (Tobacco)	Powdery mildew of tobacco	77,281
Erysiphe graminis (Barley)	Powdery mildew	19,21,23,175,231
Erysiphe graminis (Cereals unspecified)	Powdery mildew	47,232
Erysiphe graminis (Cocksfoot)	Powdery mildew	53,262
Erysiphe graminis (Fescue)	Powdery mildew	53,262
Erysiphe graminis (Rye)	Powdery mildew	248
Erysiphe graminis (Wheat)	Powdery mildew	21,40,41,43,252
Erysiphe polygoni (Clover)		53,262
Exserohilum turcicum (Maize)	Northern leaf blight	235
Fomes noxious (Oil palm)	Stem rot	68,70,159,274
Fusarium bulbigenum (Oil palm)	Boyomi disease	68,70,273
Fusarium coerulum (Potato)	Dry rot of potato	73,74,278
Fusarium culmorum (Wheat)	Brown foot rot of wheat	41,248
Fusarium lini (Flax)	Wilt	51,259
Fusarium moniliforme (Pine)	Pitch canker	57,58,265
Fusarium nivale (Ryegrass)	Snow mold	53,55,263
Fusarium nivale (Timothy)	Snow mold	57,264
Fusarium nivale (Turfgrasses)	Snow mold	292
Fusarium oxysporum (Bananas)	Banana wilt	61,269
Fusarium oxysporum (Cabbage)	Cabbage yellows	78,283
Fusarium oxysporum (Cantaloupe)	Fusarium wilt of cantaloupe	78,283
Fusarium oxysporum (Carnations)	Fusarium wilt of carnations	78,289

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Fusarium oxysporum (Celery)	Fusarium yellows	78,163,283
Fusarium oxysporum (Clover)	Root rot	261
Fusarium oxysporum (Cotton)	Cotton wilt	256
Fusarium oxysporum (Gladiolus)	Fusarium yellows	87,290
Fusarium oxysporum (Lucerne)	Root rot	263
Fusarium oxysporum (Muskmelon)	Muskmelon wilt	81,285
Fusarium oxysporum (Oil palm)	Fusarium wilt	68,70,273
Fusarium oxysporum (Onions)	Basal rot	78,81,287
Fusarium oxysporum (Pine)	Root rot	265
Fusarium oxysporum (Tomato)	Fusarium wilt of tomato	79,85,288
Fusarium roseum (Clover)	Root rot	261
Fusarium solani (Clover)	Root rot	261
Fusarium solani (Squash)	Foot rot	79,288
Fusarium sp. (Carnations)		87,289
Fusarium sp. (Gladiolus)	Fusarium basal rot	87,290
Fusarium spp. (Barley)	Dryland root rot	21,230
Fusarium spp. (Cotton)	Cotton wilt	257
Fusarium spp. (Lucerne)	Root rot	54,263
Fusarium spp. (Maize)	Root rot	24,235
Fusarium spp. (Maize)	Stalk rot	237,238,239
Fusarium spp. (Muskmelon)	Muskmelon wilt	285
Fusarium spp. (Peanut)		68,72,275
Fusarium spp. (Potato)	Potato stem-end rot	73,75,280
Fusarium spp. (Wheat)		41,256
Fusarium tricinctum (Lucerne)	Root rot	262
Gaeumannomyces graminis (Barley)	Take-all	21,23,232
Gaeumannomyces graminis (Wheat)	Take-all	40,41,45,164,173,175,255
Gibberella (Maize)	Corn root rot	233
Gibberella roseum (Maize)	Corn root rot	233
Gibberella roseum (Maize)	Stalk rot	239
Gibberella saubinetii (Maize)	Corn root rot	233
Gibberella sp. (Maize)		238,239
Gibberella spp. (Maize)	Stalk rot	238,239
Gibberella zeae (Maize)	Corn root rot	233
Gibberella zeae (Maize)	Stalk rot	236
Gloesporium (Coconut)	Shoot rot	68,273
Gloesporium album (Apple)	Gloesporium fruit rot	61,62,267
Gloesporium ssp. (Apple)		61,268
Gloesporium theae-sinensis (Tea)	Anthracnose	76,281
Gnomonia leptostyla (Black walnut)	Walnut anthracnose	57,58,264
Helminthosporium (Various		

