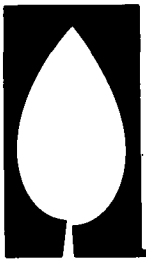
Danish Research Service
for Plant and Soil Science

Plant diseases, pests and weeds in Denmark 1984

101st annual report
Compiled by
The Research Centre for Plant Protection

Lyngby 1985



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H. Rønde Kristensen

Botany Department

Head of department: Ib G. Dinesen (acting)

Scientific staff:

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Ib G. Dinesen
Bacterial diseases of glasshouse crops, fruit trees and potatoes

Karen Bolding Jørgensen
Diseases of sour cherries; bacterial diseases of glasshouse crops and fruit trees

Henrik Albert Jørgensen
Diagnostics of fungi; diseases of horticultural crops and root rot of sugarbeets; Dutch elm disease; registration of scientific literature

Hemming Mygind
Fungus diaseases of glasshouse crops and nursery plants; potato wart, testing for resistance; diagnostic work, especially root pathogenic fungi

Hellfried Schulz (part time)
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Sten Stetter
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Boldt Welling
Diseases of cereals and grasses; storage fungi on grain

Virology Department

Head of Department: H. Rønde Kristensen

Scientific staff:

Jens Begtrup
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Vacant
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Niels Paludan
Viruses of vegetables and ornamental plants (herbaceous); production of healthy nuclear stocks

Arne Thomsen
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Zoology Department

Head of Department: Jørgen Jakobsen

Peter Esbjerg
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Lars Monrad Hansen
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Lise Stengaard Hansen
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Mogens Juhl
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Fritjof Lind

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Hellfried Schulz

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II. GENERAL SURVEY OF PLANT PATHOLOGY SUBJECTS 1984, H. RØNDE KRISTENSEN

In 1984 23 research workers and 31 laboratory assistants and other staff members were employed at the Institute of Plant Pathology.

15 voluntary workers and 12 students working on their thesis participated in the work of the institute. Besides, 10 laboratory and office apprentices and 2 working under the government employment scheme have been employed at the institute.

The leave of Arne Jensen, lic.agro., was prolonged, so that he might continue his work on plant pathology in Zambia, and Ib Dinesen, lic.agro., is still acting head of the Botany Department.

The position as research worker at the Virology Department, which became vacant when Mogens Christensen retired was unoccupied in 1984.

At the Botany Department investigations of bacterial and fungal diseases in a large number of plants were undertaken in 1984

Experiments concerning the spread of bacterial ringrot in potato fields were continued, and laboratory experiments were carried out to examine the best desinfection methods against this disease.

Bacteriological examinations have also been made in connection with the production of various types of nuclear pot plants.

Material has been collected, and comprehensive examinations have been carried out concerning take-all and eyespot.

A computer program (EPIDAN) for determining the economics of spraying against leaf diseases in spring barley has been developed. Another program (Cerco) for assessing the need for spraying against eyespot in winter crops has been worked out.

The experiments with variety mixtures in winter barley continued in 1984 just as the observations concerning the spread of mildew from winter to spring barley.

The testing for resistance to wart disease continued. Certain wart disease examinations were carried out for the Government Plant Protection Service.

Monitoring systems were developed concerning stem rot in rape.

The Botany Department carries out a considerable amount of work regarding the production of healthy nuclear plants including examinations for vascular fungi in several pot plants. Container cultures from nurseries were examined, especially for *Phytophthora cinnamoni* and *P. cactorum*.

At the Zoology Department, the series of routine examinations were continued, especially for potato cyst nematodes.

Experiments were made with control of potato and beet nematodes. Soil samples from all over the country were collected and examined in order to determine the distribution of cereal nematodes.

Continuous rearing of various insect and mite species take place in connection with experiments concerning biological control of pests.

The examinations to establish the risk of collembola attacks in beets were continued.

Systematic registrations of aphids were made in spring barley and winter wheat.

Approximately 500 growers took part in the grower-based registration of aphids in spring barley. The registration in 1984 also comprised mildew and rust.

Registrations of winged aphids have been made in a number of seed potato fields in order to find the right time for haulm desiccation.

The flying activity of the turnip moth was registered in order to be able to find the right time for control measures in carrots. Laboratory examinations were also carried out concerning the effect of pesticides on cutworms.

Several biological examinations were carried out at the Zoology Department in order to be able to give the growers the best

possible guidance. The examinations concerned the codling moth, the cabbage root fly, various beetles and rape pests.

A special project concerns the development of standard methods for determining the effect of pesticides on the beneficial arthropods - a project which is financed by the National Agency of Environmental Protection.

The examinations in order to find practical methods for control of aphids by gall midges were finished. Methods were developed for control of thrips and tomato leaf miners by means of rove beetles and parasitic wasps, respectively. There was a large-scale production of these predators for commercial retail sale.

At the Virology Department only a limited number of serological examinations were carried out as Mogens Christensen's position has been vacant since he retired by the end of 1983.

About 3500 individual electron microscopic analyses were carried out (mostly by ISEM). These analyses are extremely important - especially in connection with the propagation of virusfree horticultural plants and potatoes.

Virus attacks in ryegrass, cocksfoot and other grasses were the object of several examinations. The viruses in question are ryegrass mosaic virus, cocksfoot mottle virus and barley yellow dwarf virus.

Several winter barley fields were examined for occurrence of the virus disease barley yellow mosaic virus, which is transmitted by fungi. However, the diseases have not yet been found in Denmark.

Examinations for another fungus-borne virus *Rizomania* were carried out in beetroot fields. So far, it has not been found in this country either.

The growth of potato meristems and cuttings in test tubes under various growth conditions as well as the possibilities of preserving cuttings in test tubes have been examined.

In connection with the production of healthy nuclear material for the 'potato meristem programme', comprehensive bacterial and

virus tests are being carried out. Moreover, a number of experiments are made in order to improve the cultivation part of the programme.

Experiments were made concerning prunus ringspot virus, little cherry virus and cherry rasp leaf virus (raspberry ringspot virus).

The work on the establishment of healthy nuclear plants of fruit trees is continued. Among the fruit trees are plum, cherry, raspberry, black currant and red currant.

A special EEC research project (Cost 87) was started in 1981. Denmark participates with micro-propagation of the apple rootstock MM26 and pelargonium.

The work on ornamental plants concentrated on the genera, *Aeschynanthus, Begonia, Campanula, Chrysanthemum, Dieffenbachia, Euphorbia, Kalanchoë* and - in particular - *Pelargonium.*

In 1984 the examinations concerning vegetables were concentrated on virus diseases in pepper and cucumber.

Advisory Work

In 1984 the staff at the Institute of Plant Pathology prepared 125 publications and gave 147 lectures.

International co-operation

The profitable co-operation with foreign institutions and colleagues was continued in 1984, partly by participation in many international conferences, symposiums etc., partly by visits to plant pathology institutes in other countries.

19 staff members at the Institute of Plant Pathology made in all 57 journeys to other countries including Austria, Bangladesh, Belgium, Czechoslovakia, England, Finland, France, Germany, Hungary, Mozambique, Norway, Poland, Switzerland, the United States, Zanzibar and Zimbabwe.

The following subjects were treated during these travels: Integrated control in rape-seed production; bacterial ringrot in potatoes; *Pseudomonas spp.*; pesticide application in Bangladesh;

biological control of soil-borne pests; the use of pheromones; nematodes; pyrethroids; quality control of arthropods; pesticides and beneficial arthropods; electron microscopy; viroses in *Gramineae*; beet yellows and *Rizomania* in beetroots; barley yellow mosaic; tissue culture; diagnosis of plant diseases (especially viruses) and viruses in ornamental plants.

The international co-operation also led to visits from many foreign colleagues. In 1984 the Institute of Plant Pathology was visited by guests from the following countries: Austria, Bulgaria, Canada, Chile, China, Czechoslovakia, Egypt, England, Finland, Germany, Holland, Indonesia, Iceland, Jamaica, Nepal, Norway, Pakistan, the Philippines, Sweden, the United States and Zambia.

Plant health control and propagation of healthy plants

On July 1st 1984, Act No. 121 of April 12th, 1957, on Control of Dangerous Plant Diseases and Pests was replaced by the Act on Plant Pests and Diseases of May 9th, 1984. At the same time the more than 80 years old law of 1903 on measures against the spread of black rust fungi (the Barberry Law) was abolished. The provisions of the latter law concerning importation of barberry varieties which are susceptible to black rust are included in the Government Regulation on importation and exportation of plants etc. of April 15, 1980.

The Plant Health Council, which serves as advisers to the Ministry of Agriculture concerning public control of dangerous pests and diseases, discussed an extension of the public control areas in 1984 and found that the following pathogens should be included in the discussions concerning public control measures: *Phytophthora fragariae*, *Corynebacterium insidiosum*, *Rizomania* virus, barley yellow mosaic virus and *Meloidogyne chitwoodi*.

Considering the large Colorado beetle invasion in 1983, there were some misgivings about the situation in 1984.

Thanks to the weather conditions and especially to the vigorous efforts of the Government Plant Protection Service, no

threatening development took place in 1984, and it may still be maintained that the Colorado beetle is not permanently established in Denmark.

In 1984 winter barley was grown on approximately 16,500 properties. According to the Regulations of the Ministry of Agriculture on winter barley, owners or users of winter barley areas must treat the areas against mildew and rust according to the guidance of the Danish Research Service for Plant and Soil Science.

Enquiries among the agricultural advisers show that most of the growers (more than 90%) followed the instructions given.

Dutch elm disease, which was seen in Denmark for the first time in 1975, has spread more slowly than originally expected. The greatest spreading has taken place in Eastern Jutland, where the diseases seems to be well established.

Vigorous efforts must be made both from public authorities and private landowners in order to prevent it from spreading further.

The committee of the Plant Health Council, which was in charge of propagation of seed potatoes, was dissolved in March 1984, and the tasks of the committee are undertaken by the new special committee for potato growing set up under the Crop Husbandry Department.

The potato meristem programme, which was continued satisfactorily in 1984, runs along the following main lines:

a. At the Institute of Plant Pathology, meristem cultures of all the desired varieties are established and tested, and the first tuber generation of these varieties is produced. Specimens are kept in a 'meristem bank'.
b. In an isolated area in Vendsyssel the Tylstrup Research Station produces the second and third tuber generation.
c. The pre-basic propagation of the material from the above-mentioned area takes place at farms selected by the National Committee for Health Control of Seed Potatoes.

All potatoes planted in Denmark in 1986 should originate from potato meristems.

As for horticulture, the obligatory health control as well as the propagation of healthy plants functioned satisfactorily in 1984.

2,446 supervised enterprises were inspected by 7,103 visits in 1984. The number of rejections was small in comparison with the very great number of plants inspected.

The Nursery Control Commission has requested the Research Service for Plant and Soil Science to start propagation of 33 plants. They are mostly outdoor plants.

To comply with wishes expressed in the previous years, a fairly comprehensive production of healthy nuclear pot plants has been started within the Research Service. Among the plants are *Pelargonium, Kalanchoë, Begonia* and *Campanula*.

There is an increasing demand from the nurseries for healthy starting material from the propagation station at Lunderskov. Another insect-proof greenhouse has been built there, which will be in use from the beginning of 1985. This will increase the possibility of producing healthy starting material for Danish nurseries.

III. ADVISORY WORK. Ole Bagger, Hellfried Schulz and Lars A. Hobolth

As in previous years, the advisory work was carried out both at Lyngby and at the Plant Protection Advisory Department at Godthåb, Skanderborg, which primarily deals with the enquiries from Jutland.

As for articles and reports, see p. XX et seq.

The numbers 547-553 of the monthly survey of plant diseases were sent out. The survey is sent to 244 colleagues and to 26 professional journals and newspapers. Besides, the monthly surveys were sent to a total of 309 subscribers in and outside the country.

15 'Plant Protection Bulletins' were sent out concerning the following subjects:

No.	1	13th Jan.:	Control of mildew and rust in winter barley
-	2	3rd May:	Eyespot
-	3	16th May:	Frit flies in oats, maize and grass
-	4	23rd May:	Winter rape - 1st generation of the brassica pod midge
-	5	23rd May:	Winter rape - sclerotinia disease - downy mildew
-	6	23rd May:	Prognosis and warning against beet yellows in 1984
-	7	29th May:	Mildew in spring barley, winter barley and wheat - yellow rust in wheat
-	8	21st June:	Leaf diseases and aphids in cereals
-	9	25th June:	2nd generation of brassica pod midge in winter rape fields
-	10	25th June:	1st warning against potato late blight
-	11	25th June:	1st warning against cutworms
-	12	25th June:	Warning against sclerotinia disease in spring rape
-	13	11th July:	Warning against beet yellows in 1984

- 14 11th July: 2nd generation of the frit fly in cereals and grasses
- 15 13th July: 2nd warning against potato late blight
- 16 13th July: 2nd warning against cutworms

On 11th July the first bulletin about beet yellows was sent out. As very few peach-potato or black bean aphids occurred in 1984, no further bulletin was sent out.

Weather conditions in 1984

	Temperatures °C		Sunny hours	
	1984	normal	1984	normal
January	0.9	-0.1	41	41
February	0.1	-0.4	50	65
March	1.1	1.6	119	127
April	6.4	6.1	198	181
May	11.2	11.1	214	256
June	13.6	14.4	177	257
July	15.4	16.5	205	247
August	16.8	16.2	210	221
September	11.8	13.0	109	166
October	10.6	8.6	81	98
November	5.8	4.9	49	42
December	2.6	2.1	25	28
Mean in 1985 and total	8.0	7.8	1478	1729

	Precipitation		Deviations from normal precipitation		
	1984	normal	Jutland	Islands	Bornholm
January	104	55	55	35	41
February	34	39	-4	-9	-5
March	32	34	0	-5	-28
April	19	39	-23	-14	-18
May	34	38	-4	-5	-4
June	80	48	24	50	35
July	37	74	-37	-38	-4
August	43	81	-39	-34	-58
September	104	72	35	25	41
October	130	70	72	33	34
November	67	60	10	0	-22
December	36	55	-16	-24	-15
Total precipitation	720	665	73	14	-3

1. Diseases in agricultural plants 1984

Cereals and grasses

Overwintering of winter crops and grass. Winter wheat and winter rye overwintered most satisfactorily. In winter barley, however, fairly severe frost damages occurred, especially in fields with winter barley following winter barley, and a number of fields had to be resown. The bad overwintering was due to widespread attacks of snow rot (*Typhula incarnata*). Besides, cases of frost heaving were seen in quite a few fields, especially in humus soil.

By the end of April, plants with yellow leaf tips and brown spots along the leaf edge were seen in many winter barley fields. No fungal attacks could be detected, so the damage is probably due to growth conditions.

Grey speck (manganese deficiency) was fairly widespread in winter crops, and severe attacks of snow rot were often seen on the weakened plants.

Overwintering of grass crops was mostly satisfactory.

Barley yellow dwarf was only seen in a few winter crops and was far less widespread than in 1983. The attacks seen in spring crops were also quite few.

Cocksfoot mottle virus was fairly widespread, especially in pastures with cocksfoot, and particularly in fields with two or more successive crops of grass, but in 1984 many diseased plants were also found in first-year crops.

Barley yellow mosaic virus was not registered in winter barley fields in 1984.

Typhula blight (*Typhula incarnata*) was mostly seen in winter barley fields. The two-rowed cultivar 'Igri' is particularly sensitive, in contrast to the six-rowed cultivars. Attacks were especially severe on light soil, and in unploughed fields.

On the whole, spraying in the autumn with Bayleton 25 WP was more effective than seed treatment with Baytan, especially in cases with weak attacks of the fungus.

Spraying in the autumn with Benlate or Derosal led to a considerable increase in the attacks.

Snow mould (*Fusarium nivale*). Only very weak attacks were seen in winter crops.

Eyespot (*Pseudocercosporella herpotrichoides*). The conditions for the spread and establishment of attacks were much less favourable in 1983/84 than in the preceding year.

Spraying seemed to be required in about 45 per cent of the wheat fields, in about 35 per cent of the rye fields and in 15 per cent of the winter barley fields.

The dry and cool weather in the early spring further prevented the development of the disease.

Attacks were widespread in the fields during the summer, but they were far less severe than in 1983. Heavy attacks were only seen in a few fields with insufficient crop rotation.

Sharp eyespot (*Rhizoctonia cerealis*) occurred in many wheat fields, often with rather pronounced symptoms. The dry and cold weather in early spring offered favourable conditions for the development of the fungus.

Take all (*Gaeumannomyces graminis*). In general, only weak attacks occurred in 1983. A few fields with severe attacks could be found in some parts of the country, especially in case of insufficient crop rotation and on marginal wheat soil. The many instances of premature ripeness which were seen after a long period of drought

in July/August were not always due to attacks of £Gaeumannomyces graminis$. In many cases the rooting was insufficiently developed because of bad soil structure or possibly frost heaving in March.

Mildew (*Erysiphe graminis*). Attacks were widespread, but usually weak in winter crops. However, medium-strong attacks occurred in a few winter wheat cultivars, especially in 'Kanzler' and 'Disponent', and in winter barley when the obligatory sprayings were omitted or carried out too late.

In spring barley, initial attacks were seen mid-May, especially in fields which had been sown too late, and in fields near winter barley. At the end of May, the attacks spread, and in June and July they were widespread and in some places very severe. In many cases, two treatments were necessary.

Yellow rust (*Puccinia striiformis*) occurred very rarely, and control measures were only necessary in a few exceptional cases.

Brown rust of wheat (*Puccinia recondita*). A few fields showed severe attacks of brown rust, but, in general, only moderate attacks were recorded.

Brown rust of barley (*Puccinia hordei*). No cases of brown rust was seen in barley in 1984.

Leaf stripe (*Drechslera graminea*). Only weak attacks were observed in a few fields.

Net blotch (*Drechslera teres*). Early in the spring only weak attacks occurred in winter barley fields, although widespread attacks had been seen in the autumn of 1983 in winter barley fields following barley. The dry weather during the spring probably prevented the spring attack.

In June and July quite a few instances of net blotch were seen, mostly in the cultivar 'Gerbel'.

In spring barley the attacks were late and mostly weak.

Leaf blotch of barley (*Rhynchosporium secalis*) occurred in some spring barley fields, but usually with weak attacks.

Speckled leaf spot (*Septoria tritici*). As in the previous years speckled leaf spot was found on the oldest leaves in most wheat fields. Attacks were rare and were usually seen together with glume blotch of wheat (*Septoria nodorum*).

Glume blotch of wheat (*Septoria nodorum*). Attacks were seen in a few places towards the end of June, but they were of no importance.

Brown foot rot and ear blight (*Fusarium spp.*) was seen together with grey mould (*Botrytis cinerea*) in some fields. A number of undeveloped grains were observed. Often they had glumes covered with *Fusarium* fungi.

Grey speck (*Manganese deficiency*) was a worse problem than usual in May, especially in winter barley. The attacks were most severe by high pH values, and in a few cases they aggravated the frost injuries.

In spring crops, widespread and serious attacks were seen in May/June in the shape of light spots in the fields. The symptoms often occurred on dry and loose soil.

Potassium deficiency was seen in many cases in spring barley following grass - especially when the grass had been harvested 4 times the preceding year.

Cold weather and night frost in May caused frost injuries in many places, and instances of frosted rye were seen in low-lying fields. Low temperatures around the earing of winter crops

resulted in deform spikes and made the earing difficult, especially in winter wheat.

Legumes

Overwintering of forage legumes was satisfactory in most places. Only a few clover fields were partially or totally damaged by frost, especially in low-lying areas and where the last harvest had taken place in October.

Clover rot (*Sclerotinia trifoliorum*). Only weak attacks were seen. In some clover fields, however, quite a few instances of clover rot could be seen.

Downy mildew (*Peronospora viciae f.sp. pisi*) occurred in many pea fields. In most cases, however, the attacks were described as weak.

Verticillium wilt (*Verticillium albo-atrum*). No serious attacks were seen in the lucerne fields.

Beets

Overwintering of seed beets sown to a stand was very good due to the mild winter, and very little reploughing took place. Overwintering of beets in clamps was also satisfactory. Because of the bad harvest in 1983, stocks were small, and putrefaction was only seen in a few pits. However, vigorous sprouting was seen in most pits.

Night frost influenced several beet fields all over the country. At the end of March and the beginning of May, the day temperatures were fairly high, whereas night temperatures went down to -8 or -9°C. The growth of the beet roots was checked, and especially

beets sown in mid April showed symptoms resembling black leg with subsequent discolouring of the top.

Until the middle of May, about 1100 ha were resown, and the most likely causes of damage were a combination of cold weather (frost) and underground thrips attacks. The injuries were most widespread where the top inch of the soil was dry and loose. In many places, however, the injuries were overcome by the end of May.

Strangles was seen in resown fields. The storm around midsummer damaged a large part of the resown fields, whereas the beets which had been sown at the usual time were so big that the main shoots were protected by the foliage leaves and the damage was small.

Speckled yellows (Manganese deficiency) was widespread in June in beet fields all over the country. The attacks were considered the most severe and widespread in the last twenty years. They were ascribed to the loose and dry soil, and it was difficult to control the symptoms even by repeated sprayings. Symptoms of the deficiency were commonly seen even on the heavy soils of Lolland-Falster.

Drought. The rainfall was very scarce during the last two weeks of April and and first half of May. Thus the upper soil layers dried out, and sprouting conditions were bad. Later in the summer, the rainfall was very irregular, and in many places in Northern and Western Jutland, the beets stopped growing in July and August.

Magnesium deficiency was seen in a few places during the autumn, but the attacks were mostly weak. Symptoms were especially seen on sandy soil in connection with low pH.

Heart rot and dry rot (boron deficiency). Only few and mostly weak attacks were seen. They were considered much less severe than in 1983.

Virus yellows (Beta virus 4). In September only very weak attacks were seen, and the virus was far less widespread than in the preceding years. This may hang together with the unusually small occurrence of peach potato aphids.

Downy mildew (*Peronospora farinosa*) was not seen in 1984.

Mildew (*Erysiphe betae*) was only seen in a few cases and was of no importance.

Beet rust (*Uromyces betae*) was seen in the Stege region, where it was fairly widespread, but only weak attacks were reported.

Ramularia leaf spot (*Ramularia beticola*) was somewhat more widespread than usual, but the attacks were mostly weak and occurred in the autumn.

Swedes, oil-seed rape and other cruciferous crops

Overwintering of rape fields was rather bad in many places. The dry autumn months resulted in late sowing and heterogeneous sprouting. Many growers had to resow at the end of the winter because the winter rape fields did not develop satisfactorily.

Downy mildew (*Peronospora parasitica*) was fairly widespread both in winter and spring rape. The relatively moist and cool weather in May and June furthered the atttack. Usually, only the lower leaves were affected, and economically the attacks were not of much importance.

Club rot (*Plasmodiophora brassicae*). The faint increase in the occurrence which had been seen since tbe beginning of the 1980's seemed to continue in 1984. Attacks were seen both in winter and spring rape on soil where swedes or rape had been grown, sometimes as much as 5 or 6 years earlier. The most serious attacks occurred in spring rape fields on moist soil with low pH.

Stem rot (*Sclerotinia sclerotiorum*) did not cause any problems in winter rape as no fruit bodies were present during flowering because of the scarce rainfall in April and May. Later on, however, fruit bodies developed in spring rape as the weather became alternately rainy, dry and windy later on. Stem rot became fairly widespread in spring rape, but with varying severity of the attacks. Both air-borne contagion and heavy nitrogen fertilization seem to have aggravated some of the attacks.

Grey mould (*Botrytis cinerea*) occurred in May in a number of winter rape fields because of the moist weather. However, the attacks stopped with the onset of the drought in June.

Canker (*Phoma lingam*) was still limited to winter rape fields, mostly in Southern Zealand, but a few attacks were also seen in the western part of the country.

Leaf spot (*Alternaria spp.*). Sporadic attacks were seen at the beginning of the growth season. In a few fields, the attacks increased just before harvest, often where the infestation came from winter rape fields in the neighbourhood.

Verticillium wilt (*Verticillium dahliae*) might be found on a few plants in some rape fields just before harvest, but the attacks were not considered of any importance.

Potatoes

Because of the small harvest, most of the tubers were kept in houses, and only a few in clamps.

Overwintering was satisfactory, and only a little frost or heat damage was seen in a few lots. Sprouting was excellent and in most places very uniform.

Even under favourable sprouting conditions, it was evident that pre-germinated and preheated potatoes had better sprouting than those which were planted immediately after sorting.

Very bad sprouting was only seen in one field, and the reason here was *Fusarium* attacks.

Black scurf (*Rhizoctonia solani*). The favourable conditions at the planting, which took place in comfortable soil and at the right time, resulted in very mild attacks, which were widely spaced. Nevertheless, a good effect was obtained by controlling black scurf at the planting.

Later on, more widespread attacks than usual were found in the form of 20-30% small weak plants, but apparently not in the pre-sprouted lots.

Wet rot (*Bacteriosis*) was only seen in a few places and was of no importance.

Rattle virus. Only moderate attacks were seen, and they were much weaker than in 1983.

Wart disease (*Synchytrium endobioticum*). No new attacks were seen in 1984. The Government Plant Protection Service lifted the prohibition in a number of areas, so that now only 5 prohibited areas are left.

Gangrene (*Phoma exigua*) was not very widespread during the spring.

Blackleg (*Erwinia carotovora* var. *atroseptica*) was seen in many fields, but mostly with weak attacks.

Potato leaf-roll (*Solanum virus 14*) and streak (*Solanum virus 2*). The attacks were estimated as fairly widespread, but weak. They seemed to be more widespread than in 1983.

Potato blight (*Phytophthora infestans*). The first warnings against potato blight were sent out on June 25, and the first attacks were seen during the last days of June.

In the cool weather the attacks did not become very widespread. As the initial infection was established and epidemic attacks might be expected after the hot weather at the beginning of July, the 2nd warning was sent out on July 13.

By the end of July, untreated fields and many small potato areas in private gardens were totally withered because of potato blight.

Protective spraying, in some cases supplemented with Ridomil spraying, had a good effect, however, and assisted by dry climatic conditions in August, growers succeeded in keeping the fields reasonably free from potato blight.

Unusually little dry rot was found in seed and eating potatoes well covered with soil at the top and with proper pest control.

In some consignments of industrial potatoes and in some fields where pest control was started too late, potato blight was seen on a fairly large part of the tubers.

2. Pests in agricultural plants 1984

Jørgen Jakobsen

Cereals and grasses

Cereal nematodes (*Heterodera avenae*)
With the exception of a few localities in Jutland, only few and weak attacks were seen.

Grain thrips (*Limothrips cerealium*) and rye thrips (*L. dentocornis*) occurred early in winter crops, especially in the southern part of the country, and widespread attacks were seen in Jutland, particularly in winter barley and rye.

Bird-cherry aphids (*Rhopalosiphum padi*) and grain aphids (*Sitobion avenae*)
The wintering of bird-cherry aphids on bird cherry was bad, and the occurrence of aphids in the spring barley fields at the beginning of May was very scarce. In the latter half of June, migration started in the spring barley fields, but pesticide control was only necessary in a few fields - mainly in the south-eastern part of the country. However, vigorous propagation of aphids took place in the winter crop fields, especially in July in wheat. The unusually long growth period in 1984 resulted in aphid damage to the corn fields later than usual, and experimental results showed that control of aphids was profitable in severely attacked fields until the middle of July.

As in 1983, the grain aphid was dominating in winter wheat. The increased growing of winter crops in the last few years may be one of the reasons for the increased problems with this aphid.

Wireworms (*Agriotes spp.*)
Only sporadic and weak attacks were seen, mostly in barley fields sown after grass.

Leatherjackets (*Tipula paludosa*)
A number of winter crop fields sown after grass were reported to be damaged by leatherjackets. Most of the fields were situated in Jutland. Serious attacks were seen in spring crops after two years of grass, and a number of fields in Jutland were damaged to such a degree that they had to be resown. Some damage was also seen in grass on Funen.

Bibionid flies (*Bibio hortulanus*)
In spring, damage caused by bibionid flies were seen in one winter crop field, but only few and weak attacks were registered in spring crops. In October, a number of attacks by bibionid fly larvae occurred, especially in manured wheat fields.

Fever flies (*Dilophus febrilies*)
A single attack was seen in a field with spring barley following clover grass.

Potato stem borers (*Hydraecia micacea*)
No reports of any serious attacks were received.

Saddle gall midges (*Haplodiplosis equestris*)
Only few and weak attacks occurred in 1984.

Frit flies (*Oscinella frit*)
Widespread, but usually weak attacks were seen in the winter cereal crops, but in a few fields the attacks were so severe that the fields had to be resown.

The 1st generation started flying at mid-May, but due to the early sowing in 1984, only a few oat and maize fields were seriously damaged.

Severe attacks were seen in the autumn of 1984 in winter cereal crops following grass. The most serious injuries were seen in wheat fields.

Leaf beetles (*Oulema malanopus*)
Widespread and relatively severe attacks were seen all over the country.

Wheat gall midges (*Contarinia tritici* and *Sitodiplosis mosellana*)
Only few and weak attacks occurred.

Leaf weevils (*Phyllobius spp.*)
Attacks occurred in some winter cereal crops following grass. Besides, attacks were seen in seed grass fields, especially in red fescue.

In the autumn of 1984 a number of attacks was seen again, in winter cereal crops following grass.

The wheat flea beetle (*Crepidodera ferruginea*) occurred in a few winter wheat fields following grass.

Tortrix moth caterpillars (*Cnephasia spp.*)
In one field, injuries by tortrix moth caterpillars were registered. The larvae had gnawed the grains off the ear, and some ears were quite without of grains.

Ocsenheimeria vacculella
A number of attacks were reported in 1983 - mostly in seed grass on Funen and Zealand. Attacks by the moth were also seen in some places in 1984, that is, in mid-Zealand, in Hornsherred in Northern Zealand, and on Mors in Jutland. Attacks occurred both in spring barley and grass seed crops.

Legumes

Stem nematodes (*Ditylenchus dipsaci*)
There were no attacks of any significance.

Clover seed weevils (*Apion spp.*)
No attacks of any significance were reported.

Pea and bean weevils (*Sitona spp.*)
During the summer of 1984, a vigorous propagation of pea and bean weevils took place, and after harvest they spread to clover and clover grass fields. In some of the fields the attacks were fairly severe. Attacks of bean weevil in horse beans were also reported.

Beets

Beet nematodes (*Heterodera schachtii*)
Only few and insignificant attacks were registered in 1984.

Cabbage thrips (*Thrips angusticeps*)
It is suspected that thrips (cabbage, corn and rye thrips) in combination with the cold weather in May caused considerable damage in a number of beet fields. The attacks were so severe that relatively large areas had to be resown. On Western Zealand alone more than 1000 ha were resown. Part of the fields should probably not have been resown as it turned out later that even seriously injured plants quickly recovered.

The attacks are ascribed to the occurrence of many thrips, which damaged the stem of the tender beet plants just under the soil surface. This resulted in symptoms resembling black leg. Experiments with pesticides seem to indicate that the injuries were actually caused by thrips. The plots treated with insecticides were markedly better than the untreated plots.

Collembola (*Onichiurus spp.*) occurred in a number of beet fields and caused some damage.

Leatherjackets (*Tipula paludosa*)
Severe attacks of leatherjackets were seen in a number of fields following grass.

Bibionid flies (*Bibio hortulanus*) were seen in large numbers in manured beet fields, where the females laid their eggs.

Capsids (*Lygus rugulipennis, Calocoris norvegicus* etc.)
Only few and weak attacks were seen.

Black bean aphids (*Aphis fabae*)
No overwintering eggs were found on spindle trees, and the attacks in the beet fields were also weak and insignificant.

Peach potato aphids (*Myzus persicae*)
Only few and weak attacks were reported, mainly in the neighbourhood of greenhouses. The attacks of beet virus yellows were also weak.

Tortrix moth larvae (*Cnephasia spp.*)
The attacks were widespread, but insignificant.

Beet carrion beetles (*Blitophaga opaca*)
The attacks were fairly widespread, but weak.

Pygmy beetles (*Atomaria linearis*)
The attacks were fairly widespread, but weak. Apart from the normal gnawing of the stem, gnawings on the seed-leaves were also observed.

Beet leaf miners (*Pegomyia hyoscyami*)
On the whole, only weak attacks were registered. In Funen, however, severe attacks were seen in a few fields.

Sand weevils (*Philopedon plagiatus*)
Widespread, but weak attacks were seen in Jutland and in the North of Funen.

Nutmeg moths (*Dicestra trifolii*) and cabbage moths (*Mamestra brassicae*)
Serious attacks were seen, especially in Northern Jutland. Treatment with pyrethroids was effective.

Cutworms (*Agrotis segetum*)
Numerous fields were attacked, but the yield was not affected. Treatment with pyrethroids was also effective in this case.

Oil-seed rape and other cruciferous crops

Cabbage thrips (*Thrips angusticeps*)
Widespread and severe attacks rape were seen in oil-seed rape in Jutland and Funen.

Cabbage aphids (*Brevicoryne brassicae*)
Only a few weak attacks were seen.

Blossom beetles (*Meligethes aeneus*)
Immigration into the rape fields was considerable at the end of May, and serious and widespread attacks were seen all over the country.

Seed weevils (*Ceutorrhynchus assimilis*)
In general, only weak attacks occurred in winter rape, but attacks were widespread on Bornholm and also occurred in Central Jutland. In spring rape the attacks were a little more severe than in the last few years.

Brassica pod midges (*Dasyneura brassicae*)
The brassica pod midge started hatching around the 25th May, and considering the weak attacks in 1983, it was to be expected that attacks in 1984 would be moderate. However, the attacks of the 2nd- generation brassica pod midges turned out to be widespread and in some cases severe all over the country.

Flea beetles (*Phyllotreta spp.*)
The attacks in 1984 were few and weak.

Cabbage stem weevils (*Ceutorrhynchus quadridens*)
On light soils - especially in Jutland - the attacks of cabbage stem weevils were fairly widespread and in some cases serious.

Diamond back moths (*Plutella xylostella*)
Only few and weak attacks were seen in 1984.

Cabbage butterflies (*Pieris brassicae* and *P. rapae*)
In agricultural crops the attacks were few and weak, whereas they were widespread in cabbage crops in gardens.

Swede gall midges (*Contarinia nasturtii*)
The attacks were few and very weak, except in some swede fields near Skive in Northern Jutland.

Cabbage root flies (*Delia brassicae* and *D. floralis*)
In general, cabbage root fly attacks were weak. However, sporadic attacks were seen in spring rape in Jutland.

In Northern Jutland the attacks of the turnip root fly were widespread, but weak.

Turnip sawfly (*Athalia rosae* (colibri))
The attacks registered were few and weak.

Potatoes etc.

Potato cyst nematodes (*Heterodera rostochiensis*) were only seen in a few places, mainly in gardens.

Cutworms (*Agrotis segetum*)
As might be expected, the favourable propagation conditions in July- August 1983 led to widespread cutworm attacks in 1984 in crops which had not been treated in time.

The catch of males in pheromone traps was the biggest since 1977, and the migration period was long. In some areas, especially on Samsø, the migration was very pronounced. Here 3 treatments with pesticides were recommended. In the rest of the country, 2 treatments were recommended in beetroots, carrots, onions and leeks on light soils.

Colorado beetles (*Leptinotarsa decemlineata*)

In 1984 colorado beetles were only found in 268 of the approx. 1800 localities where colorado beetles had been found in 1983. They were mostly found in gardens, and only in 47 cases in potato fields.

The occurrence of colorado beetles in 1984 compared with 1983 confirms that efficient control measures may prevent the colorado beetle from becoming a permanent pest in Denmark.

3. Diseases and pests of horticultural plants 1984

Lars A. Hobolth

A study of the percentual distribution of enquiries in the last 7 years (table 1) shows that, in general, the enquiries are very stable. However, there are some shifts. Some of the changes may be due to the way the work is now organized at the centre. Some enquiries, which were earlier registered as physiogenic, are now classified as bacteriological questions.

Table 1

Percentual distribution of registered enquiries 1978-1984

Year	Number	Physiogenical	Mycological	Bacteriological	Virological	Zoological	Diverse	Unexplained
1978	2140	19.2	32.6	3.3	3.2	28.0	13.0	0.7
1979	1720	16.2	36.1	4.5	4.8	27.9	10.1	0.3
1980	1410	18.6	40.8	4.5	4.6	21.0	9.1	1.4
1981	1706	16.5	38.9	7.4	5.3	23.8	6.1	1.9
1982	2101	12.9	38.3	12.2	3.7	25.7	6.8	0.3
1983	2209	12.4	45.6	7.7	4.2	26.3	3.4	0.05
1984	2124	13.6	45.2	5.8	6.6	25.2	3.6	0.3

Climatic damage

The early spring and the subsequent period was characterized by yellow leaves. The first ones were seen in greenhouse cultures, where pot plants had iron and manganese deficiency. These pale leaves must be ascribed to the drastic change in the light quantity: The first two months of the year were very dark, whereas March was characterized by fine, clear weather.

Later, yellow leaf edges and light green plants occurred in cucumber and sugar corn because of very low night temperatures. The scarce light during the first months resulted in many blind shoots in greenhouse roses.

Night frost occurred at the beginning of May. Apparently, it did not damage apples and pears, whereas many plums had suberized areas around the stalk. The night frost also spoiled many of the primordial leaves in the early strawberries; but the reason for the low strawberry yield was probably insufficient development of the flowers in the autumn.

The weather during the summer resulted in widespread tip burn in many types of cabbage. Otherwise, growth conditions were favourable in 1984 and resulted in a big yield. As a consequence, cabbage heads with internal tip burn could not be used, and in some cases the crop was destroyed by means of an ensilage harvester and spread out in the field.

Many potatoes in private gardens were damaged because of the favourable conditions, which led to excessive growth. Apparently, the cultivar 'Octavia' is particularly sensitive to this kind of damage and shows the most pronounced and serious symptoms.

Fungal diseases

Club rot (*Plasmodiophora brassicae*)

Very serious attacks are sometimes found in plantlets which are to be planted out. Examination of the cultivation method seems to indicate that the infection comes from the last field where the transportation boxes were placed before they were reused. Plantlets were infected by the small quantities of soil left in the transportation boxes, although uncontaminated soil was used for the cultivation.

Pythium spp. is a common fungus in many glasshouse cultures. Often very small changes in the cultivation method may lead to

attacks on the weakened plants and complete destruction of the root.

Phythophthora spp. is almost as widespread in pot plant cultures as *Pythium*. However, *Phytophthora* is more common in the propagation stage than *Pythium*, where the blackish brown rot may ruin great quantities of cuttings.

Phytophthora porri is fairly common in leek cultures. Especially in cultures with insufficient crop rotation, whitish dead spots on the leaves show the attacks of the fungus.

Downy mildew (*Peronospora sparsa*) could be seen early in the year both outdoors and in greenhouses. It seems that the weather conditions were favourable for the fungus, for attacks were seen throughout the summer.

Downy mildew of onion (*Peronospora destructor*) was found in onions at the start of the summer. The early attacks were probably due to the cool and moist period in June.

Downy mildew of cabbage (*Peronospora parasitica*). Very serious attacks occurred in the autumn. In some cases they were so severe that the fungus had penetrated to the first leaves of the actual head.

Downy mildew of poppy (*Peronospora arborescens*). Serious, almost devastating attacks were seen in several fields with opium poppies. The attacks started some time after the flowering. However, the damage to the crops was limited by spraying with Ridomil MZ, after permission had been given by the National Agency of Environmental Protection.

Downy mildew of lettuce (*Bremia lactucae*). Apart from the usual attacks in greenhouses, downy mildew was also seen on iceberg lettuce in the field.

Apple scab (*Venturia inaequalis*) did not develop as violently as in 1983. Nevertheless, it was of significance in some commercial orchards.

Powdery mildew of strawberry (*Sphaerotheca macularis*) spread quite considerably in a cultivar like 'Zefyr'. However, it should be mentioned that the fungus spread most after harvest, so that there is a considerable risk of mildew attacks in strawberries in 1985.

American gooseberry mildew (*Sphaerotheca mors-uvae*) was particularly common in private gardens. Both berries and bushes were covered by the mycelium of the fungus.

Leaf disease (*Gnomonia veneta*) is common in plane trees. Particularly strong attacks are seen in the first year after new trees have been planted. One of the reasons for the strong attacks is the big trees which are planted along roads and streets. As they are often wounded, they are particularly exposed to attacks.

Grey mould (*Botrytis cinerea*) is a very common disease both in the fields and in greenhouses. Of outdoor cultures where attacks have occurred the following may be mentioned: strawberries, *Alnus glutinosa*, *Crataegus oxyacantha* and peas. In greenhouses severe attacks were seen in the following cultures: cucumber, tomato, *Begonia*, *Cyclamen* and *Exacum*.

Septogloeum ulmi was found on 1/0 *Ulmus glabra*, where it resulted in a serious loss of leaves.

Fusarium oxysporum was found in many different cultures both in the field and in greenhouses. Thus attacks by the fungus was registered in onions, asparagus and celery. In greenhouses the fungus was found on *Solanum*, *Hoya bella*, *Schefflera* and *Dracaena*.

White rot (*Sclerotium cepirovum*) seems to become more and more common. As efficient fungicide control of the disease is not possible, it is very much feared by growers of edible onions.

Pests on horticultural plants

Thrips (*Thysanoptera*)
Late in the summer very strong attacks of thrips were seen in various cultures, especially in roses, dill, leaks and cabbage. The attacks in cabbage are somewhat different from the rest as the sucking of the thrips causes abnormal cell division which leads to wart formation on the leaves. The wart formation may be found deep inside the cabbage heads, where the thrips are also found.

Strawberry mites (*Steneotarsonemus pallidus*) seem to have been more widespread in 1983 than in the preceding years. This may be due to the bad start the plants had because of the spring weather.

Gall mites (*Eriophyes*) had an unusual development in 1983, where reports were given of many attacks, both the normal ones in plum, pear and hazel and more unusual ones, for instance iwhere reports were given of many attacks, both the normal ones in plum, pear and hazel and more unusual ones, for instance in hornbeam and birch.

Garden chafers (*Phyllopertha horticola*)
As in the last few years, garden chafers migrated very much, and in the autumn considerable damage was seen in lawns because of larva gnawing.

Argyresthia goedartella
In the spring the larvae of this moth occurred in great numbers on birch in the Copenhagen area. In some cases the birch trunks were completely covered by the web of the larvae.

Crane flies (*Tipulidae*) had a very big and lengthy migration in the spring. In some places the larvae developed so early that damage was seen in lawns later in the year.

Hares (*Lepus europaeus*)
The wet weather in the early summer made the hares seek away from the corn fields. Sometimes they went into fields with onions, where they caused some damage by gnawing the leaves.

IV. BOTANY DEPARTMENT, Ib G. Dinesen, Acting Head of Dept.

Experimental work

Bacterial diseases (Ib G. Dinesen and Karen Jørgensen)

Potato ringrot (*Corynebacterium sepedonicum*)

The number of samples to be examined for potato ringrot was very small in 1984. Most of the material which was examined was meristem plants produced at the Virology Department of the Centre.

The investigations which were initiated last year in order to establish the spread of potato ringrot in the field were continued in 1984.