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foddergrasses)		53,264
Helminthosporium cynodontis (Bermudagrass)	Helminthosporium leaf spot	52,53,261
Helminthosporium erythrospilum (Turfgrasses)	Helminthosporium red leaf spot	87,291
Helminthosporium gramineum (Barley)	Leaf stripe of barley	21,231
Helminthosporium oryzae (Rice)	Brown leaf spot	29,30,240,241,242
Helminthosporium poae (Turf-grasses)		87,292
Helminthosporium sacchari (Sugar-cane)	Eye spot	73,280
Helminthosporium sativum (Barley)	Common root rot	19,21,230
Helminthosporium sativum (Wheat)	Common root rot	40,41,249
Helminthosporium sigmoideum (Rice)	Stem rot	246
Helminthosporium spp. (Cocksfoot)	Leaf spot	262
Helminthosporium spp. (Fescue)	Leaf spot	53,262
Helminthosporium spp. (Rice)		30,248
Helminthosporium spp. (Ryegrass)	Leaf spot	53,263
Helminthosporium spp. (Sesame)	Sesame blight	68,275
Helminthosporium spp. (Turfgrasses)		87,292
Helminthosporium teres (Barley)	Net-blotch of barley	21,22,231
Helminthosporium turcicum (Maize)	Northern corn leaf blight	24,26,235
Hemileia vastatrix (Coffee)	Rust	76,77,281
Herpotrichia juniperi (Tree unspecified)	Snow blight	57,266
Heterosporium phlei (Timothy)	Leafspot	56,263
Hypoxylon mammatum (Trembling aspen)	Hypoxylon canker	57,266
Kabatiella caulivora (Clover)	Northern anthracnose	53,261
Leptosphaeria salvini (Rice)	Sclerotiniosis	30,35,245
Linocarpon cariceti (Wheat)		41,256
Lophodermium pinastri (Pine)	Pine needle cast	57,58,264
Macrophomina corchori (Jute)	Jute stem rot	260
Macrophomina phaseoli (Jute)	Jute stem rot	51,260
Macrophomina phaseolina (Pine)	Root rot	265
Marssonina brunea (Poplar)	Leaf blotch	57,59,265

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Mastigosporium rubricosum (Cocksfoot)	Leaf fleck, leaf spot	53,262
Melamspora larici-populina (Poplar)	Poplar leaf rust	57,59,266
Melamspora lini (Flax)	Flax rust	51,259
Micosphaerella fragariae (Strawberry)	Leaf spot	87,291
Nectria ditissima (Beech)		57,264
Nigrospora spp. (Rice)	Dirty panicle disease	242
Ophiobolus graminis (Turf-grasses)	Ophiobolus patch	87,291
Penicillium ssp. (Apples)		61,268
Peronospora parasitica (Cabbage)	Downy mildew	78,283
Peronospora parasitica (Cauli-flower)	Downy mildew	78,283
Pestalozzia palmarum (Coconut)	Leaf spot	69,273
Pestalozzia theae (Tea)		77,281
Phacidium infestans (Pine)	Snow blight	57,265
Phoma betae (Beets)		278
Phoma chrysanthemicola (Chry-santhemum)	Phoma root rot	87,289
Phoma tracheiphila (Citrus)	Mal secco	61,270
Phomopsis sp. (Soybeans)	Phomopsis seed rot	64, 65,275,277
Phytophthora cambivora (Chestnut)	Ink disease	61,270
Phytophthora cinnamoni (Avocado)	Phytophthora root rot	61,269
Phytophthora drechsleri (Pigeon pea)	Phytophthora blight of pigeon pea	79,84,159,288
Phytophthora infestans (Potato)	Late blight	72,73,74,279
Phytophthora megasperma (Lucerne)	Phytophthora root rot	53,262
Phytophthora palmivora (Cacao)	Blackpod	77,280
Phytophthora sp. (Tobacco)		77,281
Phytophthora spp. (Philodendron)	Phytophthora leaf spot	87,290
Phytophthora spp. (Potato)		13,73,280
Plasmodiophora brassicae (Cabbage)	Cabbage clubroot	78,282
Plasmodiophora brassicae (Mustard)	Cabbage clubroot	78,286
Plasmodiophora brassicae (Turnip)	Cabbage clubroot	78,79,289
Plasmopara viticola (Grapes)	Downy mildew	60,61,63,270
Podosphaera leucotricha (Apples)	Apple powdery mildew	60,61,267