Laboratory tests were carried out to find suitable desinfectants against potato ringrot.

The Government Council for Agricultural and Veterinary Research granted financial means for 7 months' work on the project: 'Examination of the serological cross reaction between serum against potato ringrot and nonpathogenic soil bacteria'. The project was finished in 1984.

Fireblight (*Erwinia amylovora*)

The forecast model for fireblight was related to observations of fireblight in hawthorn hedges. Countings were carried out at the Institute for Landscape Plants at Hornum in Jutland, and in mid-Zealand. The observations in Zealand were in better agreement with the model than those from Jutland.

Production of healthy nuclear plants

In connection with the renewal of the nuclear plants at the Institute of Glasshouse Crops, the bases of cuttings were examined for plantpathogenic bacteria. Thus *Kalanchoë blossfeldiana* and *Dieffenbachia maculata* were examined for *Erwinia chrysanthemi* and *Pelargonium hortorum* for *Xanthomonas pelargonii*. All the samples were free from plantpathogenic bacteria.

Two new Dieffenbachia cultivars 'Anne' and 'Catharina' were also found to be free from *Erwinia chrysanthemi*. *Hedera helix*: The Institute of Glasshouse Crops was visited regularly to make sure that the nuclear plants are still free from *Xanthomonas hederae*. *Begonia hiemalis*: The cleaning by meristem production of *Begonia elatior* hybrids was fairly extensive in 1984. The tube plants are examined twice for *Xanthomonas begoniae* before delivery to the Institute of Glasshouse Crops.

Fungal diseases

Takeall and eyespot in cereals (H. Schulz)

Takeall (*Gaeumannomyces graminis*)

In 1984 the total number of stubble samples examined for takeall was 1978. The attacks in spring barley were at the same level as in 1983. However, a few fields had fairly severe attacks. In about 11% of the fields examined, over 20% of the roots were attacked. In winter barley more than 20% of the roots were infected in 23% of the fields, and in 10% of the winter rye fields. In general, the attacks in winter wheat were slightly less severe than in the preceding years. However, an infection percentage of more than 20% was found in almost one fifth of the fields, especially when the crop rotation included many cereals.

Eyespot (*Pseudocercosporella herpotrichoides*)

In the springtime about 527 samples of winter crops were examined for eyespot with a view to prognoses, warnings and spraying guidance in winter crops. Climatic observations and spore counts showed that the infection possibilities were considerably less than in the two preceding years. The main part of the contamination probably took place in October/November.

According to the observations, spring infestation was only possible in the first week of April at Abed.

It was estimated that spraying was necessary in 45% of the wheat fields, in 35% of the rye fields and in 15% of the winter barley fields.

The summer estimates of 1978 samples showed weaker less widespread attacks of eyespot than in 1983. In 14% of the winter barley fields, more than 40% of the straws had been attacked, 13% in rye, and in winter wheat more than 40% infested straws were found in 23% of the fields, which is considerably below the 1983 level. In 61% of the spring barley fields, weak attacks of eyespot were registered.

Sharp eyespot (*Rhizoctonia cerealis*) was somewhat more widespread than in 1983. Attacks were observed in 2% of the spring barley fields examined, in 51% of the winter barley fields, in 44% of the winter rye fields and in 80% of the winter wheat fields. The attacks observed in some of these were fairly severe.

Damage thresholds in spring barley (Sten Stetter)

Since 1984 investigations have been carried out to find the damage thresholds for mildew, brown rust, net and leaf blotch in spring barley. The results were used for working out the computer program 'Epidan', which was tested in the field in 1983 and 1984. The preliminary results were given in the supplement for the Meeting of the Government Crop Husbandry Research Service 1984.

Epidan gives the participants and the spring barley growers guidance. Either the growers are advised not to take any control measures, or spraying with the fungicide which is most economic under the prevailing conditions is recommended. The 1984 edition of Epidan was extended to comprise evaluation of the need for spraying against aphids. The estimate was made at the Zoology Department.

The test work will be continued in 1985, and from the spring of 1986, the corrected Epidan edition will be accessible via the Field Management Program of the National Committee of Crop Husbandry.

Variety mixtures in spring barley (Boldt Welling and Mogens Houmøller)

The experiments with variety mixtures in spring barley were finished, and report No. 2 will be published in 1985. Instead, infestations and yield from variety mixtures of winter barley is being examined.

The results from the first year showed limited attacks of mildew (*Erysiphe graminis*) and leaf blotch (*Rhynchosporium secalis*) in mixtures compared with the attacks on the varieties grown as monocultures. The difference in yield is called the yield effect of variety mixtures.

Besides, increases in yield of 02.3 hkg were found in the mixtures. The increase was most pronounced when the yield was high. The grain weight was not affected in any of the mixtures. Fungicide treatment with Bayleton 25 WP and Tilt 250 EC did not have any influence on the yield increase of variety mixtures.

The trials were carried out in cooperation with the Government Research Station at Rønhave and the Agricultural Plant Department of the Royal Veterinary and Agricultural University. The project will be continued in 1985.

Observations of net blotch of barley (*Drechslera teres*) in a differential assortment (Boldt Welling)

In cooperation with the Agricultural Department at Risø, a differential assortment selected by P. Lundin, Weibull and J.C.N. Knudsen, Risø, was observed for attacks. The varieties were sown in small plots surrounded by winter barley, so that the inoculum level is very high.

A severe attack in the first growth stages (about 6) does not necessarily mean a serious attack at a later growth stage (10.4).

There were great differences between the level of attack of the different varieties, varying from 0 to 12% attacks (Welam) estimated on the 2nd leaf at growth stage 10.4 on 26th June 1984.

The observations continue and, if possible, they are going to be part of the virulence survey of *D. teres*.

Winter barley examinations 1984 (Boldt Welling)

Random sampling in 23 winter barley fields in Zealand during the spring of 1984 showed that the mildew attacks were on a low level: 20 fields had 00.1% mildew. The attacks in the remaining three were somewhat more widespread.

In the neighbouring spring barley fields, about half had attacks above the background contamination of 0.5%. It is concluded that severe mildew attacks in two spring barley fields may quite definitely be ascribed to contamination from winter barley due to lack of protective spraying.

Examinations of 42 winter barley fields in the autumn of 1984 revealed mildew attacks in nearly all fields and net blotch in about 80% of the fields, especially when following a barley crop.

The quality of stored grain (Boldt Welling and Anita Idoff)

In cooperation with the National Institute of Animal Science, investigations were made to register the occurrence of storage fungi with different preservation methods. The results from 1984 were published in report No. 559 from the National Institute of Animal Science.

The experiments will be continued.

Diseases in grass (Boldt Welling)

The relation of diseases and yield in seed grass and routine fungicide sprayings was examined. The investigations were carried out in cooperation with A. Nordestgaard, Roskilde Research Station.

The investigations in 1984 did not indicate any clear correlation between disease, yield and treatment with fungicides.

The experiments are continued in 1985.

Introductory investigaitons on *Polymyxa graminis* on wheat and winter barley (Boldt Welling & Bent Engsbro)

The virus disease BYMV on wheat and winter barley is transferred with the fungus *Polymyxa*. Symptoms of attacks has not yet been

seen in Denmark, whereas they occur in many of the neighbouring countries.

No *P. graminis* was found by direct microscopy of winter barley samples (mostly plants from seed left in the fields) gathered in November/December.

A greenhouse test where 'Igri' winter barley was sown in soil from some of the samples showed weak symptoms of *P. graminis* on the oldest roots after about 2 months. Standard procedures for these examinations will be developed.

Estimate of *Septoria* attacks in 5 localities (Boldt Welling)

Examinations in 1984 showed attacks of both *S. nodorum* and *S. tritici* on 'Kraka' wheat. In general, the attacks were characterized as weak.

The registrations will be used for estimating the relation between climatic conditions and *S.* attacks. The estimate will be made in cooperation with the Institute of Agricultural Meteorology.

Fungal diseases in rape (Lone Buchwaldt)

In 1984 there was no risk of attacks of stem rot fungus (*Sclerotinia sclerotiorum*) in winter rape because the scarce rainfall in April and May prevented the sclerotia from sprouting. There were no aphothecia when the forecast was made at the beginning of the flowering. However, there was a risk of attacks on spring rape when the weather became rainy alternating with dry and windy periods. The result was more attacks of stem rot fungus than in the two preceding years. Apart from that, no serious attacks occurred in rape.

Experiments carried out in order to establish the right time for control of stem rot fungus were concluded after three years. They resulted in a recommendation of spraying with Ronilan (vinclozolin 1.0 kg/ha) or with Rovral Flo (iprodion 2.0 l/ha) at beginning or at full flowering. The results obtained with later spraying and reduced doses were less good. Experiments with che-

mical control of black spot (*Alternaria spp.*) were concluded after three years. They showed little effect of treatment as there were practically no attacks.

A method for examining the susceptibility of rape to stem rot fungus was tried for two years under field and greenhouse conditions. The fungus is grown on wheat grain which is fastened to the stems with moist cotton wool and parafilm. All the varieties were fairly susceptible. A few varieties in each test series showed extreme sensitivity. The statistical analysis has not yet been concluded.

Potato wart (*Synchytrium endobioticum*) (H. Mygind)

Examinations were carried out for the Government Plant Protection Service to establish whether live fungi (resting sporangiums) could be found in soil samples taken from areas where potato wart has occurred earlier, so that the prohibition might be lifted in case the results were negative. 14 soil samples taken in the autumn of 1983 were examined. The tests were carried out in greenhouse pots with the highly susceptible cultivar 'Alma'.

By the end of the test, no wart was found on the plants. Thus it may be concluded that the soil samples did not contain any live infectious matter.

Healthy nuclear stock of ornamental pot plants (H. Mygind)

From the Institute of Glasshouse Crops, we received 11 clone samples of the pot plant *Campanula isophylla* to be tested for *Fusarium tabacinum*. This vascular fungus was not found in the material.

In December we received test material from *Centradenia inaequilateralis*, which is a new pot plant. No vascular fungi were found in the material.

From the Institute of Landscape Plants we received plant material from April to September to be examined for vascular fungi. There were samples of a number of perennials of different

families, genera and varieties, and 4 samples of woody ornamental plants.

Fusarium oxysporum was found in four perennials. Out of three samples of *Lavandula*, *F. oxysporum* was found in one, and *Phytophthora cinnamoni* in another sample.

Diseases on sour cherry (Karen Jørgensen)

Investigations of the diseases occurring in sour cherry are carried out in cooperation with the Institute of Pomology.

In a number of the orchards, the following pathogenes were found: Prunus necrotic ringspot virus, bacterial canker (*Pseudomonas mors prunorum*), blossom wilt (*Sclerotinia laxa*) and leaf spot and shot hole (*Blumeriella jaapii*).

The life cycle of bacterial canker under Danish climatic conditions was studied by inoculation experiments, and the susceptibility of different sour cherry varieties to bacterial canker was examined.

In cooperation with the Virology Department, a method for quick and certain detection of prunus necrotic ringspot virus was developed.

Red core (*Phytophthora fragariae*) in strawberries (H. A. Jørgensen)

Infection experiments on *Fragaria vesca* were again carried out in a greenhouse with pure cultures of the fungus received from Sweden, England and Germany. Besides, roots of diseased plants imported from Sweden were used as inoculation material in order to provide plant material which could be used as a basis for comparison by identification.

Downy mildew (*Bremia lactucae*) in lettuce (H. A. Jørgensen)

Tests for the resistance of greenhousegrown lettuce and iceberg lettuce to downy mildew were carried out, partly to find suitable cultivars, partly to map out the physiological races present in Denmark. As the year before, there were few attacks of downy mildew.

New attacks of fungal diseases (H. A. Jørgensen)

Pythium megalacanthum de By. on *Chrysanthemum hortorum*
Phytophthora verrucosa Alcock et Foister on *Arabis alpina*
Fusarium lateritium Nees on *Hibiscus rosa-sinensis*
Phyllosticta gardeniae Cke. on *Gardenia florida*
Phomopsis radula Grove on *Platanus acerifolius*
Cytospora subclypeata Sacc. on *Rhododendron indicum*
Coniothyrium dracaenae Stevens et Weedon on *Dracaena sp.*

Diagnostic work (H. A. Jørgensen, H. Mygind, Karen Jørgensen and Ib G. Dinesen)

In the course of the year the Botany Department received 574 plant samples for diagnoses of bacterial and fungal diseases. It was mostly a matter of horticultural plants.

V. VIROLOGY DEPARTMENT, H. Rønde Kristensen

1. Experimental work

By the end of 1983 Mogens Christensen, who was in charge of the serological research, retired from the Virology Department. Since no one took over his post in 1984, the serological work was much reduced.

Consequently, the demands on the electron microscopical work were increased in 1984, and about 3500 analyses were carried out by means of the ISEM method.

Part of the samples which are examined by electron microscopy are received from outside, and part of them are samples examined in connection with the research of the department as well as the various stages of the comprehensive work done by the department in order to establish healthy nuclear plants of potatoes and a great number of vegetatively propagated horticultural plants (the "meristem" programmes).

The potato meristem programme went according to plan also in 1984. Apart from the establishment of healthy, thoroughly tested nuclear material, several tests were carried out to improve the reproduction procedure. In 1984 the FAO started video takes of the Danish "potato meristem programme" with a view to implementing similar programmes in the developing countries.

The meristem culture experiments with woody plants comprised the following families: *Cydonia, Daphne, Lonicera, Malus, Prunus, Quercus, Rubus* and *Weigela.*

Diagnostic, therapeutic and other examinations and tests were made with *Aeschynanthus hildebrandii, Begonia elatior, Campanula isophylla, Chrysanthemum indicum, Dieffenbachia maculata, Euphorbia pulcherrima, Kalanchoë blossfeldiana, Miscanthus sinensis, Musa spp., Narcissus spp., Pelargonium zonale, Philodendron selloum* and *Tulipa spp.*

The scientific staff made 18 trips to other countries in 1984 and visited 11 countries. Guests from 16 countries visited the Virology Department in 1984.

Virus diseases in agricultural plants (B. Engsbro)

Barley yellow mosaic (B. Engsbro)

In 1984, 35 winter barley fields were examined for the occurrence of plants or areas with symptoms of barley yellow mosaic.

The disease was not found in any of the examined fields.

Tobacco rattle virus in seed potatoes (B. Engsbro)

54 potato varieties (including 33 number varieties from the breeding station at Vandel) were examined for susceptibility to spraing (tobacco rattle virus).

In 3 controls an average of 25% tubers were attacked by spraing.

In 30 varieties no infected tubers were found. In 16 varieties up to 2% was found, in 6 varieties up to 10%, and in 2 varieties more than 10% infected tubers.

Prevention of virus attacks in seed potatoes (B. Engsbro)

In the tests 1981-83, where sources of infection of both potato leaf- roll and streak (potato virus Y) were in close proximity, protective spraying against aphids was effected by means of mineral oil, Pirimor and Tamaron and by scattering Temik at the planting.

Leaf-roll as well as streak spread very little in 1981 (0-2%), whereas streak spread to about 40% of the tubers in untreated plots in 1982 and 1983.

Temik had no effect on the spread of the virus diseases.

In 1982 a reduction of the spread of streak was only found after application of mineral oil (both by early and late withering).

In 1983, early withering reduced the spreading of streak, so that only 15-25% tubers were attacked.

No effect of the application was registered at later withering.

In 1983 (but not in the other years) a 3-6% yield decrease was registered in the plots which had been sprayed with mineral oil.

Yield of minicuttings in net houses (B. Engsbro)

Rooted, about 1-month-old minicuttings were planted out in the middle of May 1984, partly in an insectproof net house, partly in the open at distances of 25 x 60 cm.

In an average of 8 varieties, 12.3 tubers were harvested per plant = 82 tubers over 20 mm/sq.m. in the net house. 15.3 tubers over 20 mm per plant, corresponding to 101 tubers per sq.m., were harvested in the open.

Development of minicuttings (B. Engsbro)

864 minicuttings of 12 varieties were placed in trays in the greenhouse in the spring of 1984. After about 1 month, 87% (71-100%) of the minicuttings had developed into fine rooted plants, ready for further growth elsewhere.

Shortening of potato stems (B. Engsbro)

When potatoes are grown in greenhouse, the top will reach heights of 1½-2 m. Therefore, it must be supported in order not to collapse.

To avoid this as well as secondary fungal attacks, efforts have been made to shorten the top by spraying with Alar 85.

The top was much shortened, but one net was still needed to keep the top vertical.

A reduction in the yield of about 40% was found after the treatment.

Virus diseases in fruit trees (A. Thomsen)

Apple rootstock, meristem culture

Experiments have shown that glucose is better than saccharose as energy source for the meristems.

By both sources the best growth was obtained at 30 and 50 g/l, whereas 10 g/l was insufficient.

Virusfree plants with roots have been established with rootstock M9.

Quince, meristem culture

Experiments with minicuttings of quince C grown in mediums with either saccharose or glucose as the source of energy showed that the medium with glucose gave twice as high plants as saccharose.

Besides, the reproduction speed was increased with the use of glucose.

The leaf colour was gradually improved with increasing energy content, glucose as well as with saccharose, ranging from 10 to 50 g/l.

The callus formation is increased with the addition of IBA.

The best and most harmonious plants were obtained by addition of 2 mg IBA/l.

Plum, meristem culture

Experiments with Italian prune showed that callus formation is furthered and rooting is hampered by large quantities of IBA.

The colour of the plants are changed from green to brown when using 0-10 mg IBA/l.

A greener growth is seen after use of saccharose than after glucose.

Callus formation is furthered by a high sugar content, i.e., 30 g/l or more.

Virus diseases in fruit bushes (Arne Thomsen)

Raspberries, meristem-tip culture

Rooted plants have been produced by means of material from the varieties 'Vega' and 'Zenith'.

Virusfree meristem plants are bred from root suckers in greenhouse.

Virus diseases in forest plants (A. Thomsen)

Prunus padus

Attacks of prunus ringspot virus were found in *Prunus padus* with yellow-spotted leaves (by the ISEM method).

Quercus borealis

Virus attacks were found in *Quercus borealis* with lopsided, yellow-spotted leaves. Experimentally infected *Pyronia veitchii* reacted with curled and yellow-spotted leaves.

Virus diseases in vegetables (Niels Paludan)

Inactivation experiments with tomato mosaic virus (ToMV)

It appears that the desinfectant 'Korsolin', which is a gluteraldehyde, is very efficient against bacteria, fungi and viruses. However, there are no concrete investigations within the field of plant virology where only flaming of the scalpel is used in practice, and therefore it would be desirable to find out whether 'Korsolin' would also be effective.

Virus transfer was tried by cutting ToMV-infected tobacco plants with scalpel and afterwards healthy plants with the same scalpel after dipping or not dipping it into a 3% 'Korsolin' solution.

When the scalpel had not been dipped into 'Korsolin', ToMV was transferred in all the 11 experiments. When the scalpel had been dipped in 'Korsolin', no transfer of the virus took place in any of the 19 experiments.

Experiments with transfer by sap inoculation were also carried out. A finger was used for the inoculation. Dipping the fingers in a 3% 'Korsolin' solution did not prevent transfer of ToMV in any of the 9 experiments with sap inoculation.

Seed from pepper plants infected with different TMV strains was used for inactivation experiments with trisodiumphosphate in connection with the surfactant 'Teepol', sodium hypochloride and the glutaraldehyde 'Korsolin'. The treated seeds were ground down and transferred by sap inoculation to *Nicotiana t.* 'Xanthi' comprising 5 group tests of 5 seeds.

The combination of trisodiumphosphate and 'Teepol', both in 1% solutions, was the only effective treatment. After 1 and 3 days

an average of respectively 2.6 and 0.8 local lesions developed, as opposed to untreated seeds with 100 lesions.

Allium viroses

Previously freeze-dried virus isolates from leeks and shallots were propagated on *Chenopodium quinoa*, and local lesions were diagnosed by the ISEM method. Onion mosaic virus was not found in 6 isolates from leeks and shallots. Shallot latent virus was found in 5 isolates from shallots, and leek yellow stripe virus was found in 2 isolates from leek and 1 isolate from shallot.

Virus diseases in ornamental plants (N. Paludan and A. Thomsen)

Chrysanthemum indicum hybrid

A repetition of the experiment with inactivation of viroids by cold treatment and meristem culture was carried out with chrysanthemum stunt virus (CSV) and chrysanthemum chlorotic mottle virus (CCMV). Both viroids were estimated on the basis of the symptoms developed in the meristem plants in 2-3 months under optimum temperature (25-27PC) and light conditions (18,000 lux at the plant top).

Meristems were cut after cold treatment for the following number of months at 5PC: 3, 5, 6 and 9. CSV was inactivated in 53, 57, 10 and 82%, respectively, and CCMV in 0, 57, 52 and 88%.

Pelargonium zonale

Infection trials were made with the variety 'Springtime Irene' with pelargonium flower break virus (PFBV) as well as with tomato ringspot virus (TomRV).

The trial comprised 3 isolates of PFBV and 2 isolates of the virus combination PFBVTomRV as well as healthy plants.

The symptoms of the plants were assessed every month throughout the year. Besides, the plants were tested every other month by dry inoculation to *Chenopodium quinoa* and diagnosed serologically by the ISEM method.

The results showed that it was possible to assess symptoms, test and diagnose both PFBV and TomRV all the year round. Typical PFBV symptoms consisted of chlorotic 2-5 mm spots in the leaves, a few deformed, wrinkled leaves with chlorotic vein bands and white stripes in the petals. The ISEM method turned out to be slightly more sensitive than the use of test plants.

Infection trials with 'Springtime Irene' has also been made with PFBV where both sap and knife contamination was effected between infected and healthy pelargonium plants.

Typical PFBV symptoms developed on all 18 sap-inoculated plants and in 2 of 14 cuttings by the use of a virus-infected knife.

Begonia elatior

After carnation mottle virus was found in plants with curled leaves, infection trials were carried out with the virus from test plants as well as from begonia. Trials were made to infect symptomless meristem plants by sap and by dry inoculation as well as by injection of partly purified virus in leaf veins On an average, 8 begonia plants out of 58 inoculated ones developed leaf curl after 8-10 months.

Begonia plants in glass tubes were kept with good result for 1 year at 12PC with 16 hours' illumination in a modified medium of Horst et al. 1976 (without coconut milk and with a reduction of NH_4NO_3 to 638 mg/l).

Aeschynanthus hildebrandii

Tobacco mosaic virus was inactivated by means of meristem culture and increasingly by previous heat treatment.

Campanula isophylla

It was checked that plants kept for 1 year in glass tubes would develop quite normal flowers. Tube plants delivered to the Propagation Station for commercial use developed satisfactorily into vigorous and healthy plants.

Experiments with storage of tube plants for 1 year succeeded best by 3PC without illumination in modified MS-62 media without auxins.

Araceae

Cultures of *Dieffenbachia maculata* and *Philodendron selloum* were established in glass tubes by means of mini-cuttings after desinfection with a 3% 'Korsolin' solution for 30 minutes. The MS-62 medium with 1 mg benzyl amino purin and 0.2 mg indoleacetic acid per liter resulted in increased shoot production, and the same media without auxins caused increased root production.

Euphorbia pulcherrima

Poinsettia mosaic virus and *Poinsettia* cryptic virus were both inactivated increasingly with prolonged heat treatment combined with a culture of mini-cuttings.

Kalanchoë blossfeldiana

Kalanchoë latent virus line 1 was diagnosed by the ISEM method by means of antiserum from S. S. Hearon, U.S.A.

KVL-1 was inactivated by meristem culture and to a still increasing degree by previous heat treatment.

Trials were made to rinse several varieties with mosaic on the leaves by means of meristem culture in combination with heat and chemical treatment. However, the efforts to produce symptomless plants did not succeed, and it has not been possible to diagnose the virus in question either.

Kalanchoë plants in glass tubes have successfully been kept for 1 year at 12°C with 16 hours' illumination. The medium was MS-62 in 3/4 strength with 0.2 mg/litre of kinetin and indolebutyric acid.

Prunus autumnale, meristem tip culture

By culture in MS medium at half amount of macronutrients it was possible to produce harmonious plants of *Prunus autumnale*.

Root development takes place in a medium with 0.5 mg IBA/1.

Daphne meristem tip culture

In *Daphne mezerium* greener plants are obtained in a growth medium with 10 g agar/l than in medium with 7.5 g. The plant elongation in *Daphne* was examined with different concentrations of macronutrients.

The best plant elongation was obtained in media with a low nitrogen content (1000 mg NH_4NO_3 per 1).

Glucose used as source of energy gave a better growth of the meristem plants than saccharose.

Musa meristem tip culture

Meristem plants of banana received from a Danish nursery, but produced in another country, were examined for virus infection because of slanting, deform leaves. No virus could be found, and the deformities must be ascribed to genetic causes.

Tulipa spp. breeding control

A number of plants with greyish leaves were seen in the tulip variety 'Monte Carlo' in 1984. Examinations are carried out to find out whether it is due to a primary virus attack of tulip mosaic.

Narcissus spp. breeding control

During the spring attacks by mosaic virus (yellow stripe virus) in combination with rattle virus were seen in several samples of potted narcissus plants with defective growth.

Lonicera 'Ledebourie' storage in vitro

Rooted cuttings were kept in darkness in test tubes for 24 months at 12°C.

Weigela 'Styrica' kept in vitro

Rooted cuttings were kept in darkness in test tubes for 24 months at 12°C.

Miscanthus sinensis meristem tip culture

Meristem cultures of rhizomes from *Miscanthus sinensis giganteus* were established.

Propagation

In 1984 parts of the following species and varieties of woodish ornamentals were examined and found free from virus:

Betula pubescens
Fabiana inbricata
Myrica Pennsylvanica 'Myda'
Myrica Pennsylvanica 'Myriman'
Rosa multiflora

Electron microscopy (J. Begtrup)

A total of 3500 EM analyses were made with the ISEM technique. As was the case in the previous years, the testing in connection with the production of virusfree material for agricultural and horticultural use (meristem cultures of potatoes, *Kalanchoë*, *Begonia*, *Euphorbia*, etc.) comprised many samples from the so-called "Cost-87" programme (European cooperation concerning the production of virusfree plant material). Besides, many heat-treated poinsettias (*Euphorbia*) were examined on several occasions to detect possible seasonal variations.

Besides, a number of experiments with bacteria were carried out in order to ascertain whether serological electron microscopy

might be used for finding very small quantities of bacteria (*Corynebacteria* in potato tubers).

The electron microscopical examinations comprised two fungus-borne viruses: barley yellow mosaic and beet necrotic yellow vein. However, the pathogens in question have not yet been found in Denmark.

Virus infection was found by means of electron microscopy in the following plant species in 1984: *Aeschynanthus, Allium, Betula, Brassica, Chrysanthemum, Cucumis, Dactylis, Euphorbia, Freesia, Helenium, Hordeum, Kalanchoë, Lycopersicum, Narcissus, Pelargonium, Pentas, Prunus, Ribes, Rosa, Solanum, Triticum, Tulipa* and *Zantedescia*.

The following viruses were detected: cucumber mosaic, arabis mosaic, cauliflower mosaic, chrysanthemum virus B, dasheen mosaic, barley yellow dwarf, raspberry ringspot, Kalanchoe" latent virus 1, potato leaf-roll, potato virus M, potato virus S, potato virus X, potato virus Y, onion yellow dwarf, carnation mottle, pelargonium flower break, pelargonium line pattern, pelargonium ring pattern, pelargonium leaf curl, poinsettia cryptic, poinsettia mosaic, prunus ringspot, shallot latent, tobacco mosaic pepper strain 8, tobacco mosaic pepper strain 11, tobacco mosaic tobacco strain, tobacco mosaic tomato strain, tomato aspermy, tomato ringspot virus and tomato blackring virus.

Number of ISEM analyses carried out at the Virology Department 1975- 84:

2. New attacks 1984 (Niels Paludan, A. Thomsen)

Viruslike symptoms were observed in:

Pelargonium peltatum	pelargonium ringspot (1977)

Virus infections were detected in:

Arabis caucasica	tomato blackring virus
Dipladenia sp.	rod-shaped particles
Euphorbia fulgens	poinsettia mosaic virus
Euphorbia fulgens	poinsettia cryptic virus
Hemorocallis sp.	arabis mosaic virus
Pelargonium zonale	pelargonium line-pattern virus
Pelargonium zonale	pelargonium ringpattern virus
Prunus padus	prunus ringspot virus
Zantedeschia aethiopica	dasheen mosaic virus

V. ZOOLOGY DEPARTMENT, J. Jakobsen

1. Experimental work

Potato cyst nematodes (*Globodera rostochiensis*) (J. Jakobsen and L. Monrad Hansen)

Distribution of potato cyst nematodes in selected areas in Jutland

In 1983 about 700 samples from potato flour factories etc. were examined. 45 of these samples could be tracked to the fields where the potato had been grown.

To check the samples from 1983, samples were taken direct from the fields in question in 1984.

The soil samples examined in 1983 did not have any demonstrable content of potato nematodes. The same was the case with the samples taken out in 1984, except for one single sample which contained a few potato cyst nematodes.

Testing of potato hybrids for resistance to potato cyst nematodes

For the potato breeding station at Vandel, 265 new potato crosses were examined for resistance to pathotype Ro-1 of the potato cyst nematode. 50 new crosses were examined for resistance to PA-2 and PA-3.

Examinations of soil samples taken by the Government Plant Protection Service

The following number of samples distributed on the below categories were examined in 1984:

	Export	Growers	Seed potatoes	Nurseries	Potato cyst nematode localities	Others
Total number of samples	198	448	6,477	718	247	993
Samples with cysts	0	3	38	7	58	132

Cereal cyst nematodes (*Heterodera avenae*)

Distribution of cereal cyst nematodes (L. Monrad Hansen)

During the autumn of 1984 about 250 soil samples were taken from fields where spring barley had been grown during the year.

Cereal cyst nematodes occurred as follows:

Occurrence of cereal cyst nematodes

Eggs per kg	Number of fields	Per cent
0	84	33
0- 1,000	62	25
1,000- 5,000	62	25
5,000-10,000	22	9
10,000-20,000	10	3
over 20,000	10	3

The occurrence of cereal cyst nematodes corresponds to the results of similar, but more comprehensive investigations which were carried out in cooperation with the Crop Husbandry Department at the beginning of the seventies.

Nematode-parasitizing fungi (M. Juhl)

To examine the effect of parasitizing fungi on cyst nematodes, formalin treatment has been tried out in various tests with cereal and beet cyst nematodes.

In a test, which included application of varying quantities of nitrogen, the formalin treatment caused a reduction in the percentage of parasitized cysts from 46 to 16. In untreated plots the corresponding figures were 70 and 50%. The greatest parasitizing percentages were found in the plots which had received the greatest quantity of nitrogen.

A corresponding test was carried out in plots where half the plots were kept free from frost. All the plots were treated with formalin during the autumn of 1983. The treatment resulted in a decrease in the parasitizing percentage in the frost-free plots from 52% to 5%. In the plots which were not frost-free the corresponding figures were 39% and 5%.

In an area infested by the beet cyst nematode *Heterodera schachtii*, annual formalin treatment was carried out in parts of the area.

The number of beet cyst nematodes in the part treated with formalin was 2,200 in the autumn of 1982 and increased to 46,700 in the autumn of 1983. The great increase in the population of the part treated with formalin is thought to be due to the effect of formalin treatment on nematode-parasitizing fungi.

From 1983 to 1984 the parasitizing percentage in the untreated part rose from 24 to 39. The corresponding figures for the part treated with formalin was 21 and 11.

As part of a cooperation within the IOBC*), experiments were made with the fungus *Hirsutella heteroderae*.

The test was carried out in pots in greenhouses. 2 different concentrations of fungal spores were introduced into autoclaved soil where beets were grown. 14 days after the sprouting, 6,000 nematode larvae were introduced into each pot.

Soil which had been naturally infested with beet cyst nematodes was also used.

The number of newly formed cysts was high in autoclaved soil, but *A. heteroderae* reduced the number by 45 and 52%, respectively, according to the concentration of fungal spores.

In naturally infested soil, the cyst formation was somewhat smaller, while *H. heteroderae* reduced the cyst formation by 55 and 92% respectively with the same spore concentrations.

Migrating nematodes as pests in sugar beets ("Docking disorder") (L. Monrad Hansen)

The occurrence of the nematode genera *Trichodorus* and *Longidorus* was investigated in about 50 fields distributed all over Denmark. The suvey was carried out in connection with other examinations.

Trichodorus spp. was found in about 26% of the fields. The number of animals per 200 ml soil was distributed as follows: 0-6 in 12%, 6-10 in 6% and > 10 in 7%. Fields with more than 10 animals per 100 ml of soil probably passed the damage threshold and showed a reduction in yield. However, no yield estimates were made.

A small number of *Longidorus spp.* was found in 6% of the fields.

Prognosis of collembola attacks in sugar beets estimated on the basis of soil samples taken in the autumn (L. Monrad Hansen)

The possibilities of making a prognosis for occurrence of collembola based on examination of soil samples taken in the autumn were further investigated.

About 20 fields on Falster were examined in the spring and autumn of 1984. Besides, another 10 fields in Funen were examined in the autumn with a view to the spring of 1985. The average occurrence of collembola in the fields was 0-10 collembola per sample. The damage threshold in the spring is about 10 collembola per sample.

In general, the results of these investigations are in agreement with the results of the previous years. If the number of collembola is low in the autumn, it will also be low in the following spring, and no control is necessary.

The investigations in the 30 fields will be continued, and samples will be taken in the spring and autumn to register the fluctuations in the occurrence of soil-inhabiting pests also in years where no beets are grown.

Experiments with seed dressing and granule application in sugar beets (L. Monrad Hansen)

In cooperation with the sugar factories, examinations of soil samples from 10 seed treatment and granule experiments and 3 crop rotation experiments were carried out in 1984. The insecticides used in the 7 seed treatment and granule experiments were Promet, Marchal, Ambush, Oncol and Curaterr, with Thiram as control. In the remaining 3 tests, only the seed dressing compound Promet was used. In general, it seems that Promet as seed dressing is just as efficient as the granule Curaterr against collembola attacks if the attacks are not too vigorous. The experiments will be continued in 1985.

In cooperation with the Crop Husbandry Department, soil samples from 11 seed dressing and granule experiments were examined. In none of the experiments, soil-inhabiting pests were found in such numbers that the effect of the products might be established. The products used were mainly the same as at the experiments set up by the sugar factories. The examinations will be continued in 1985.

In cooperation with the Institute of Pesticides, 9 fiedl experiments with seed dressing and granule application were carried out. Collembola attacks were only registered in one of the experiments. The yield was not determined, but Promet seems to have as good an effect as Furadan on the number of collembola.

Registration of aphids in selected propagation areas (J. Reitzel)

The purpose of the examinations is to establish the relation between the occurrence of winged aphids and the spread of virus to fields with seed potatoes.

In 15 fields with seed potatoes the occurrence of winged aphids was registered by means of yellow tray traps. According to Dutch examinations, the aphid species which are known as poor vectors of streak have been given a relatively low value. The actual vector pressure equals the sum of the values of caught aphids.

Of the aphid species living on the potato plants, peach potato and cucumber aphids were the only major species present in the samples.

Compared with the results of the previous year, the occurrence of aphids was very low in 1984, and the period with many winged aphids was at the beginning of August, whereas it usually falls in the middle of July.

The moderate number of virus-infected potatoes found at the winter testing corresponds very well to the few aphids during the year.

Grower registration - aphids and mildew in spring barley (L. Monrad Hansen, F. Lind and J. Jakobsen)

"Registration of aphids and mildew in spring barley" is a registration and forecasting system which is constructed as a simplified edition of the Dutch EPIPRE system. The Danish system was initiated in 1983 where aphids were the only pest registered. In 1984, aphids, powdery mildew and rust were included in the programme.

600 spring barley growers took part in the system in 1984. Before the growth season the growers send in basic information about the fields in question. The basic information comprises soil type, crop rotation, soil treatment, fertilization, cultivar and sowing time. On receipt of this information, the first registration form is sent out, and the growers are given notice of when the registration starts.

The data from the growers are fed into a computer, and recommendations to the grower are automatically written out.

Registration takes place at intervals of from 4 to 14 days depending on the occurrence of pests, growth stage and meteorological conditions. The registraiton is stopped when there is no longer any risk of serious damage to the crop. After harvest, the growers are asked to give information about the yield.

During the season, the grower sends in information about date of registration, growth stage of the crop (Feeke's scale), number of straws with aphids, mildew or rust and control measures, if any.

The next registration date is calculated on the basis of the previous registration, and whether control is advisable or not. If the next registration dates for aphids and mildew do not coincide, efforts are made to find one common date. Thus the growers will only have to make registrations 3 or 4 times during the season. Notice about control measures and the next date of registration will be sent on the same day as the information is received from the grower.

In 1984, mildew attacks were widespread. Because of technical problems, the sending out of the first registration form was delayed. Therefore a number of growers had already started pesticide treatment before the first registration. In general, 87% of the fields received 1 fungicide treatment, 28% of the fields 2 fungicide treatments and 2% of the fields 3 fungicide treatments.

As to the fungicides used, Tilt 250 EC was by far the most common product used.

The occurrence of aphids was not great in 1984. 40% of the fields received one insecticide treatment while only 3% received 2 insecticide treatments.

All insecticide treatments - with the exception of one - were carried out in combination with a fungicide treatment. If aphid occurrence is calculated as a mean of the regions, it is seen that Lolland, Falster, Møn and Himmerland had the highest densities after the first registration. After the second and third registrations, Bornholm and Funen reached the same population densities. The high aphid density in Himmerland is atypical for the year.

Control was recommended after about 15% of the registrations in 1984. This corresponds to 84 instances. In fact, control measures were taken in 248 cases, which means that control was unnecessary in 66% of the cases.

The pronounced "overcontrol" is probably due to the fact that the growers had to spray with fungicides anyway, and they mixed in an insecticide whether aphids occurred or not.

Pirimor was the most commonly used insecticide, whereas the use of Parathion was much reduced from 1983 to 1984.

The participating growers have generally been satisfied with the warning system. Only about 20% do not want to participate in 1985. Not all growers followed the recommendations given, which is the reason for the considerable overcontrol.

Due to the uneven distribution of aphids in the Danish area, control measures do not have to be taken in all fields in years with many aphids, while some fields will need control even in years with few aphids. The decisive factor is the occurrence of aphids in the individual field.

After analysis of the data, it may be concluded that the data collected are too few to reveal correlations between methods of cultivation and aphid occurrence.

Semi-field experiments with aphids on rye (J. Jakobsen)

To examine the harmful effects of aphids on rye, a container experiment was carried out, where aphids were introduced at 4 points: 30th May, 6th, 13th and 20th June.

Compared with control plants, the yield was respectively 43, 57, 33 and 33% lower from plants with aphids introduced at the times mentioned above.

Semi-field experiments to determine the effect of pesticides on aphids in spring barley (J. Jakobsen)

In a container experiment, aphids were introduced 2, 5, 10 and 14 days after treatment with fenitrothion, pirimor and sumicidin. The last introduction of aphids took place on the 6th July.

Aphids were counted every 4 days from 5th July till 2nd August. For all times of introduction, the smallest number of aphids was found after treatment with fenitrothion and the biggest number after treatment with sumicidin.

Pests on oil-seed rape (F. Lind)

The registration of pests on winter and spring oil-seed rape was continued in 1984. Compared with 1982 and 1983, the occurrence of brassica pod midges on winter rape, which caused problems in some parts of the country, showed a slight increase. The attacks of cabbage seed weevils were similar to those of the brassica pod midges.

In spring rape the attacks of cabbage seed weevils and brassica pod midges were more vigorous than in 1982 and 1983. In the areas where both winter and spring rape is grown, spring rape growers had increasing problems with cabbage seed weevils and brassica pod midges.

The hatching of the 2nd and 3rd generation brasssica pod midges was registered in 16 localities. The registrations show great variations as to the time of migration of the 2nd generation brassica pod midge in different parts of the country.

Experiments under semi-field conditions have been carried out to establish the damage thresholds of blossom beetles and cabbage seed weevils. The time of attack was examined in experiments with spring rape damabged by blossom beetles. The main purpose was to reproduce results from previous years. The conclusion of the experiments in 1984 was that spring rape plants are more sensitive to attacks in the bud stage than at the start of the flowering.

In practice, the density of blossom beetles is determined by counting the insects per plant. However, this method should be supplemented by some kind of trapping system. One of the trap types which might be used for this purpose are yellow sticky tubes. 5 different shades of yellow sticky tube traps were compared as to their ability to attract blossom beetles and cabbage

seed weevils. It turned out that the saturated yellow shades attracted the two insects. The blossom beetles and the cabbage seed weevils did not react on fluorescent yellow and mixtures of yellow and green colours.

Migration of turnip moths (*Agrotis segetum*), warning against pest attacks and registration of damage (P. Esbjerg)

The use of turnip moth pheromone traps was extended to comprise 35 localities. In 4 localities catches were registered every 24 hours and in 31 they were registered twice a week. In 3 special test localities detailed meteorological measurements were undertaken with a view to calculate the actual population density after making correction for the weather. - This work was carried out in cooperation with the Zoology Institute of the Royal Veterinary and Agricultural University and the Agrometeorological Service. The ultimate purpose is to be able to determine damage thresholds on the basis of trap catches.

The catches in the many localities are used partly as basis for warnings and partly to gain information about the regional variations in migration time and population density. - The migration was intense over a long period. One early warning was sent out for Samsø alone and two Plant Protection Bulletins with warnings for the country as a whole. However, growers were told to take the rainfall in their particular part of the country into account because of the great regional variations in the rainfall in June and July.

The value of the warnings was examined by registration of damage on samples of red beet, carrot and onion. The examinations showed that none of the growers which had followed the instructions had damage of any economic importance. In a few places, the state of the untreated areas seems to indicate that the control measures taken had been unnecessary; but in most cases the treatments turned out to have prevented damage to 18-20% of the carrots and to 30-40% of the red beets. The material also confirmed the correctness and importance of the optimum times of control

calculated on the basis of trap catches. Thus 5-10% damage occurred in certain cases where the time indications had not been observed concerning two or more treatments.

Pesticide effects on cutworms (P. Esbjerg)

The sensitivity of cutworms at various stages of development to acephat, permethrin, cypermetrin and fenvalerat was examined in various types of setups: artificial contact surface, treated carrot top and treated soil carrot top and root collar. There were some difficulties with the reproducibility, but it was established that the sensitivity to all compounds declined with the number of generations grown in artificial substrate. That is, somehow, the larvae were influenced by the breeding conditions. Besides, the 12th-15th generations after insects gathered in the field were small, and their wings did not develop satisfactorily. - In spite of these difficulties, it was clearly demonstrated that the effect of the pyrethroids was at least as good as that of acephat - in some cases even better - especially in the case of big larvae.

Pheromone traps for codling moths and pea moths (P. Esbjerg)

In cooperation with fruit growers, advisors on fruit growing, and Hoechst, codling moths were caught in a number of localities - with 2 traps per locality. The material caught in the traps was used to determine the variation in time and locality of the start and peak of the migration as well the number of migrating insects.

A conservative guidance was given as to time and need of control measures. No actual estimate was made of the damage. No reports were received of "worms in apples" from growers who had taken control measures, or from growers who had omitted treatment, as advised.