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Polystictus sp. (Apples)		61,268
Polystictus sp. (Pears)		61,272
Pseudoperonospora cubensis (Muskmelon)	Downy mildew	78,284
Pseudopeziza medicaginis (Lucerne)	Leaf spot	53,262
Pseudopeziza ribis (Black currant)	Currant anthracnose	61,269
Pseudopeziza trifolii (Clover)	Leafspot	53,261
Puccinia coronifera (Oats)	Crown rust of oats	47,239
Puccinia dispersa (Rye)	Brown rust of rye	47,248
Puccinia glumarum (Wheat)	Stripe rust	41,254
Puccinia graminis (Wheat)	Stem rust	41,253
Puccinia menthae (Mint)	Mint rust	87,290
Puccinia purpurea (Sorghum)	Rust	47,248
Puccinia recondita (Wheat)	Leaf rust	251
Puccinia simplex (Barley)	Brown rust of barley	21,230
Puccinia sorghi (Maize)	Corn rust	24,233
Puccinia spp. (Wheat)	Rusts	41,159,160,253
Puccinia tritici (Wheat)	Leaf rust	252
Puccinia tritici-repentis (Wheat)	Leaf spot	252
Puccinia triticina (Wheat)	Brown rust of wheat	41,249
Pyricularia oryzae (Rice)	Rice blast	19,21,30,32,159,242
Pyricularia setariae (Finger millet)	Ragi blast	46,47,159,162,233
Pythium (Beets)		278
Pythium butleri (Sunn hemp)		51,260
Pythium debaryanum (Beets)	Damping-off	278
Pythium spp. (Maize)	Stalk rot	236
Pythium ultimum (Beets)	Damping-off	278
Rhizoctonia (Beets)		278
Rhizoctonia bataticola (Maize)	Stalk rot	237
Rhizoctonia solani (Cotton)	Damping-off	48,259
Rhizoctonia solani (Cowpea)	Damping-off	78,284
Rhizoctonia solani (Lentil)		78,284
Rhizoctonia solani (Peanut)		68,72,275
Rhizoctonia solani (Potato)	Black scurf	73,278
Rhizoctonia solani (Rice)	Sheath blight	36,246
Rhizoctonia solani (Sesame)	Root rot	68,275
Rhizoctonia solani (Soybeans)	Stem and crown blight	64,277