Pea moth traps were only set up in a few localities in connection with pest control experiments, and where growers had bought them. The material will be used statistically when a test series has been running for 3-5 years.

Yellow sticky tray traps for carrot flies and felt rolls for cabbage root fly eggs

By arrangement with growers and agricultural advisors, yellow sticky tray traps were set up at 15 localities. Carrot flies were registered and advice about periods when control measures were unnecessary was given in cooperation with the Zoology Institute of the Danish Agricultural and Veterinary University. Besides, the information was part of a research project concerning the influence of weather conditions on trap catches. - Yellow sticky traps were used to monitor 2nd generation carrot flies with a view to carrots harvested in the autumn. However, unexpected attacks on early carrots and a heavy subsequent migration showed that in certain areas and at some periods there is a need for monitoring the 1st generation on early carrots.

A subsequent survey of the damage showed that the principle of negative monitoring must be said to work satisfactorily. As usual, it was impossible quite to avoid attacks, but a limited control based on tray trap catches gave just as good results as many routine treatments.

Heavy attacks only occurred in small sheltered spots where carrots should not be grown anyway.

The experiments with felt rolls for "catching" the eggs of cabbage root flies, which started in 1983, were continued in 1984 on cauliflower. 10 traps in a field seem to give a fair impression of the egglaying and may be used as guidance concerning control by negative monitoring.

Methods for determining carabid populations (J. Brenøe and P. Esbjerg)

With a view to future use of carabids as beneficials, two methods for determining the number per square metre were examined. The work was concentrated on the most common species found in Danish rural districts: *Bembidion lampros* which is an important predator of aphids in cereals, cabbage root fly eggs, carrot fly eggs and various eggs and larvae from harmful butterflies. Setting up 0.7

sq.metres of metal frames and subsequent catching of the beetles in the fenced-in area turned out to be a laborious and uncertain method. The greatest problem was the evident migration of beetles under the frames in spite of the fact that they had been dug 2-3 cm into the ground.

On the other hand, it turned out to be possible to hammer a simple iron cylinder into the ground and chase the beetles from within the ring by subsequent watering. - It was established that no poisonous expulsion means such as formalin were necessary. As opposed to the frame method, which involves disturbing the field for 1-2 weeks during the sowing or sprouting period, determinations by means of steel rings may be carried out in one day. The number of tests and the cost involved depend on the required precision, but a minimum testing will take 2-4 hours.

Biological control of pests in greenhouses (L. Stengård Hansen)

Biological control of aphids

The production of aphid gall midges (*Aphidoletes aphidimyza*) was increased in 1984, so that aphid gall midge pupae might be offered to all pepper growers in the country. From 1st April to about 1st June, the weakly production was 10-15,000 pupae. 1-2 pupae per square metre of greenhouse area were sent to interested growers every 14 days after planting.

The examinations comprised a total of 15,000 sq.m. greenhouse area with pepper. On 9400 sq.m. (>69 per cent) chemical control of aphids was not necessary in 1984. On another 2200 sq.m. one single treatment or partial treatment was enough, as the aphid gall midges controlled the aphids for the rest of the season.

On 25 per cent of the area (3900 sq.m. - all were heated greenhouses) the result of the control was negative, and several chemical treatments were necessary. In some cases this was due to the presence of aphids on the plants right from the start of the growth season.

The rate of introduction was in most cases sufficient to ensure satisfactory aphid control for the whole of the growth season. In heated greenhouses a greater number of gall midge pupae are necessary if control is to succeed everywhere. If aphids are present already at the planting, a very large number of pupae must be introduced - in some cases preceded by chemical treatment.

Biological control of tomato leafminers

In two greenhouses of 750 sq.m. with tomatoes, overwintering tomato leafminers (*Liriomyza bryoniae*) were controlled by means of parasitic wasps. The endoparasite *Dacnusa sibirica* was found overwintering in the green houses. Therefore, parasitic wasps were introduced into one of the houses only (about 1 per sq.m.) in order to make comparisons with the house where overwintering wasps alone were used for the pest control.

In both greenhouses the control was satisfactory during the whole of the growth season. However, the leafminer population was somewhat smaller in the house where extra parasitic wasps were introduced. At the beginning of July, another parasitic wasp (*Diglyphus iseae*) was seen in both greenhouses. 2 months later, this species was the only one found in both greenhouses, and the leafminer population was kept at a very low level for the rest of the season.

Biological control of thrips

Important experience concerning mass rearing of the predatory mite *Amblyseius mackenziei* (optimum temperature and humidity, hygienic conditions, growth medium, etc.) has been gathered, and a mass production plant is under construction.

Mass rearing and distribution of predatory mites and parasitic wasps for use in hobby greenhouses (J. Reitzel)

In 1984 the Zoology Department made a contract with a cooperative seed company about the development of production and distribution

methods, so that predatory mites and parasitic wasps might be sold in the shops.

The work resulted in development of standard packages with 100 predatory mites or 100 parasitic wasps, which could survive for at least 10 days when kept at 8°C. A total of about 25,000 packages were delivered in the period from the end of May till the end of August.

In connection with the production of predatory mites a method of rearing spinning mites as food for predatory mites was developed: Bean plants infested with spinning mites were treated with a synthetic pyrethroid. This treatment ensured against unintended occurrence of predatory mites until 14 days after the treatment.

Examination of the development of the parasitic wasp *Encarsia formosa* at low temperatures (J. Reitzel)

The parasitic wasp is used for biological control of whiteflies, and therefore it is of interest to be able to keep the parasitic wasps at low temperatures if the production of the wasp exceeds the immediate demand.

Parasitic wasps were cooled down as pupae at 5, 8 and 12°C, respectively 2, 6 and 10 days after pupation.

When cooling down 6-day-old pupae to 8°C, 31 per cent of the pupae hatched in the course of 4 weeks as compared to a total hatch of 73 per cent after 2 weeks at 18°C after the cooling period.

Thus the results show that parasitic wasps may be kept for several weeks at 8°C without any apparent harm to the animals. However, it should be mentioned that the parasitizing ability of the wasps after the cooling period has not been examined.

Development of test methods for examining the effect of pesticides on beneficial species (L. Samsøe-Petersen)

The experimental work in order to develop a test method for examining the effect of pesticides on the rove beetle *Aleochara bilineata* has been concluded. A test for adult rove beetles has

been developed and approved by the IOBC group "Pesticides and Beneficial Organisms". A corresponding test for rove beetle larvae is not quite finished.

Diseases in the rove beetle culture have caused difficulties. The species in question seems to be particularly sensitive to the fungal disease *Beauveria bassiana*.

The carabid *Bembidion lampros* was gathered in the field during the summer, and the experimental work on developing a method for rearing this species in the laboratory has been started. The adult carabids are kept in cages with "artificial soil" (Leca) where they feed on raw beef, dog biscuits and housefly eggs. The carabids are collected, and the larvae are reared individually on housefly eggs. The egg-laying declined during December, but it is not yet certain whether this is due to a diapause mechanism or for instance to the age of the animals.

B. Pesticide Research Institute

I. DIRECTORY

Director of Institute

E. Nøddegaard

Scientific staff:

Bent Bromand

Insecticides for agricultural purposes

Kirsten Junker

Fungicide resistance in plant pathogens. Occurrence and importance of powdery mildew and snow mould in cereals

Bent Løschenkohl

Fungicides for control of diseases in oil seed rape, potatoes, beets, peas and vegetables

Bent J. Nielsen

Fungicides for control of diseases in cereals, maize and grassland

Steen Lykke Nielsen*)

Reduction in the use of pesticides by changing dose and spraying time for apple trees and black currants

A. Nøhr Rasmussen

Fungicides, insecticides and nematicides for greenhouse and nursery purposes

E. Schadegg

Fungicides and insecticides for fruit growing and gardening purposes, secretariat, List of Approved Products

*): Paid by means of special funds

II. GENERAL SURVEY, by E. Nøddegaard

The Institute of Pesticides carries out tests and investigations to obtain a sufficient basis for approval of pesticides and plant regulators. Further, the institute carries out evaluation of data for efficacy in connection with the registration of pesticides and plant growth regulators by the National Agency of Environmental Protection.

The approval scheme

The scheme is carried out in accordance with an agreement between the Ministry for Agriculture and the Danish Agrochemical Association as the representative body of the agrochemical industry.

The latest agreement is from 1983 with a supplementary agreement in 1984 on the testing and approval of tank mixtures (mixtures of 2 or more compounds at the spraying).

The companies pay for the testing according to fixed rules and rates.

The rates are index-regulated and will be increased by January 1st, 1985.

The results of the testing, which were formerly given confidentially to the companies, may now be used in accordance with the provisions of the Marketing Act.

A registered mark may be used by the chemical companies on labels, in advertisements, leaflets, etc., of approved pesticides and growth regulators, and it will be used by the Danish Research Service for Plant and Soil Science when mentioning the approved chemicals.

The time-limit for application for approval of all agricultural chemicals is February 1st, with the exception of fungicides for winter crops, where the time-limit is August 15th.

Products with satisfactory efficacy are entered into the list of "Pesticides and plant growth regulators approved by the Danish Research Service for Plant and Soil Science for control of plant diseases, pests and weeds, for withering of seed crops and potato haulm and for growth regulation".

The List of Approved Products is revised annually and sent out in January. A list of additions and amendments is issued in April. Only products registered by the Environmental Protection Agency for use according to the approval may be entered into the list.

The Evaluation Scheme

According to the provisions of Act No. 410 of 17th September 1980 on chemical products, the Institute of Pesticides shall be consulted as to the efficacy of pesticides and growth regulators before the registration by the Environmental Protection Agency is carried out. The efficacy is estimated on the basis of test results sent in by the companies, experience and literature studies. If necessary, further tests and investigations may be carried out.

Old Products

The above act also stipulates that all chemicals classified by the Toxicological Board shall be evaluated by the Bureau of Chemicals and Pesticides under the Environmental Protection Agency. According to an agreement between the Bureau and the Research Centre, the Institute of Pesticides shall assist the Environmental Protection Agency by the reevaluation of pesticides and growth regulators. If this gives cause to limitations in the use of the products, the Research Centre will be asked to make suggestions for possible alternative pesticides and control measures.

III. AGRICULTURE

1. Experimental work

Fungal diseases (Bent J. Nielsen)

Bunt (*Tilletia caries*)

In experiments with treatment against bunt on wheat a severe attack was obtained after artifical inoculation of the seed, and a complete control was obtained by compounds containing triadimenol + imazalil + fuberidazol and bitertanol + fuberidazol and metfuroxam + thiabendazol.

Stripe smut (*Urocystis occulta*)

Although rye which had been artificially ioculated by stripe smut was used for the experiment, the attack in untreated was very weak.

. Complete control was obtained by compounds containing triadimenol + imazalil + fuberidazol and bitertanol + fuberidazol and metfuroxam + thiabendazol, whereas compounds containing Na-N-dimethyldithiocarbamat + fuberidazol and carboxin + imazalil+ thiabendazol did not give efficient control of the attack.

Leaf stripe (*Drechslera graminea*)

Three experiments were made with spring barley infected by leaf stripe. The attack in untreated was moderate, and a good control was obtained by normal dosage, whereas the effect by the lowest dosage (1/4) was small after treatment with imazalil + thiabendazol and triadimenol + imazalil + fuberidaol (liquid form) and prochloraz + furmecyclox.

Eyespot (*Pseudocercosporella herpotrichoides*)

4 experiments were made in wheat fields where severe attacks of eyespot had been registered in April.

The attacks were found to be severe in all the experiments (61-71 per cent) in July, and in general the control had little effect under these conditions. The best effect was obtained with prochloraz carbendazim (450 g + 120 g per ha) with an effect of 41 per cent (full control = 100). The main effect must be ascribed to prochloraz as the efficacy of the MBC compounds was as little as 24 per cent on an average. It was seen that carbendazim mixed with propiconazol or triadimefon did not improve the effect.

The attacks seen in the experiments were very severe, which may explain the fairly poor effect of prochloraz + carbendazim compared with previous years. The MBC compounds has very little effect, and it is not impossible that MBC-resistant strains of the eyespot fungus was propagated in the field.

The purpose of the experiments with eyespot at the Research Centre is to make a survey of the importance and spread of MBC resistance.

In spite of the small effect of the treatment against eyespot, there was an average yield increase of 3.9 hkg per ha for the pure MBC products. Prochloraz carbendazim gave the highest yield increase (6.2 hkg per ha). The harvest conditions were good, and there was little lodging.

Powdery mildew on wheat (*Erysiphe graminis f. sp. tritici*)

5 experiments with mildew control in wheat were carried out. In one of the experiments moderate to severe attacks were seen from the end of June. Weak attacks of *Septoria* (both nodorum and tritici) were seen as well.

The best effect was obtained after spraying with fenprophimorph + prochloraz (99% effect about 13 days after spraying declining to 79% 26 days after the last spraying). The other compounds had almost the same effect (79% and 50% effect respectively 13 and 26 days after the last spraying).

After spraying with compounds containing propiconazol, the increase in yield was 11-12% and 6% after spraying with tria-

dimefon. The slightly smaller yield after spraying with triadimefon may be because this compound is less effective against *Septoria*.

The effect of various formulations of propiconazol with chlorothalonil and tridemorph was investigated in two test series.

Addition of tridemorph to propiconazol improved the efficacy against mildew as compared with pure propiconazol, whereas chlorothalonil or tridemorph did not improve the *Septoria* control.

Powdery mildew on barley (*Erysiphe graminis s.sp. hordei*)

In three tests in winter barley the first spraying took place around the 20th April (stage 4) and the second on the 7th May (stage 6-7).

The mildew attack developed during the latter half of May and was very severe at the beginning of June. The compounds used all had a good effect 3 weeks after the spraying. After the spraying with fenpropimorph + prochloraz or tridemorph + dichlobutrazol a good long-term effect was obtained, whereas the effect of nuarimol was rather short.

3 tests were carried out in spring barley, where the first spraying took place on the 2nd June and the second on the 14th June. The control of mildew was satisfactory, but had a weaker long-term effect after nuarimol.

Two experiments with early spraying on the 27th May and the second around the 13 June were carried out in order to examine the effect of "older products" against mildew. The mildew attacks were severe and none of the compounds containing sulphur, sulphur-thiram, maneb or trifonin could control the attack under these conditions. However, triadimefon and ethirimol had a very good effect.

Net blotch on barley (*Drechslera teres*)

No heavy attacks of net blotch were seen, whereas mildew was a dominating disease in all the trials. The weak effect on mildew of anilazin, chlorothalonil and to some extent nuarimol and iprodion was clearly reflected in the yield.

Anilazin in combination with triadimenol improved the effect on net blotch compared with the combination with triadimefon, while chlorothalonil mixed with fenpropimorph did not improve the effect as compared with pure chlorothalonil.

Scald (*Rhynchosporium secalis*)

Only weak attacks of scald were seen in the experiments. In 3 experiments with spring barley a good control was obtained after spraying with propiconazol, triadimefon and nuarimol, whereas the effect after pyrazophos and chlorothalonil was somewhat smaller.

Leaf and glume blotch (*Septoria nodorum*) and leaf blotch (*Septoria tritici*)

Four experiments were made with control of *Septoria* on wheat. Three of the experiments concerned *Septoria nodorum* and the fourth *Septoria tritici*. Complete control of the disease is difficult, but good results were obtained with most products. However, pure captafol had less effect in these experiments.

Another series included 4 experiments with wheat. Leaf and glume blotch occurred in two of the experiments. Chlorothalonil mixed with propiconazol gave a good control (90% effect), whereas the effect of the other compounds was somewhat smaller, but still good (about 77%).

Snow rot on winter barley (*Typhula incarnata*)

The weather conditions for snow rot were good in 1983/84, and varying degrees of attacks by the fungus were seen in several experiments. Spraying with mepronil in the autumn had a good effect against snow rot. Products containing triadimefon also had a good effect and resulted in good overwintering. Carbendazim and prochloraz were without any effect on snow rot.

Carbendazim resistance of eyespot (*Pseudocercosporella herpotrichoides*) (Bent J. Nielsen and Hellfried Schulz of the Botany Department)

Products with content of carbendazim (MBC compounds) have been used for many years - with good effect - against eyespot. At the beginning of the 1980'ies several reports on resistance to these products were received. In the large areas with wheat in England, Germany and France it was possible to isolate strains of the eyespot fungus which were resistant to the MBC compounds.

Danish investigations showed a similar fall since 1980 in the efficacy of the MBC compounds in areas with wheat.

A number of examinations of wheat, rye and winter barley were started in 1983 in order to establish whether the eyespot fungus had also developed resistance to the MBC compounds under Danish conditions.

In July 1983 straws with unmistakable eye spots were selected at random from a great number of stubble samples sent in to the Research Centre from all over the country to be examined for eyespot. Small pieces of straw were cut out from these lesions, and they were tested on 2 ppm benomyl. The examination of the samples from 1983 was finished in 1984.

In 56% of the wheat fields which were examined at least one of the isolated fungi was resistant, and out of a total of 717 tested isolates of wheat 21% was resistant. Resistance was most frequent in Zealand, Lolland, Falster, Funen and Southern Jutland.

19 rye fields were examined. In 63% of these resistant isolates were found. Out of 276 isolated fungi 25% were resistant. Rye fields with resistant isolates were fairly widespread all over the country, whereas the greatest number of resistant isolates were found in Zealand and Funen. In winter barley resistance occurred in 4 out of 7 fields. 24% of the 87 isolates were resistant.

The examinations showed that resistant isolates are most often found in the parts of the country where many cereals are grown intensively. Pure MBC compounds are not recommended for control of eyespot in those areas.

Control of fungal diseases on potatoes, root crops, industrial crops and vegetables grown outdoors (Bent Løschenkohl)

Seed treatment of winter rape, spring rape and peas

5 products were examined in 4 tests. No difference was found as to germination or overwintering. In a test on soil with a high risk of infection from *Phoma lingam* about 80% of the plants were attacked in the spring. There was no difference between untreated and treated.

11 products were tested in spring rape, and combinations of fungicides and insecticides were examined in 4 experiments as well as laboratory and greenhouse tests. The field tests showed effect of treatment, but not great differences between the compounds.

In peas, 13 compounds and combinations of compounds have been examined in 3 tests. No result of the treatments was registered.

Treatment of potatoes against black scurf (*Rhizoctonia solani*)

6 compounds for treatment of potatoes were tested in 4 experiments. The control of black scurf was good, especially in a test at the Research Station at Tylstrup which showed more stems and stolons per plant, 16-20% yield increase and a better distribution on size of the tubers. The products Basitac 10 D, Rizolex 10 D, Rovral 50 WP and Monceren were approved. Dithane M 45 was without any effect.

Spraying of rape against fungal diseases

9 compounds and combinations of fungicides have been examined in 3 tests both in winter and spring rape. Ridomil MZ 63 WP halved the attack of downy mildew (*Peronospora parasitica*) in all three tests with winter rape. There were no serious attacks of sclerotinia disease or dark leaf spot and no difference in yield.

In an experiment with autumn and spring spraying of winter rape against *Phoma lingam*, considerable yield increases were obtained when autumn spraying with Sportak 45 EC and Topas 100

EC, i.e. 37% and 33%. The treatments resulted in a better overwintering of the rape plants. The big yield increases were due to the great quantity of weeds, particularly in plots which had not been treated in the autumn, where the smaller number of rape plants could not compete.

Spraying of peas against fungal diseases

In peas, 10 compounds and combinations of fungicides were examined in 3 tests. Yield increases by spraying with Ridomil MZ 63 WP were only seen in one test with downy mildew (*Peronospora pisi*). Apart from that, no attacks were registered, and no difference was found between the effect of the compounds as to sprouting percentage or fungal growth on the crop.

Spraying of potatoes against late blight (*Phytophthora infestans*)

9 compounds for treatment against late blight were examined in 4 tests. Besides, 3 older products were examined in two of the tests. Heavy attacks were seen in all the experiments. Among the products with systemic components, Sandofan M8 had the same good effect as Ridomil MZ 63 WP, whereas Cyperal had a less good effect. Among the newer contact compounds, Cillus Maneb 40 and Brestan 10 had good effect, the effect of FM 383 was less good, and Galben was almost without any effect. Previously approved products like OB 21, Manacol and Antracol were as effective as newer products from the same group.

As a result of the testing, Sandofan M 8, Brestan 10 and Cillus Maneb 40 were approved.

Pests in agriculture and outdoor vegetables (Bent Bromand)

Bird-cherry aphids (*Rhopalosiphum padi*), rose-grain aphids (*Metopoliphium dirhodum*) and grain aphids (*Sitobion avenae*) in winter wheat and spring barley

6 experiments were carried out with a number of synthetic pyrethroids, pirimicarb and dimethoat compounds. The aphid attacks

started late, and it was never a question of an epidemic development. Nevertheless, good results with fair yield increases were obtained, and 5 new products were approved.

Frit flies (*Oscinella frit*) in cereals, maize and undersown grass

In one single test with seed coating of winter wheat the percentage of attacked plants was reduced from 10.7 in untreated to 0.0-6.6 with the different treatments. In general, the yield increases were small. However, a 6 per cent increase was obtained in one test.

A good effect of 5 pyrethroids was seen in oats when spraying at the 2-leaf stage. In the untreated control 38.4% of the shoots were damaged.

5 tests were carried out in undersown grass. Spraying took place out 7-10 days after the cover crop had been harvested. The effect of the pyrethroids was very fine, and yield increases of up to 20% were registered with 1 spraying.

Experiments were made with incorporation of granules (carbofuran) and spraying with pyrethroids in maize. The granules were found to have a good effect. The maize was not sprayed until the 3-leaf stage, which is supposed to be the reason why the effect of the pyrethroids was moderate.