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Rhizoctonia solani (Sunn hemp)		51,260
Rhizoctonia solani (Turfgrasses)	Brown patch	87,291
Rhizoctonia sp. (Sunn hemp)		51,260
Rhynchosporium orthosporum (Cocksfoot)	Leafspot	262
Sarocladium oryzae (Rice)	Sheath rot	30,36,246
Sclerospora graminicola (Pearl millet)	Downy mildew	47,239
Sclerotinia (Carrots)		78,283
Sclerotinia borealis (Timothy)	Snow mold	57,264
Sclerotina fructicola (Apricots)	Brown rot of apricots	60,61,62,268
Sclerotinia homeocarpa (Bermudagrass)	Dollarspot	52,53,260
Sclerotinia homeocarpa (Turfgrasses)	Dollarspot	87,291
Sclerotinia sclerotiorum (Pumpkin)		79,288
Sclerotinia sclerotiorum (Rape)		68,275
Sclerotinia sclerotiorum (Sunflower)		68,277
Sclerotium bataticola (Maize)	Charcoal rot	24,233
Sclerotium cepivorum (Onions)	White rot	78,82,286
Sclerotium rolfsii (Lentil)		78,284
Sclerotium rolfsii (Sunn hemp)		51,260
Septoria avenae (Oats)	Septoria	46,47,239
Septoria avenae (Wheat)	Leafspot	252
Septoria nodorum (Wheat)	Glume blotch	40,41,42,250
Septoria tritici (Wheat)	Speckled leaf blotch	41,45,253
Sphacelia sorghi (Sorghum)	Sugary disease of sorghum	46,47,248
Sphaerotheca mors (Gooseberry)	Gooseberry mildew	61,270
Sphaerotheca mors (Red currant)	Gooseberry mildew	61,272
Sphaerotheca pannosa (Roses)	Powdery mildew	87,290
Spongospora subterranea (Potato)	Powdery scab of potato	73,75,280
Stemphylium sarciniforme (Lucerne)	Stemphylium leaf spot	53,263
Stereum sp. (Apples)		61,268
Stereum sp. (Pears)		61,272
Stromatinia gladioli (Gladiolus)	Dry rot	87,290
Thanatephorus cucumeris (Rice)	Sheath blight	246
Tilletia foetida (Wheat)	Bunt of wheat	249
Tilletia spp. (Wheat)	Bunt of wheat	249
Typhula ishikariensis (Timothy)	Snow mold	57,264
Typhula itoana (Turfgrasses)	Snow mold	292

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Uncinula necator (Grapes)	Powdery mildew	60,61,271
Urocystis tritici (Wheat)	Flag smut	40,41,250
Uromyces appendiculatus (Beans)	Brown rust	282
Uromyces betae (Beets)	Beet rust	53,73,277
Uromyces betae (Fodder beet)	Beet rust	262
Uromyces phaseoli (Beans)	Brown rust	282
Ustilago maydis (Maize)	Corn smut	234
Ustilago striiformis (Turf-grasses)	Stripe smut	87,292
Ustilago zeae (Maize)	Corn smut	234
Venturia inaequalis (Apples)	Scab	61,268
Verticillium albo-atrum (Cotton)	Verticillium wilt	259
Verticillium albo-atrum (Egg-plant)	Verticillium wilt	78,284
Verticillium albo-atrum (Tomato)	Verticillium wilt	79,289
Verticillium dahliae (Anti-rrhinum)	Antirrhinum wilt	87,289
Verticillium dahliae (Cacao)	Verticillium wilt	77,280
Verticillium dahliae (Cotton)	Verticillium wilt	50,259
Verticillium dahliae (Pistachio)	Verticillium wilt	61,272
Verticillium sp. (Cotton)	Verticillium wilt	259
Verticillium sp. (Radish)	Verticillium wilt	79,288
Verticillium spp. (Hops)		86,87,290
Verticillium spp. (Lion's mouth)	Verticillium wilt	87,290

15.2.2. Insects and mites

Aceria sheldoni	Citrus bud mite	117,118,314
Acyrthosiphon pisum	Pea aphid	91,92,295
Aphis craccivora	Groundnut aphid	92,295
Aphis fabae	Bean aphid	92,93,296
Aphis gossypii	Cotton aphid	92,296
Aphis pomi	Apple aphid	92,296
Aphis rhamni		92,296
Baliothrips biformis		90,91,294
Bemisia tabaci	Sweet potato whitefly	101,102,306
Blissus leucopterus	Chinch bug	90,91,294
Brachycolus noxius		92,296
Brachyrhinus sulcatus	Black vine weevil	113,114,311
Brevicoryne brassicae	Cabbage aphid	92,94,296

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Brevipalpus sp.		118,314
Bryobia praetiosa	Clover mite	118,314
Cephus cinctus	Wheat stem sawfly	116,312
Chilo auricilus	Stalk borer	106,307
Chilo infuscatellus	Sugarcane shoot borer	106,307
Chilo sacchariphagus	Internode borer	106,307
Chilo suppressalis	Rice stem borer	106,307
Chloethrips oryzae		90,91,294
Chlorops taeniopus	Goutfly	117,313
Choristoneura occidentalis	Western spruce budworm	106,108,307
Cnaphalocrocis medinalis	Leaf roller	106,108,308
Cylas formicarius	Sweet potato weevil	113,114,311
Diabrotica spp.	Corn rootworm	114,311
Dioryctria splendidella		106,109,308
Diprion pini	Pine sawfly	115,116,313
Doralis rhamni		92,95,296
Empoasca devastans	Cotton jassid	101,303
Empoasca fabae	Potato leafhopper	101,303
Epitrix hirtipennis	Tobacco flea beetle	114,115,311
Eriosoma lanigerum	Woolly apple aphid	92,95,296
Eulecanium corni	Robinia scale	102,305
Eulecanium rufulum	Oak scale	102,103,305
Frankliniella fusca	Tobacco thrips	90,91,294
Heliothis armigera	Capitulum borer	106,109,308
Helopeltis theivora	Tea mosquito	91,294
Heliothis zea	Corn earworm	106,109,308
Hydrellia sasakii	Rice whorl maggot	116,117,313
Lema melanopus	Cereal leaf beetle	114,311
Lema sp.		114,311
Lepidosaphes beckii	Purple scale	102,104,306
Leucinodes orbonalis	Fruit borer	107,110,159,162,308
Lipaphis erysimi	Mustard aphid	92,95,297
Lissorhoptrus brevirostris		114,115,311
Lymantria dispar		107,110,308
Lymantria monacha		107,110,308
Macrosiphum euphorbiae	Potato aphid	92,95,297
Manduca sexta	Tobacco hornworm	107,110,308
Melanaspis glomerata	Sugarcane scale	102,104,306
Mononychellus sp.		118,314
Mononychellus tanajoa		118,314
Myzus persicae	Green peach aphid	91,92,96,298
Nephotettix virescens	Green leafhopper	100,101,303

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Nilaparvata lugens	Brown planthopper	100,101,304
Oscinella frit	Frit fly	117,313
Pachydiplosis oryzae	Rice gall fly	117,313
Panonychus ulmi	European red mite	118,314
Parlatoria ziziphi		102,105,306
Pempheres offinis	Stem weevil	114,312
Phaedon cochleariae	Mustard beetle	114,312
Phenacoccus manihoti	Cassava mealybug	100,101,303
Phorbia coarctata	Wheat bulb fly	117,313
Pieris brassicae	Large cabbage white	107,111,308
Pissodes strobu	White pine weevil	114,312
Planococcus citri	Citrus mealybug	101,304
Pristiphora abietina	Small pine sawfly	116,313
Pseudococcus comstocki	Comstock mealybug	101,304
Pyrausta nubilalis	European corn borer	107,111,309
Pyrilla pusana	Sugarcane leafhopper	101,304
Pyrilla spp.		101,305
Rhopalosiphum fitchi	Apple grain aphid	92,300
Rhopalosiphum padi	Apple grain aphid	92,99,300
Rhyacionia buoliania	European pine shoot moth	107,111,309
Rhyacionia spp.		107,112,309
Saccharosydne saccharivora		101,305
Saissetia oleae	Black scale	102,105,306
Schizaphis graminum	Greenbug	92,300
Sciopithes obscurus	Obscure root weevil	114,312
Scolytus rugolosus	Shot-hole borer	114,312
Sitona lineatus	Pea weevil	114,312
Sitophilus oryzae	Rice weevil	114,312
Spodoptera frugiperda	Fall armyworm	107,309
Spodoptera litura	Leaf caterpillar	107,112,310
Tetranychus atlanticus		118,314
Tetranychus bimaculatus		118,314
Tetranychus spp.		118,314
Tetranychus telarius	Carmine mite	118,119,315
Tetranychus urticae	Twospotted spider mite	118,120,315
Therioaphis maculata	Spotted alfalfa aphid	92,99,301
Thrips lini		91,294
Thrips sp.		91,294
Tipula sp.		117,313
Toxoptera graminum	Greenbug	92,100,301
Tryporyza incertulas	Yellow borer	107,112,310
Zygina maculifrons	Blue jassid	100,101,303