Blossom beetles (*Meligethes aeneus*), cabbage seed weevils (*Ceutorrhynchus assimilis*) and brassica pod midges (*Dasyneura brassicae*) in rape

The experimental work on spraying with synthetic pyrethroids was continued, and the product Sumicombi 30 FW, which is a mixture of fenitrothion and fenvalerat, was included in the tests. Generally, pyrethroids had a good effect on the three pests.

Seed treatment against flea beetles (*Phyllotreta spp.*) and thrips (*Thrips*) in spring rape

Large numbers of flea beetles and especially thrips occurred at the beginning of May, and three experiments with control of the

pests were carried out. The following active ingredients were used in the tests, often in combination with fungicides: Fenvalerat, lindan, acephat, carbosulfan and furathiocarb. Furathiocarb and carbosulfan had a good effect against both pests. In the experiments the powder compounds were used together with sacrust, whereas this was not the case with liquid products.

Spraying against pea and bean weevils (*Sitona lineatus*) in peas

Experiments were made with Sumicidin 10 FW and Sumicombi 30 FW. The width of the plots used for the experiment was 2.5 m, which turned out to be too small for tests with such mobile animals. The effect estimated on the basis of leaf gnawing was excellent, but little effect was seen on the damage done to root nodules by the larvae. The occurrence of animals in soil samples was examined on the 18th July, and the hatch of pea and bean weevils was followed in hatching traps from 18th July till 10th August where the peas were harvested. The differences in yield were very small.

Pea moths (*Cydia nigricana*) and pea aphids (*Acyrthosiphon pisum*)

4 spraying experiments were carried out. The sprayings were carried out after catch of pea moth males in pheromone traps or by initial attacks of pea aphids. Pirimicarb, fenitrothion and 6 pyrethroids were used for the tests. All the compounds had a good effect against pea moths, but 4 compounds differed from the others as their effect lasted 1-2 weeks longer. Serious damage by pea moths only occurred in one of the tests. All the compounds were effective except pirimicarb which is specific for aphids. Sumicidin 10 FW was sprayed both at the beginning of the flowering and 3 weeks later - the same time as in the rest of the experiments. It was established that the effect of spraying at the beginning of the flowering was unsatisfactory both on pea aphids and pea moths.

Soil-borne pests on sugar beets

In cooperation with the Danish Sugar Factories and the Zoology Department experiments were made with seed dressing, incorporation of granules and spraying against soil-borne pests, such as collembola, millipedes, symphilids, pygmy beetles, wireworms and thrips. Severe attacks of thrips occurred at the beginning of May, and a good control was obtained with carbofuran granule and seed treatment with furathiocarb. The same compounds had a good effect on beet-flies right until July. The other pests only occurred in limited numbers.

Beet-flies (*Pegomya hyoscyami*) in beets

5 experiments were carried out with fenitrothion, dimethoat, pyrethroids and a mixed compound containing deltamethrin heptenophos. In general, the phosphorous compounds were quickest to take effect. It was followed by the mixed compound and then pyrethroids. Of the pyrethroids, KVK Permethrin had a slightly worse effect. However, the overall effect of the pyrethroids was excellent.

Control of the cabbage root fly (*Delia brassicae*) on cauliflower

Several experiments were made with seed treatment, granule incorporation, soil drenching before planting and spraying, but with varying result. The best effect was obtained with Shell Birlane 24 EC and the granules carbofuran and furathiocarb.

In connection with the cabbage root fly investigations the migration was registered in yellow water traps and the egg-laying in egg traps consisting of felt rolls placed around the root collar of the plants. There was a fine correlation between the migration of cabbage root fly females and the egg-laying, and therefore forecasts about cabbage root flies will be sent out in 1985 on the basis of egg- laying.

Cutworms (*Agrotis segetum*) in carrots

Experiments were carried out with Parathion, Orthene 75 SP, Ambush, Basudin 25 Emulsion, Baythroid and Ripcord. 1 or 2 sprayings were placed according to the catch of turnip moth males in pheromone traps. The effect of Parathion and Basudin 25 Emulsion was unsatisfactory. Orthene 75 SP and Ambush reduced the attack by one third, and Baythroid and Ripcord had a very fine effect.

Procuring samples for residue analyses

The following samples were taken out for residue analyses: Wheat: 28, barley: 28, spring rape: 20, beets: 36, undersown grass: 30.

IV. FRUIT GROWING (E. Schadegg)

Fungal diseases

Apple scab (*Venturia inaequalis*)

The testing of fungicides against apple scab which had been carried out in the two previous years was continued in 1984. With a few exceptions the compounds were placed in the same order of effectivity in all the three years. However, there were considerable variations from year to year as to the degree of apple scab control. The worst effect was obtained in 1983, and the best in 1984. The reason is probably that in 1984 the 1st spraying could take place at the mouse-ear stage, whereas spraying started much too late in 1983 because of the wet spring. This confirms the fact that too late spring spraying may result in bad scab control.

Biternatol and a combined fungicide consisting of captan/penconazol had the best effect in all 3 years, followed by maneb, thiram, dithianon and fenarimol. Phtalimid compounds give good prevention, but are insufficient when used curatively. The combined dithiocarbamates had the best effect when used curatively. Benzimiodazol, sulphur and combined sulphur compounds were less effective. However, these compounds had the lowest russeting index number.

A new 40% maneb compound (Cillus Maneb 40) was approved in 1984.

In order to reveal possible resistance to benzimidazol compounds, experiments with benzimidazol compounds were started in 2 different localities.

Pear scab (*Venturia pirina*)

There was a severe attack of pear scab in 1984. Topas C 50 WP and Baycor 25 WP were approved as fungicides against this disease.

Fire blight (*Erwinia amylorora*)

A fungicide was tried against fire blight in a hawthorn hedge. The attack was very vigorous, and no appreciable effect of the spraying could be seen, which may be due to the fact that the attack was located so late that the 1st spraying was not carried out until the end of the flowering.

Pests

Fruit tree red spider mites (*Panonychus ulmi*)

A total of 10 compounds were tested in 4 experiments. An M 96 oil emulsion was used before the hatching of the winter eggs, and the concentration used should be sufficient to replace the fruit tree carbolineums. The compound was approved in 2 per cent concentrations for spraying against winter eggs when the buds burst. Apollo was tried for the first time in 1984. The compound has a long-term effect and is effective at the larval stage. Therefore it should be applied early; between green cluster and pink bud.

Quite a number of other compounds were tried out against the mobile stage. Danitol 5 EC, which is another formulation of Danitol 10 FW, was approved in 0.15% concentrations.

Winter moths (*Operophtera brumata*) and tortrix moths (*Tortricidae*)

In two tests a total of 9 compounds were tested. Sumicombi 30 FW was approved, whereas the approved concentration of Baythroid was reduced to 0.06%.

Woolly aphid (*Eriosoma lanigerum*)

5 compounds were tested in two experiments against a severe attack of wooly aphids. Pirimor G had the best effect followed by Ekamet and Hostaquick.

Codling moth (*Carpocapsa pomonella*)

7 compounds were tested in 2 experiments. Pyrethroids had the best effect. Because of the weak attack, approval could not be given on the basis of the tests.

Green apple aphid (*Aphis pomi*)

Because of the wet and cold weather the first green apple aphids did not appear until the beginning of August, when the weather became a little warmer. KVK Dimethoat 40 was approved for control of green apple aphids.

Growth regulators

A growth regulator containing 'puclobutrazol' was tested in 5 apple and 2 pear varieties. The tests were carried out in 3-4-year-old and 8-year-old trees. The results showed that the effect of the compound depends very much on the variety. The best effect was obtained in young trees. The greatest reduction in apple shoot length was 20% in the variety 'Gråsten', whereas it was 29% in the pear variety 'Conference'.

Reduced pesticide application for fruit growing (Steen Lykke Nielsen)

The relation between the dosage of pesticide and the quantity of liquid was examined by spraying against 3 kinds of pests and diseases.

Apple scab

An experiment spray volume varying from 400 to 50 l per ha and with different dosages of captan penconazol was continued from 1983. The results show that the effect of the fungicide against apple scab fell with the reduced dosage.

The deposit of fungicide on the leaves increased with a reduced spray volume, but this did not result in any improved ef-

fect against apple scab. Moreover, it appears from the results that the quantity of liquid may be reduced from 400 to 50 l per ha without any reduction in the effect against apple scab.

Fruit tree red spider mites

Spraying took place with 3 different spray volumes in fixed concentration. The effect against the spider mites fell with the combined reduction of the spray volume (200, 100 and 50 per ha) and of the concentration of the pesticide.

American gooseberry mildew

Black currants were sprayed with varying spray volumes and varying dosages. The effect was found to be twice as good with 1200 litres per ha and full dosage (100%) as with 200 l per ha and 100% dosage. A reduction of the quantity of liquid and dosage from 1200 l per ha with a 100% dosage to 900 l per ha with 75% dosage did not reduce the effect against the mildew. A further reduction, however, to 600 l per ha and 50% dosage halved the effect.

Reduced dosage of 4 pesticides against apple scab

4 pesticides were used against apple scab. The effect at full dosage was compared to the effect with a 75% dosage. 2 of the pesticides had the same effect against the scab, irrespective of the dosage, whereas 2 other pesticides showed a less good effect by reduction of the dosage.

Spraying of every other row

The effect against apple scab was 2-3 times less when spraying every other row compared to spraying of every row throughout the season.

Black currant gall mites

The migration of the gall mites was observed. Migration started at the middle of May and ended about July 1st.

Experiments were made with a number of pesticides against the gall mites.

The effect of endosulfan and methomyl by 2 sprayings at the beginning and end of flowering was compared to the effect of the same 2 sprayings combined with an extra spraying 14 days after the second one. The extra spraying more than doubled the effect against the gall mites.

Spraying with different spray volumes showed that 400 l per ha was considerably better than 800 and 1200 l per ha.

As in 1983, spraying with oxamyl and methomyl 3 times after harvest did not have any effect against the gall mites.

An experiment was started to explain why the end buds of the blackcurrant shoots are often infested by gall mites although the migration of the gall mites ceases before the shoot growth is ended and the end bud has been formed.

The spread of black currant gall mites in a new plantation of black currants planted close to a severely infested blackcurrant field was examined.

Soft fruit, horticulture and nursery plants (A. Nøhr Rasmussen)

Grey mould on strawberries (*Botrytis cinerea*)

8 approved pesticides were compared in 2 experiments. The best were Drawifol and Ronilan with increases in yield in relation to untreated of 47 and 43% respectively, whereas Danatex S (thiram) and Euparen increased the yield by 36 and 32% respectively. Orthocid 83 (captan), Benlate, Topsin Fl. and Rovral 50 WP increased the yield of healthy berries by 22-25%.

Mealybugs on *Asplenium nidus* (*Pseudococcus adomidum*)

In 1983-84 12 compounds were tested against mealybugs. The average effect in 4 experiments with Lannate 20 L, Orthene 75 SP and

Shell Phosdrin was 100% after only 1 spraying. In 2 experiments Gusathion M WP 25 and Temik 10 G showed 98-99% effect, Thiodan emuls. and Ambush showed 93-94% and Dacamox 10 G 84% effect. Parathion and malathion were only tried in 1 experiment where their effect was 100% after one spraying.

Leafminers, *Phytomyza syngenesiae* on *Chrysanthemum* and *Liriomyza bryoniae* on tomato

Baythroid, Fastac and MK 0936 (avermectin) had an excellent effect both on adult leafminers and larvae. Trigard 75 WP had no effect on the leafminers, but a good effect on the larvae.

Growth regulation of pot plants

4 experiments were carried out with *Chrysanthemum x morifolium* where Bonzi in concentration of 1.25% was compared with Alar 85 in 0.3%. The varieties 'Maximo', 'Dramatic', 'Sapphire', 'Circus', 'Garland' and 'Pert' were tested. They were sprayed twice at intervals of 7 days with 200 ml of liquid per sq.m.

The plants sprayed with Bonzi did not only grow too big; they also differed very much both from pot to pot and within the individual pots. This did not change although the dosage was increased to 2.5%.

On the other hand, the plants sprayed with Alar 85 were very homogeneous and had a suitable height.

Two experiments were made with the Azalea varieties 'Helmuth Vogel', 'Inga', 'Ambrosius' and 'Ambrosiana' where Bonzi in 2.5% concentration was compared with Alar 85 in 0.3% and Cycocel in 0.5% strength. The spraying took place twice at 14 days' interval. The first spraying was just after the last pinching when the new shoots were 3-7 cm long.

If was not possible to find any certain differences between the three compounds, whereas there was a significant difference between treated and untreated plants. The untreated plants were not only much taller, but also more open and heterogeneous than those which had been treated. They were compact and had a homogeneous development also as to bud formation.

Fungicide resistance of plant pathogenic fungi (Kirsten Junker) Research project 1983-85

To examine the resistance of cereal mildew (*Erysiphe graminis*) against ergosterol-inhibiting fungicides a new method was developed in 1984. The sensitivity of mildew is tested on plants grown in glass tubes into which different dosages of fungicides has been introduced.

The examinations showed that considerable variations may be found between samples taken from the same field at the same time. No clear correlation could be seen between the percentual attack in the field, fungicide sprayings and the sensitivity of the mildew. There is some indication of a seasonal variation, as reduced sensitivity was seen both in treated and untreated fields in the middle of the summer.

Attacks of snow mould (*Gerlachia nivalis*) were examined on wheat and rye grains harvested in 1984. About 30,000 grains were examined. The attack varied from about 2 to about 20%. A widespread and considerable degree of carbendazim resistance could be seen. All the isolates tested could grow on agar with 1 ppm carbendazim, and many grew on concentrations as high as 1000 ppm. Isolates with normal sensitivity can be controlled by 0.1-1 ppm carbendazim.

V. NEW PESTICIDES TESTED IN 1983 (E. Schadegg)

In 1984 the Pesticide Research Institute, Lyngby, evaluated a total of 106 fungicides and 62 insecticides in 295 experiments. Besides 51 standard compounds were tested.

The compounds listed below were approved by the the State Research Service for Plant and Soil Science:

Larvae of the beet leaf miner (*Pegomya hyoscymi*)
KVK Dimethoat 400

Grain aphids (*Sitobion avenae*) on barley
Cybolt, Ripcord

Grain aphids (*Sitobion avenae*) on cereals
Baythroid, Pirimor G, Sumicidin 10 FW

Grain aphids (*Sitobion avenae*) on peas
Baythroid, Cybolt, Sumicidin 10 FW

Leaf spot (*Drechslera teres*) on barley
A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B,
A 7099 A 390 FW, Tilt turbo (A 7114 A),

Glume blotch (*Septoria nodorum*) on wheat
A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B,
A 7099 A 390 FW, Arbosan S, Bayleton DF,
Baytan seed compound IM WS 28,3, Corbel Star, Panoctine 30,
Sibutol, Tilt turbo (A 7114 A)

Brown rust (*Puccinia recondita*) on wheat
A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B,
A 7099 A 390 FW, Tilt turbo (A 7114 A)

Brown rust (*Puccinia hordei*) on barley
A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B,
A 7099 A 390 FW, Tilt turbo (A 7114 A)

Peach-potato aphids (*Myzus persicae*)
Baythroid

Peach-potato aphids (*Myzus persicae*) in greenhouses
Fastac

Frit flies (*Oscinella frit*) on grass
Fastac, FMC 54800, Ripcord

Frit flies (*Oscinella frit*) on cereals
Fastac, FMC 54800, Ripcord

Frit flies (*Oscinella frit*) on maize
Curaterr, Fastac, FMC 54800, Ripcord

Winter moths (*Cheimatobia spp.*)
Baythroid, Sumicombi 30 FW

Fruit tree red spider mites (*Panonychus ulmi*)
Danitol 5 EC

Winter eggs of fruit tree red spider mites (*Panonychus ulmi*)
M 96 Oil emulsion

Fusariosis
on wheat: Arbosan S, Baytan seed dressing IM WS 28,3, Panoctine 30, Sibutol,
on rye: Arbosan S, Baytan seed dressing IM WS 28,3, Sibutol

Blossom beetles (*Meligethes aeneus*) on rape
FMC 54800, XN 100

Grey mould (*Botrytis cinerea*) on strawberries
Drawifol, Rovral 50 WP

Stripe rust (*Puccinia striiformis*) on wheat
A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B, A 7099 A 390 FW, Tilt turbo (A 7114 A)

Flea beetles (*Phyllotreta spp.*)
Promet 47 SD, Promet Twin 47,5 SD, Rapcol 49,5 SD

Potato blight (*Phytophthora infestans*)
Brestan 10, Cillus Maneb 40, Sandofan M 8,

Tortrix moths (*Torticidae*)
Baythroid, Sumicombi 30 FW

Mildew (*Erysiphe graminis*) on barley
Afugan

Mildew (*Erysiphe graminis*) on cereals
A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B, A 7099 A 390 FW, Tilt turbo (A 7114 A).
The approval for sulphur, sulphur-thiram and triforin was withdrawn.

Whiteflies (*Trialeurodes vaporariorum*) in greenhouses

Baythroid, Danitol 5 EC, Fastac

Leafminers (*Liriomyza bryoniae*) in greenhouses

Baythroid, Fastac

Leafminer larvae (*Liriomyza bryoniae*)

Trigard 75 WP

Pear scab (*Venturia pirinae*)

Baycor 25 WP, Topas C 50 WP

Black scurf and stem canker (*Rhizoctonia solani*) on seed potatoes

Basitac 10%, Monceren, Rizolex 10 D, Rovral 50 WP

Root aphids (*Prociphilus pini*) on pine

Dacamox 10 g

Downy mildew (*Bremia lactucae*)

Previcur N

Scale insects (*Coccidae*) on ornamentals

Gusathion MWP 25, Lannate 20 L, Temik 10 G

Leaf blotch (*Rhynchosporium secalis*) on barley

A 6761 B 437,5 FW, A 6959 B 350 FW, A 6960 B,
A 7099 A 390 FW, Bayleton DF, Tilt 250 EC,
Tilt 250 EC (A 6097 C), Tilt turbo (A 7114 A)

Brassica pod midges (*Dasyneura brassicae*) on rape

FMC 54800, XN 100

Seed weevils (*Ceutorrhynchus assimilis*) on rape

FMC 54800, XN 100

Bunt (*Tilletia caries*) on wheat

Arbosan S, Baytan seed dressing IM WS 28,3, Panoctine 30,
Sibutol,

Black spot (*Diplocarpon rosae*) on outdoor roses

Daconil 500 F, Topas 100 EC

Stripe smut (*Urocystis occulata*) on rye

Arbosan S, Baytan bejdse IM WS 28,3, Sibutol

Thrips (*Thrips*), outdoors

Curaterr, Furadan 5 G, Promet 47 SD, Promet 800 SCO,
Rapcol 49,5 SD

Thrips (*Thrips*) in greenhouses

Baythroid, Fastac

Thrips (*Thrips*) on ornamentals

MK 0936

Mealybugs (*Pseudococcus*) on ornamentals

Gusathion MWP 25, Lannate 20 L, Orthene 75 SP,
Shell Phosdrin, Temik 10 G

Greenhouse red spider mite (*Tetranychus urticae*) on ornamentals

Cybolt, MK 0936

Red spider mite (*Tetranychus urticae*) on blackcurrant

Danitol 5 EC

Apple aphids (*Aphis pomi*)

KVK Dimethoat 400

Apple scab (*Venturia inaequalis*)

Cillus Maneb 40

C. PLANT PROTECTION ADVISORY DEPARTMENT, GODTHÅB
Låsbyvej 18, DK-8660 Skanderborg
(A. From Nielsen)

The department was established in 1979 in order to initiate a closer co-operation concerning plant protection between the Danish Research Service for Plant and Soil Science and the National Committee on Crop Husbandry. The main aim of the service is to act as advisers on plant protection and to test pesticides for use in agriculture. This work is carried out in close co-operation with the staff of the National Department of Crop Husbandry in this area.

Prognosis methods concerning potato late blight (S. Holm)

Based on negative prognosis warnings against potato late blight were sent out on June 25 and July 13. The agreement between the negative prognosis and the blitecaster was good again in 1984 with regard to the first warning.

Frit flies (S. Holm)

The correlation between plant development and attack of frit flies were established in an experiment with chemical control in oats. One well-timed spraying with pyrethroid in leaf stage 1.5-2.5 could prevent practically all attacks on the main shoot.

Blue tray traps were set up at various places in Jutland, partly to assist the agricultural advisers and partly to ascertain differences in the flying activity.

Crane flies (S. Holm)

Crane fly larvae are often a problem in old grassing fields or subsequent crops. Experiments have been started to find a method of determining the number of larvae in the soil and the damage thresholds for the relevant crops both in spring and in autumn.

Cephalosporium stripe (*Cephalosporium gramineum*) on ryegrass (J. Simonsen)

The reduction of seed yield was 40-50% where only half the plants had survived in the spring because of this fungus. The investigation was carried out in a first-year field with the late ryegrass variety 'Barlemma', where fungal attacks appeared in spots.

Control of black scurf and stem canker (*Rhizoctonia solani*) on presprouted potatoes (J. Bak Henriksen)

Methods of controlling black scurf on sprouted potatoes were examined in an experiment where "fumigation" with Orbivet by means of Pulsfog was compared with spraying with Dithane M 45 and with Rovral Flo on the potatoes in the field after planting, but before the furrows had been closed with the hoes.

The "fumigation" with Orbivet and the spraying with Rovral Flo reduced the black scurf attack on stems and runners and the sclerotia layer on the tubers. Compared with untreated, the effect of Dithane registered in this experiment was small and uncertain. After treatment with Orbivet, sprouting damage was seen in two repetitions, probably because the Pulsfog had come too close to the boxes containing the tubers during the treatment.