15.2.3. Nematodes

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Aphelencoides oryzae	Rice nematode	121,318
Aphelencoides spp.		121,318
Heterodera avenae		121,318
Heterodera glycines	Soybean cyst nematode	121,122,318
Heterodera schachtii	Sugarbeet nematode	121,122,318
Meloidogyne exigua		121,319
Meloidogyne hapla	Northern root-knot nematode	121,123,319
Meloidogyne incognita	Root-knot nematode	121,123,159, 173,319
Meloidogyne javanica	Javanese root-knot nematode	121,126,322
Meloidogyne sp., spp.		121,322
Pratylenchus penetrans	Cobb's meadow nematode	121,127,322
Rotylenchus reniformis	Reniform nematode	121,128,323
Tylenchorhynchus latus	Stunt nematode	121,324
Tylenchorhynchus sp.		121,324
Tylenchulus semipenetrans		121,324
Xiphinema americanum	American dagger nematode	121,324

15.2.4. Bacteria

Agrobacterium tumefaciens (Grapes)		151,152,334
Bacillus betae (Fodder beet)		151,152,334
Bacillus phytophthorus (Potato)		152,334
Bacillus spp. (Potato)		152,334
Bacterium lathyri (Tomato)	Streak disease of tomato	152,334
Corynebacterium insidiosum (Lucerne)	Bacterial wilt of alfalfa	152,334
Corynebacterium michiganense (Tomato)	Bacterial canker of tomato	152,334
Corynebacterium sepedonicum (Tomato)	Tomato ring rot	152,334
Erwinia amylovora (Pear)	Fire blight	152,334
Erwinia carotovora (Cabbage)	Soft rot	152,335
Erwinia chrysanthemi (Philodendron)	Bacterial leaf blight	152,159,335

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Erwinia herbicola (Tomato)	Tomato graywall	152,153,335
Phytomonas stewartii (Maize)	Bacterial wilt of maize	152,153,335
Pseudomonas angulata (Tobacco)	Angular leaf spot, Blackfire	143,335
Pseudomonas lachrymans (Cucumbers)	Angular leaf spot	143,336
Pseudomonas phaseolicola (Beans)	Halo blight	143,336
Pseudomonas solanacearum (Potato)	Bacterial wilt of potato	336
Pseudomonas solanacearum (Tomato)	Bacterial wilt of tomato	144,336
Pseudomonas syringae (Lima bean)	Bacterial blight	145,337
Pseudomonas syringae (Maize)	Chocolate spot	336
Pseudomonas tabaci (Tobacco)	Wildfire	143,337
Streptomyces scabies (Potato)	Potato scab	152,153,337
Xanthomonas axonoperis (Imperial grass)	Gomosis	146,338
Xanthomonas campestris (Cabbage)	Cabbage black rot	338
Xanthomonas campestris (Cassava)	Cassava bacterial blight	338
Xanthomonas campestris (Rice)	Bacterial leaf blight	147,338
Xanthomonas malvacearum (Cotton)	Angular leaf spot	146,339
Xanthomonas manihotis (Cassava)	Cassava bacterial blight	146,148,339
Xanthomonas oryzae (Rice)	Bacterial leaf blight	146,148,339
Xanthomonas pelargonii (Geranium)	Bacterial stem rot	146,340
Xanthomonas phaseoli (Beans)	Common blight	146,340
Xanthomonas pruni (Peaches)	Bacterial spot	146,149,340
Xanthomonas sp. (Philodendron)		146,340
Xanthomonas spp. (Cabbage)		146,340
Xanthomonas vesicatoria (Tomato)		146,150,340