D. INSTITUTE OF WEED CONTROL

Flakkebjerg, DK-4200 Slagelse
(K. E. Thonke)

I. FIELD OF ACTIVITY

The institute continued its research and testing within the area of weed biology and control including herbicide testing and approval. In addition, the institute is responsible for research, testing and approval of growth regulators for agricultural crops.

Distribution of main tasks

Agricultural crops in the area of the institute, root-propagated weeds and spraying technique (Ole Permin)
Testing and experiments in agricultural crops (Egon Juhl Petersen and Peder Elbæk Jensen)
Horticulture, vegetables, fruit and nursery cultures (Georg Noyé)
Forestry, windbreaks and coverts (Thomas Rubow)
Weed biology, distribution and spread (C. Holm-Nielsen)
Aftereffect of herbicides in soil (Johannes Røyrvik)
Experiments in containers and climate chambers (Per Nielsen Kudsk and Knud Erich Thonke)
The advisory service (Karen Ravn)

II. AGRICULTURE

1. Field experiments concerning development, testing and advisory work

Control of common couch (O. Permin)

Experiments have been carried out concerning the influence of chemical compounds on common couch when cultivated without ploughing. The purpose of the experiments is to show how often the various chemical compounds should be applied when ploughing is omitted and the common couch is to be kept at the same level

as after ordinary harrowing and ploughing of the stubble fields. The experiments were carried out at four localities, and the results varied according to the locality. Thus, treatment with TCA had to be carried out every year at three of the localities when the soil preparation in the autumn was finished by harrowing. At one locality with clayey soil, treatment every other year was sufficient. At all four localities, treatment with MH or Roundup was necessary every other year when no final preparation of the stubble field was carried out.

Experiments to examine the effect of Roundup against couch grass in stubble fields were carried out by applying reduced quantities of liquid with ordinary field sprayers and with CDA spraying technique. The effect when using CDA technique and 20 l of liquid corresponded to the effect obtained with an ordinary field sprayer using 250 l of liquid per hectare and one third of the normal dosage of Roundup. With equal doses the optimum effect was obtained with an ordinary field sprayer and 62 l of liquid per ha.

Experiments carried out in 16 cultures to examine compounds against monocotyledonous weeds in beets showed that fluazifob-butyl (Fusilade), haloxyfob-ethoxyethyl (Gallant 125 EE) and sethoxydim (Fervinal) in normal and double dosage did not have any apparent harmful effect on spring rape, caraway, peas, white clover, red clover, lucerne, beet or swede, whereas it had a destructive effect on spring barley, spring wheat, Italian rye grass, timothy, meadow grass, cock's foot grass and meadow fescue. The damage on red fescue was limited with normal dosage and best when Fusilade was used.

Control of wild oat-grass (O. Permin)

Investigations were continued in 1984 to find out how quickly land, cultivated without ploughing, is emptied of seeds of viable wild oat seeds. The wild oat grains were laid in depths of 5, 15 and 30 cm in the autumn of 1980.

Direct sowing, without preparation of the stubble field, in the autumn gave the smallest number of wild oat plants germinated, and only from a depth of 5 cm. The more the soil had been prepared, the greater the number of wild oat plants. Most plants were seen where ploughing had taken place. During the first three years wild oat grass germinated from seed laid in a depth of 15 cm, but not from seeds laid in a depth of 30 cm. After four years equally few wild oat plants came from seed laid in depths of 5 and 15 cm independent of soil preparation or sowing method. The experiments will be continued.

Tolerance tests in winter crops (O. Permin)

Tolerance tests were made with 5 varieties of winter barley and 7 varieties of winter wheat, where increasing doses of chlortoluron (Dicuran 500 FW) were applied. The winter barley varieties Igri, Gerbel, Hasso, Mammut and Freja seem to be fairly resistant to Dicuran. No definite decrease in yield could be seen with normal dosage, and double dosage only gave small yield reductions with the varieties Hasso, Mammut and Freja. However, there was a great difference between the reactions of the winter wheat varieties. Thus the varieties Kraka, Imba and Disponent tolerated Dicuran well in both normal and double dosage. The varieties Longbow, Brigand, Vuka and Falke must be described as sensitive, as they were damaged by normal dosage, and double dosage led to disastrous yield decreases.

The effect of commonly used soil herbicides on the germination and development of winter wheat and winter barley was examined by increasing precipitation just after the spraying and by supplementary spraying with DNOC. Of the soil herbicides methabenzthiazuron (Tribunil), isoproturon (Arelon fl.), Phendimethalin (Stomp) and trifluralin linuron (Trinulan), only Arelon fl. in double dosage had any noticeable effect on both winter wheat and winter barley. The damage to the yield of winter barley by a double dose of Arelon fl. was greater than that produced in winter wheat. Preliminary experiments have been carried out to

examine the effect on winter wheat when spraying in the autumn with hormone compounds of the ester type. Winter wheat was sprayed at 1, 2, 3, 4 and 5 leaves with normal and double dose of the compounds mechlorprop, ioxynil + mechlorprop (Mylone), dinoterb + mechlorprop (DM 68), dichlorprop, MCPA, clopyralid + dichlorprop (Lontrel DP). Only MCPA caused deformities on the winter wheat plants.

Tolerance experiments in peas (O. Permin)

The tolerance of peas to combinations of soil and leaf-applied compounds was investigated. If the effect on the weeds is too small, it may, in practice, be necessary with supplementary application of leaf-applied herbicides. The effect on the yield of the soil compounds trifluralin (Treflan), cyanazin (Bladex) and pendimethalin (Stomp), combined with leaf-applied herbicides, was examined. Only the soil herbicide Treflan showed a tendency to cause yield reduction when combined with the leaf-applied herbicides dinoseb, MCPA + Aretit and cyanazin + bentazon (Bladex + Basagran). The other leaf-applied herbicides were Aretit and bentazon (Basagran 480). The control of common couch and harmful insects often coincides when spraying for weeds. A preliminary experiment was carried out to examine the tolerance of peas to mixtures of the compounds both with and without a preceding treatment of soil compounds. The soil compounds were applied in normal and in double dosage, and the following leaf-applied compounds were used for the mixtures: Parathion fl. and as powder, alloxydim (Fervin) and addition of Fevinol or Actipron oil. Only when the herbicides were mixed with Parathion (liquid or Fervin + Fevinol), serious damage was seen on the peas. The damage is estimated visually; the size of the plot is 2 square metres with 105 plots and 3 repetitions.

Germination ability retained by winter barley grains in the soil (O. Permin)

It is known from practice that grains of winter barley which did not germinate in the autumn may retain the ability to germinate until the following year. The purpose of the experiment is to elucidate the risk of winter barley occurring as weed in subsequent crops. Grains of 2 varieties: Igri and Gerbel, were laid in soil depths of 5, 15 and 25 cm in a quantity that would give 100 plants per sq.m. if only 1% of the grains retained their germinating ability.

To ascertain whether the grains are able to germinate, grains from lower layers are placed on the ground surface. The grains were placed in the ground in October 1983. When they were dug out, it was established that no grains had retained their ability to germinate.

Possible alternatives to weed control in poppies by means of Reglone (O. Permin)

According to foreign literature a number of compounds have some effect on fathen and other weeds in poppies. Preliminary experiments in 1984 with sprayers for 2 m^2 plots were carried out to examine the compounds chlortuloron (Dicuran), matholoachlor (Dual) and asulam (Asulox) at increasing dosages and in different mixtures. The results seem to indicate that selective control of fathen in poppies is possible with Dicuran 1-2 kg active ingredient/ha or a mixture of chlortuloron metholachlor 0.5 1.0 kg active ingredient/ha or 1.0 1.0 kg active ingredient/ha.

Spraying time and additives for herbicides in beets (O.Permin)

With reduced doses it is particularly necessary to treat at the right development stage of the weed and in weather conditions which are favourable for the effect of the compounds. Often the most favourable time of treatment is at the germination of the beets, which may cause damage to the beets. The compounds phenmedipham (Betanal), metamitron (Goltix) and ethofumesat (Nortron)

were used in mixtures with small and big dosages. The result, which was assessed visually, showed that small doses like Betanal Goltix 2 l + 2 kg/ha or Betanal + Nortron, 2 l + 2 l/ha did not damage the beets, whereas Betanal + Goltix 4 l + 4 kg/ha damaged the beets at the seed-leaf stage, and Betanal + Nortron 4 l + 4 l damaged the beets when the first true leaf was about 1 cm long.

Effect of herbicides on undersown crops (O. Permin)

The purpose of the experiment is to estimate the effect of new herbicides on cultivated plants used as cover crop or undersown. The experiment does not only reveal which cultures are tolerant and may be used as undersown crops, but also gives information about the possibility of controlling volunteer plants from different cultures. Soil and leaf-applied herbicides were used in the experiment for control of dicotyledonous weeds in spring rape. The visual assessment of the effect on the cultivated plants showed that it was a prerequisite for the effect of 2 of the soil herbicides, metazolachlor (Butisan S), butam + alachlor (Comodor Plus), that the soil had been watered with 20 mm shortly after the spraying. Without watering there was no damage on barley, winter wheat and a number of grasses, whereas these species were almost totally damaged after 20 mm watering. The experiment comprised the following plants: spring rape, caraway, peas, white clover, red clover, lucerne, barley, spring rape, Italian ryegrass, timothy, smooth-stalked meadow grass, cocksfoot, meadow fescue, red fescue, beetroots and swedes. The leaf-applied herbicide clopyralid (Matrigon) did much damage to the legumes. A mixture of benezolin + clopyralid + cyanazin (Benasalox + Bladex) cause serious damage both to legumes and beets, whereas the grasses were not damaged.

By application of 2 doses of chlorsulfuron (Glean 20 DF), all species except spring barley, spring wheat and to some extent red fescue were almost totally damaged.

An experiment with bromophenoxim + terbulethylazin (Vegoran) with and without addition of vegetable oil (Codacide) showed that the effect of Vegoran was not increased by the addition.

The influence of the climate on straw reduction in spring barley (O. Permin)

By continuous registration of temperature, humidity and light, the influence of the climate on the straw-reducing effect of ethephon (Cerone) and mepiquat-chloride + ethophon (Terpal) on winter barley was examined. The effect is estimated on the basis of the straw length.

In one experiment spraying took place over 3 days with 2 hours' interval from 5 a.m. to 11 p.m. The weather was mostly sunny and no clouds during two of the days and overcast on the third day. The test showed that the greatest straw reducing effect was obtained in the period where the temperatures were between 7.5°C and 15°C. The relative humidity was about 80% or more. Later in the day the light quantity improved the effect, which seemed to be reduced when the temperature approached 20°C and the relative humidity fell below 70%. Spraying during the evening had the same effect as spraying in the middle of the day, but on all 3 days the lowest effect was registered when spraying at 9 or 11 o'clock in the evening. The straw reducing effect within the individual day might vary from 20% at the best effect to 10% at the lowest effect.

In another experiment, where spraying took place over 10 days with 1 spraying per day from stage 7 to stage 10.1 (Feekes) of the barley plants, a similar result was obtained as when spraying at 2 hours' interval.

The reactions of barley varieties to treatment with straw reducing compounds (O. Permin)

In order to examine the reaction of the commonly used barley varieties to treatment with the straw-reducing compounds ethephon (Cerone) and mepiquat-chloride + ethephon (Terpal), the varieties Harry, Gunhild, Jenny, Susan and Tårn were treated with normal and double dosage. The experiment was carried out at 2 nitrogen levels (90 N and 130 N) and estimated on the basis of yield.

It appeared from the results that Cerone gave the greater straw reducing effect. The tendency to lodging was the same at the two nitrogen levels. The advantage of straw reduction was not any greater at the 130 nitrogen level than at 90. The variety Susan gave a definite increase in yield when treated with normal dose as opposed to the other varieties. Considering the reaction to double dosage, the varieties Jenny and Tårn seem to be less resistant to the treatment than the other varieties. The experiment is now finished since the difference in varieties seems to be of less importance to the result of straw reduction than the conditions during the growth period and climatic conditions at the spraying.

Spraying technique: Reduced doses of plant protection compounds distributed by means of Sprafoil (O. Permin)

Sprafoil is a new type of field sprayer where air is led through special nozzles placed at 20 cm intervals on a 12 m broad spray boom. The air current causes the spraying liquid to split into drops and takes the drops right down to the bottom of the plants, which should give a better deposition everywhere on the plants. The liquid quantity is between 30 and 90 l of liquid per ha, which gives a higher concentration in the spraying liquid. The spray has been tested in experiments with control of weeds and leaf diseases, in spring barley and winter wheat, in connection with reduced doses compared to the normal dosage. The result was compared with the effect when spraying with ordinary field sprayers and a liquid quantity of 200 l per ha. Compared with this, no improved effect on weeds was obtained by using Sprafoil, whereas the effect of fungicides in winter wheat was improved. It was established that the distribution from Sprafoil was poor.

The experiments will be continued in 1985 after changing the nozzles of the Sprafoil, which is now produced in Denmark under the name of Danfoil.

Spraying technique: Deposit of spraying liquid on the plants (O. Permin)

The tracer Helios (Uvitex) has made it possible to determine the percentage of spraying liquid deposited on various parts of the cereal plants when the plants are fractionated into for instance leaves and stem pieces. Experiments in spring barley with different pressures of liquid and one size of nozzle (4110-16) showed that more liquid was deposited on the cereal plants at 2.5 bars than at 1 or 5 bars. The deposit on the top leaves was greater at 5 bars and at 1 bar, but further down on the cereal plants there was not any difference in the deposits at the two pressures. No difference was seen in amount deposited with an LP nozzle 11002 and 4110-16 at the same pressure. The experiments with different types of nozzles, nozzle dimensions and fluid pressure will be continued.

Another experiment in winter wheat concerning the influence of additives on the deposit of propiconazol (Tilt 250 EC) showed that the addition of Sun-oil 2%, of the spreader Extravon 0.1% or of the insecticide Fenom 0.25 l/ha increased the deposit on the upper sections of the plants. The deposit on the lower sections of the plants, especially on the stems, was smaller when Extravon or Fenom had been added to the spraying liquid. The weather during the spraying must be characterized as dry. Lower temperatures, higher humidity and no wind did not give the same results of the treatment. The use of 150 l liquid per ha gave greater deposits on the top leaves and stems than 300 l liquid per ha.

The effect of Tilt 250 EC with or without additives were estimated biologically. An increased effect of Tilt on mildew as well as leaf and glume blotch was registered when adding Sun-oil 2% or Extravon 0.1%. The addition of Codacide did not improve the effect against mildew and leaf and glume blotch to the same degree as Sun-oil or Extravon. The addition of Fenom to Tilt reduced the effect of Tilt against mildew. There was a tendency to an improved effect against mildew and leaf and glume blotch when distributed in 300 instead of 150 l of liquid per ha.

Spraying technique: The influence of the CDA distribution on the effect of straw-reducing compounds (O. Permin)

The CDA distribution was carried out in field experiments with a Micromax CDA distributor and 10 l of liquid per ha. The compounds examined were ethephon (Cerone) in one third of the normal dose with addition of Sandovit 0.1% or Actipron 2.5% as well as the fungicide Tilt 250 EC also in one third of the normal dose. Compared with ordinary field spraying and 200 l of liquid per ha, the straw reducing effect was just as good by corresponding dosages, and there was less lodging with CDA distributors and 10 l of liquid per ha than with ordinary field sprayers.

Spraying technique: Reduction of liquid quantity and dosage by spraying with Cerone for straw reduction in barley (O. Permin)

Greenhouse experiments have shown that the effect of ethephon (Cerone) may be increased by distributing a small quantity of liquid and small drops as well as by addition of wetters. To make the straw-reducing effect of Cerone more certain, the results were confirmed in field tests. 250, 125 and 62 l of liquid per ha were used for the field tests, and nozzles in the sizes 4110-24, 4110-16 and 4110-10, respectively, were used at 3 bars and 6.5 km per hour. The result of the experiment was that a similar straw-reducing effect was obtained by 0.33 l of Cerone Sandovit 0.1% as with 0.5 l of Cerone only. The greatest straw-reducing effect was obtained with nozzle 4110-16 and 125 l of liquid per ha.

2. Testing of compounds

Testing of herbicides and growth regulators in agricultural crops (E. Juhl Petersen and P. Elbæk Jensen)

The testing carried out in 1984 was very much influenced by the increased growing of winter crops, about half of the 74 herbicides being tested were for use in winter crops.

A great part of these compounds were combinations of mechlorprop with ioxynil and/or bromoxynil.

These combinations have proved very suitable for controlling the weeds normally occurring in winter crops, either by spraying in the autumn or at the germination early in the spring. Thus this group of compounds is an alternative to the dinitrophenols for use in the autumn, but at a considerably higher price per ha.

An extension of the agreement with The Danish Agrochemical Association to include testing and approval of tank mixtures resulted in registration of tank mixtures for beets, peas and cereals for testing.

The testing also includes haulm destructors and growth regulators.

This did not involve anything new. However, a new product was registered for growth regulation of seed grasses, especially rye grass. This compound, paclobutrazol, is primarily absorbed through the root system.

The effect of the compound was fairly limited in the relatively dry spring of 1984.

By the end of the year 24 compounds were approved. 5 of these were tank mixtures. 10 of the approved compounds have not yet been authorized by the National Agency of Environmental Protection.

The section of the blue book on approved herbicides was revised, so that hormone compounds, hormone mixtures, and hormone compounds in combination with other compounds, were divided into separate subsections. All other compounds are listed subsequently in alphabetic order according to the active ingredient.

In March 1984 a multi-user microcomputer was installed at the Institute of Weed Control to replace a single-user microcomputer. This made it possible to use electronic, instead of manual, word processing of the test results and to combine the possibilities of reporting via mainframe at the computing centre NEUCC (the Northern European University Computing Centre) and the word-processing part of the microcomputer.

The following procedure is used in the data capture: When data are received from the field as tables or in a 'field book', they are skimmed manually. Data are then entered into the data-logger

and sent to the mainframe at NEUCC via a modem and the telephone. By means of the programs of the Biometric Section, the institute receives a copy of the data in order to detect typing errors. If any errors are found, they are corrected, and an analysis of variance is carried out. The result is written out at the NEUCC and sent to the institute. At the same time, or earlier, the trial design is entered into the microcomputer, checked and sent via modem and telephone to the NEUCC. The data files and the trial design are completed by means of a report generator. Thus the file is almost ready for printing in the form in which the results are published in "Results from the testing of herbicides".

The file containing the trial design and the data is transferred via modem and telephone to the microcomputer at the institute, where it is provided with headings and pagination before the final printout is made.

The aim of using electronic data and word processing was to reduce time. This has been achieved by saving time on writing out tables, reports and proof-reading, despite initial difficulties.

Another long-term aim is to store data at the NEUCC in such a way that they may be used in other connections, for instance for our advisory work, when planning experiments for and in connection with approval, and finally as a basis for a proper data base.

Re-evaluation and evaluation of efficacy (E. Juhl Petersen, G. Noyé and T. Rubow

An estimate was made to establish the possible consequences of the limitation or withdrawal of the following phenol compounds: cyaniazin, hexazinon, metamitron, metribuzin, terbulthylazin and trifluralin. Such a limitation may be the outcome of the general reevaluation of pesticides which is to be carried out by the National Agency of Environmental Protection.

Supplementary statements were given about the compounds amitrol, diquat, atrazin and simazin.

In cooperation with the Pesticide Bureau of the agency, new guidelines were made for the use of compounds in uncultivated areas. The dosage recommended in the Approvals List used to be very high, whereas the new approvals are based on a maintenance principle with lower dosages. This adjustment is based on results of experiments carried out at the Research Centre for Plant Protection. 11 estimates of efficacy were carried out in connection with applications to the National Agency of Environmental Protection for registration of new herbicides and growth regulators. The 11 products all contain well-known active ingredients.

III. HORTICULTURE

Georg Noyé & Kirsten Yates

35 experiments were made in 1984 with field vegetables, 11 in plant nurseries, 6 in fruit and berry orchards and 2 in various cultures.

1. Field-grown vegetables

Chives

3 experiments showed that chives tolerate the common herbicides, but use of leaf-applied herbicides, such as cyanamid, applied on newly cut plants, caused damage. Chives seem to tolerate methabenzthiazuron, but not glyphosate.

Substitutes for Reglone

5 compounds: diquat + lissapol, glyphosat, bromophenoxim, ioxynil and glyfosinat ammonium applied in 9 different cultures.

The purpose was to find compounds which were suitable as substitutes for Reglone when treatment is carried out 1) before germination and 2) when two thirds of the culture has germinated.

The result of the experiment showed that peas, caraway, chrysanthemum, oilseed rape, radish and spinach tolerated treatment before germination. Onions tolerated everything which was applied before germination except bromofenoxim and glyfosinat-ammonium.

Sown onions: Soil/leaf-applied compounds

Experiments were carried out with two times of application: 1) Just after sowing, and 2) when the onions were 8 cm. There was a tendency for bromofenoxim + terbulthyulazin to retard the growth of the onions a little, but the yield was not influenced. Compared with chlorphropham + propachlor an increase in yield was seen in all the plots with pendimethalin without ioxynil. As to weeds, the best long-term effect was obtained when pendimethalin 6.0 l was applied after the culture had been established.

Experiments were carried out with 3 different times of application: 1) Just after sowing, 2) when the onions are 4-5 cm, and weeds are at the seedling stage, and 3) two weeks later.

All the treatments had effect against weeds. Methabenzthiazuron 2.0 kgs/ha followed by cyanamid 40 l/ha and RH 2115 was found to have a similar effect as difenoxuron.

Grass compounds

Experiments with the tolerance of grasses showed a great tolerance to the compounds including alloxydim-sodium and fluazifop-butyl.

Leeks

Experiments with planted leeks showed that they are very tolerant. The results seem to indicate that methabenzthiazuron 4.0 kg/ha was too much. As to weeds, methabenzthiazuron 2.0 kgs did give sufficient control of fathen. The inability to control certain types of weeds is confirmed in experiments with Stomp 6.0 l.

Cabbage

Experiments were carried out with Chinese cabbage and cauliflower with two kinds of covering and in uncovered plots. 5 herbicides were tested. The experiments with Chinese cabbage demonstrated, above all, the influence of the covering on the development of the Chinese cabbage. The results seem to indicate that all treatments, especially with metazochlor, delayed the development of Chinese cabbage in the uncovered plots. Napropamide and particularly trifluralin, caused very little damage to the culture.

The effect of the herbicides on the weeds did not seem to be influenced by the covering. Metazolachlor and propachlor had the best overall effect on weeds.

Experiments were carried out with red cabbage and with conical cabbage. Propachlor 7.0 kgs and metazolachlor 1.5 and 2.5 l/ha were applied just after sowing, and 3.6 clopyralid was applied at the two-leaf stage.

Red cabbage was not damaged by the treatments, but the oxheart cabbage was damaged by clopyralid.

Spinach for seed production

One experiment showed that spinach was tolerant to all herbicides used. However, lenacil + asulam 0.5 + 3.5 and lenacil + cycloat 0.5 + 4.0, which had been incorporated, did cause some temporary damage.

As to weeds, the experiment showed that the mixture lenacil + cycloat had the best effect. Asulam did not have much effect on black bindweed.

Tinned peas

A tolerance test showed that trifluralin 3.0 l, which had been incorporated, reduced the crop by one third. Cyanamid 2.0 kgs and pendimethalin were applied immediately after sowing. Cyanamid 0.6 kg + bentazon 1.0 l did not cause any damage, whereas bromofenoxim + terbulthylazin 1.5 l made the plants turn yellow temporarily. However, this did not have any influence on the yield.

Sweet corn

Experiments were carried out with atrazin and mixtures of atrazin sprayed on to the corn at the 4- or 5-leaf stage.

Atrazin + dicamba resulted in a significant reduction in the yield, and atrazin + pyridate 2.0 - 8.0 l also gave a smaller yield.

2. Fruit and berry orchards

Strawberries: Grass compounds

An experiment was carried out with grass compounds in Senga sengana and Zephyr with the 1st treatment late in the autumn and the 2nd treatment in April of the following year. The results were as follows:

Fluazifop 1.5 l + Lissapol delayed the ripening of Zephyr. Sengana tolerated all the compounds.

Soil/leaf-applied compounds

An experiment with lenacil + phenmedipham 2.5 kgs + 4 l/ha and metamitron + phenmediapham was carried out in sengana and Zefyr about the 1st October.

The experiment showed a reasonable long-term effect on grass and dicotyledoneous weeds, especially the lenacil + phenmedipham treatment.

Cherries

An experiment with soil herbicides was carried out for the tenth consecutive year, on the same area: Diuron 3.2 kgs active ingredients/ha again caused chlorotic leaves, especially on the sunny side of the tree.

Blackcurrants

Still no damage to the blackcurrants was seen in the plots, which have been treated with soil compounds since 1977.

3. Plant nurseries

Grass compounds

For two consecutive years grass compounds have been sprayed on to Bornholm mountain ash and caucasian fir late in the autumn and early in the following spring:

Both cultures showed tolerance to the compounds.

Soil herbicides

3 experiments were carried out: One in a standoverbed, 2 in Norway spruce, and one in mountain pine. All the plots were treated in April. One of the Norway spruces was treated for two consecutive years. Both the cultures showed tolerance to the soil

compounds, including chlortal, simazin, atrazin + simazin and methabenzthiazuron. Experiments with Norway spruce which were only treated for one year showed damage when treated with methabenzthiazuron + simazin 160 kgs/ha and terbuthylazin.

Clopyralid

The compound was applied to 39 species of ornamental bushes in August and September with 1.2 and 2.4 l per treatment:

The damage on the species varied: No damage occurred in *Sorbus aucuparia* until a year after the treatment. Temporary damage was seen on *S. latifolia* in the autumn. This was followed by new undamaged shoots, but damage was seen again in the late summer - about one year after the treatment.

Amelanchier canadensis was slightly damaged, whereas *A. spicata* was severely damaged. As for *Spirea*, temporary damage was seen on *S. arguta*.

The following species were more or less severely damaged: *Deutzia, Sorbaria, Kerria stephanandra, Euonymus, Lonicera, Acer* and *Sambucus, Hypericum, Philadelphus, Kolkwitzia*.

Visible damage was neither seen in 1983 nor in 1984 on beech and lilac treated in September 1983.

An experiment was carried out in a prickling bed where Norway spruce, caucasian fir and Austrian pine was treated on the (1) 3rd May 1984, (2) 20th June 1984, (3) 24th July 1984 with 1.2 and 2.4 l/ha.

Austrian pine was severely damaged after all 3 treatments.

In the case of Norway spruce, the plant quality, but not the yield was influenced.

The quality of nordmann fir deteriorated slightly.

Miscellaneous

Tulips

Experiments showed that 2 x 6 l pendimethalin applied before funnel formation is tolerated by tulips, but by later treatment the tulips are damaged.

Lawns

Experiments with treatment early in the summer of 1983 showed that chlortal 14.0 kg/ha still has a good effect on speedwell without damaging the grass.

IV. FORESTRY, WINDBREAKS

T. Rubow

Control of foliiferous growth in coniferous cultures

The highly varying results obtained by cutting down and stump treating by means of scrub cutters with built-in sprayers, have increased the need to analyse which are the decisive factors. A major test series seems to indicate that the covering of the stump surface with spraying liquid, the time of treatment (season), the concentration and the type of herbicide influence the result. Factors like stump height and diameter and weather during and after the treatment, is of less importance.

It was found that a number of improvements - mostly ergonomic - on the existing tools were required.

Supplementary herbicides

The need for less harmful supplementary herbicides for use in forest cultures as well as windbreaks has been felt for a long time. They would be useful in critical weed situations. It seems that a number of vegetation problems (composite plants, couch) can be solved by means of clopyralid and fluazifob-butyl. A considerable number of experiments, in different coniferous cultures, have given a clear picture of the way the two herbicides may be used. The work in foliiferous cultures on this problem will be intensified in 1985.

V. WEED BIOLOGY

Chr. Holm-Nielsen with assistance from Søren Thorup

In the early spring, soil samples from 4 different depths were taken at a number of farms, and the germinaiton of the weed seed reserve was examined in a greenhouse. Weed countings will take place in the coming years to make comparison possible.

From June, weed counts and biomass determinations were made in spring barley experiments with reduced soil cultivation/direct drilling combined with determination of the seed production of common weeds.

Just before and after seed and cereal harvest, weed counts were made at farms where crops have grown with reduced soil treatment for 15-30 years.

The experimental results were computed during the autumn and winter and literature studies were carried out. Besides, efforts are made to develop methods for finding seed and for determining the seed reserve of the soil by washing out soil samples. The purpose is to find a method which may be used for quick and exact seed population determination in Danish arable land.

VI. THE PERSISTENCE OF HERBICIDES IN SOIL

J. Røyrvik

Outdoor decomposition of chlorsulfuron (Glean) and DPX T6376 (metsulfuron)

The outdoor experiment was started in the spring of 1984 and was combined with soil sampling every 6 weeks for biological tests in controlled environment chambers. The test plant used was spring rape (Topas). A similar experiment with the same herbicides was also carried out in 1983.

The shortest decomposition time in 1983 occurred during the dry and hot summer period, whereas the moist early summer caused the quickest decomposition in 1984. During most of the growth period, the half-life was between 0.6 and 1.5 months, but in a

few periods it was considerably longer, especially that of DPX T6376. All in all, it may be concluded that the conditions of decomposition for both chlorsulfuron and DPX T6376 are favourable under the climatic conditions occurring during the growth period.

Greenhouse experiments concerning herbicide persistence

Soil samples from Du Pont were examined. The examinations were paid for by the company. Several new herbicides and several types of soil were examined. The samples were diluted, and standard graphs were made of each herbicide. The test plant was white mustard (Bixly). Examinations were also carried out for Elanco. The sensitivity of poppy, fodder sugar beets (Kyros), barley (Triumph) and spring rape (Topas) to trifluralin (Treflan) were examined. Poppy was the most sensitive plant. However, beets were also very sensitive, whereas barley was almost as tolerant as spring rape.

Damage thresholds for weed control in spring barley (Peter Kryger Jensen)

The feeding into the data bank of the test material on which the project is based was completed in 1984. More than 1000 experiments with weed control in spring barley have been carried out by the Crop Husbandry Department since 1974.

Analyses of the data show that it is possible to correlate the increases in yield by spraying with a number of weed parameters.

The increase in yield by weed control is, above all, influenced by the number and species of weeds. The correlation between the number of weeds per square metre and the increase in yield by spraying is linear within a broad weed range. The extent of the linear course is influenced by the variety of species, type of soil, etc.

With the same number of weeds, the biggest increases in yield are obtained by weed control on humus soil and the smallest on clayey soil, whereas the increases on sandy soil lie between the two types of soil.

Apart from the actual increase in yield, the remunerativeness of weed control is influenced by a number of factors which will be examined in the years to come, such as the influence of weeds on the harvesting process.

VII. CONTROLLED ENVIRONMENT DEPARTMENT

P. Kudsk and K. E. Thonke

Investigations into the influence of additives on the effect of herbicides

In 1984 container experiments were made with compounds acting on the leaf-surface (surfactants) and with penetration oils in order to examine the hypothesis of parallel displacement of the dosage curves which has been put forward. The hypothesis is based on the fact that the shape of the dosage curve (fresh/dry weight registered as a function of the logarithm to the dosage) is only determined by the effect of the herbicide, whereas the horizontal position depends on the quantity of herbicide reaching the 'site of action'. The effect of the herbicides will not be influenced by additives, but by retention and penetration, i.e. the quantity of herbicide reaching the 'site of action'. The dosage curves for a herbicide with and without additive will therefore be of the same shape, but have a different horizontal position, i.e., they will be parallel.

The results of the examinations in 1984 support the previously suggested hypothesis that the change in the effect of the herbicide caused by an additive may be described as a parallel displacement of the dosage curve. This means that it is possible to quantify the increase in the effect of a herbicide usually obtained when introducing additives, i.e., it is possible to calculate how much the dosage of the herbicide may be reduced by admixture of additives without any reduction in the effect.

In one container experiment concerning the effect of difenzoquat (Avenge) on wild oat it turned out that the change in the effect of difenzoquat when sprayed out in tank mixtures with a

fungicide and/or an insecticide might equally well be described as a parallel displacement of the dosage curve. Thus, it seems that the hypothesis may be extended to include tank mixtures if the other pesticides in the tank mixture do not have any significant influence on the growth of the test plant, as was the case in this experiment.

Project concerning dosages 'adjusted to the prevailing conditions'

In 1984 some preliminary container experiments were carried out concerning the application of the above hypothesis when determining dosages adjusted to the prevailing conditions. This means that the dosages are adjusted according to climatic conditions, weed composition, development stage of the weed and possibly formulation of herbicide and additive type.

In 1984, a climate chamber experiment was carried out with white mustard (Sinapis alba) as test plant as well as a greenhouse experiment with 8 weeds at 3 different stages of development. A mixture of MCPA and dichlorprop was used in both experiments.

Climate chamber experiments showed that the changes in the effect of the herbicide caused by changes in temperature and humidity might be described as parallel displacements of a given dosage curve. The results from the greenhouse experiments were more uncertain, but it was evident that the dosage curves of the different species at different stages of development might be assumed to be parallel. This seems to indicate that the hypothesis of parallel displacement of the dosage curves may also be applied in connection with the project concerning dosages 'according to the prevailing conditions'. This means that the effect of the factors examined as well as the effect of the additives may be quantified.

During the next few years, further experiments will be carried out to examine the applicability of the hypothesis on the project. The project was started on January 1st 1985 when the construction of the new controlled environment chambers was started.

VIII. GROWTH REGULATION IN CEREALS AND OTHER CROPS

Cereals

Container experiments were carried out both with winter wheat and with spring barley.

In the winter wheat experiment the plants were split-treated, i.e. sprayed with CCC at stage 3-4 and with CCC + ethephon (Terpal C) at stage 8-9. The influence of the first CCC treatment was mainly on the straw length, harvest index (grain/haulm) and thousand corn weight, but not on the straw and ear number. The late treatment, however, mostly influenced straw and ear number, as well as the straw length.

The effect of ethephon (Cerone) on spring barley was examined at different nitrogen levels and early and late sowing, in order to establish whether growth regulators might, under certain conditions be used for growth stimulation. No significant interaction was seen between nitrogen quantity/sowing time and dosage of growth regulators, and the theory of growth stimulation could not be confirmed. In another experiment with spring barley, the speed of absorption of ethephon was examined by measuring, after 3 weeks, the straw reduction after 3 weeks of plants which had been rinsed at different times after spraying. The experiment showed that ethephon is absorbed very quickly by the plants.

Other crops

In a preliminary container experiment using growth regulation of maize with CCM, it was found that the optimum spraying time seems to be at the 10-12-leaf stage, and that the dosage of ethephon (Cerone) and CCC + ethephon (Terpal C) should be about 60-80% of the dosage in spring crops.

Desiccation of potato haulm on unripened seed potatoes

The possibility of combining the use of diquat (Reglone) with the use of growth regulators, as well as the influence of the spraying technique on the effect of diquat, were examined in two container experiments.

The use of ethephon (Cerone) before, after or together with diquat neither improved the desiccation of the existing foliage nor prevented leaf formation from the lateral buds.

The same result was obtained with small quantities of liquid (about 100 l/ha) and high pressure (about 5 atm.) as with the recommended quantities of liquid (4-500 l/ha).

Reduced quantities of liquid and mixture with fungicides and/or insecticides by spraying with difenzoquat (Avenge) against wild oat

Container experiments were carried out to examine the possibility of reducing the quantity of liquid by spraying with difenzoquat (Avenge) and to find out whether spraying in tank mixtures with propiconazol (Tilt 250 EC) and/or fenvalerat (Sumicidin 10 FW) changed the effect of difenzoquat on wild oat.

The experiment showed that a reduction in the quantity of liquid from 417 l/ha to 64 l/ha caused a significant increase in the effect of difenzoquat. Moreover, the effect of difenzoquat was increased by spraying in tank mixtures with propiconazol, whereas fenvalerat did not influence the effect.

In 1985, the tolerance of spring barley to small quantities of liquid will be examined in container experiments.

Experiments with new formulations of phenmedipham

Container experiments have been carried out for a number of companies to investigate the effect of the new phenmedipham formulations. As considerable differences were found in the effect of the different formulations, all the phenmedipham formulations on the market will be examined in 1985.

Experiments in climate chambers with new active ingredients

Experiments were carried out to examine the influence of temperature and humidity of the atmosphere on the effect of DPX M6316 and haloxyfob-ethoxyethyl (Gallant) on white mustard (Sinapis alba) and ordinary couch (Elymus repens).

The effect of DPX M6316 turned out to depend very much on both temperature and humidity. By adding 0.1% Citowett it was possible to reduce the influence of humidity a little, but not the influence of temperature.

The influence of temperature and humidity on the effect of haloxyfob-ethoxyethyl was examined by determining the effect on the rhizones (% living buds). The temperature had the greatest influence on the effect, but the humidity of the atmosphere was also important.

IX. ADVISORY WORK

Karen Ravn

As in previous years, the advisory work was carried out through various channels.

Telephone

Many enquiries have been made over the telephone throughout the year, but particularly in the months of April, May and June. Many of the questions concerned new crops and crops where a considerable extension of the area has taken place, such as for instance peas, horse beans and flax. Glean 20 DF was one of new compounds which has been of general interst. This compound is used in very small quantities, which makes transportation and packing easier.

There have been increasing problems with several weeds, such as for instance hemp nettle in winter crops, fool's parsley in beets, and tarweed, which is a problem in several crops, especially in Jutland.

In several places there were problems with the effect of the compounds against wild oat-grass. The effect was satisfactory after the spraying, but the wild oat started to germinate again, especially in fairly thinly covered fields. This may be due to the excellent growth conditions in 1984.

About the time of earing, several instances of ear deformities with smaller and thicker ears were seen in wheat and winter bar-

ley. The damage was seen in fields which had been sprayed with a hormone mixture during the first days of May. No doubt, the damage was due to the weather conditions at that time with fairly warm days and frost at night.

The increase in the winter crop area led to many questions about winter crop spraying in the autumn and especially about substitutes for the phenols.

Sometimes the telephone enquiries were followed by inspection in the field.

Lectures and seminars

During the year, staff members gave 106 lectures at meetings and seminars, including lectures at the 15 spraying courses, which took place all over the country. Several lectures were given at courses for agricultural advisers at Tune.

Inspection tours with agricultural advisers, etc.

The local agricultural advisers arrange excursions during May and June, where the problems are discussed in the field. A representative of the Institute of Weed Control has taken part in these inspection tours. 29 excursions with advisers or similar field inspections took place in 1984.

Cattle shows

This year the the exhibition of the Plant and Soil Service at the three cattle shows at Roskilde, Odense and Herning concerned weed control. The Institute of Weed Control contributed with plants, spraying equipment, tables and written material. Moreover, a representative of the Institute was present at the stand at all three shows.

Publications

The publications written by the staff members during the year are mentioned in the list of literature.

E. LABORATORY FOR PESTICIDE ANALYSIS

Flakkebjerg, 4200 Slagelse
(Arne Helweg, Erik Kirknel and Peder Odgaard)

I. FIELD OF ACTIVITY

The main tasks are examination of pesticides as to stability, decomposition and washing out in the soil as well as adsorption, transportation and transformation in plants. Besides, the influence of the pesticides on the nutritional value of certain crops and on the microorganisms of the soil is investigated.

Distribution of main tasks

Pesticide decomposition etc. in soil (Arne Helweg)
Fungicides and insecticides in plants (Erik Kirknel)
Herbicides in plants (Peder Odgaard)

II. DECOMPOSITION AND MICROBIOLOGICAL EFFECT OF PESTICIDES IN SOIL

Arne Helweg

To establish whether a decomposition of pesticide chemicals is taking place in deep soil layers, experiments have been carried out with ^{14}C-labelled MCPA, dichlorprop and 2.4-dichlorophenol. The results show that after 1 year of incubation, decomposition may take place in soil samples taken out from a depth of 1 metre, even if they are incubated at $10^{o}C$ in N_2 atmosphere. However, the decomposition is slow and obviously dependent on the type of soil. The soil content of NO_3 may be of importance to the decomposing capacity.

The influence of soil temperature and water content on the decomposition of ^{14}C-labelled MCPA and TCA was examined. It appears that for these pesticides with catabolic decomposition the influence of soil temperature and water content on the rate of decomposition speed may only be described by means of rectilinear logarithmic values for the first few days - in the case of

the temperature effect by Q_{10} values between 2 and 4. An exponential growth of the decomposing microorganisms is seen during the incubation period, the doubling time depending on temperature and water content. This results in an increasing difference between the rate of decomposition under optimum and under less favourable conditions.

A literature study was carried out to determine whether pesticides may occur in ground or drainage water. The conclusion is that about 30 of the approximately 200 different pesticides used in this country are potential pollutants of the ground water. A dozen of these are particularly dangerous, and a proposal has been made for a monitoring system starting in 1984 and financed by the Government Research Council.

The microbiological activity in soil from orchards with intensive pesticide treatment has been compared to that of soil from traditionally treated field soil, which is sprayed somewhat less. The activity seemed to be about the same when when ammonification, nitrification, respiration, non-symbiotic N fixation, decomposition of haulm and decomposition of a pesticide was determined in the soils.

III. FUNGICIDES AND INSECTICIDES IN PLANTS

Erik Kirknel

The influence of pesticides on crop quality and nutritional content

Analyses of pesticide residues and feeding experiments with rats have been carried out since 1984. A report has been sent to the Research Council with a request for continuance of the project in 1985.

Experiments with potatoes sprayed with fungicides and insecticides were carried out. The National Food Agency is analysing potatoes for their content of important nutrients.

Absorption and biological effect of pesticides as a function of pesticide formulation and mixture with other pesticides

Barley plants were sprayed with different dosages of propiconasol mixed with different additives. At intervals after the spraying the plants were inocculated with mildew. This was done in co-operation with J. Nørgård Knudsen at Risø. The development of mildew was correlated with the pesticide residue in and on the barley plants.

Tilt deposit on plants when adding additives or other pesticides

Contract research for Ciba-Geigy in co-operation with Ole Permin. Analysis of the tracer Uvitex sprayed out in field tests. A report is available.

Analyses for residues of a new commercial propiconasol compound (new formula) in connection with application for approval

Research for Ciba-Geigy in co-operation with Bent Nielsen. A report is available.

Control of mildew in winter barley

In co-operation with Bent Nielsen analyses were carried for residues in winter barley surface-treated with triadimenol and sprayed with tridimefon. Analyses were made in 1984 and will be made in 1985 if required. Results from 1984 are available.

Application of reduced quantities of liquid and pesticide on blackcurrant

In co-operation with Sten Lykke Nielsen blackcurrant bushes sprayed with Uvitex were analysed. Report from this Joint Council project is available.

Characterization of granule matrix for slow release of pesticides

Analyses of Carbofuron as model compound in slow release of a new granulated product were carried out for Superfos, Specialty

Chemicals A/S. It should be possible to produce the granule with varying pore diameter. In connection with these investigations the Laboratory was able to find new applications for granules within analytical chemistry. A report is available.

Analysis of Uvitex from the company of Hardi, Glostrup

Uvitex analyses were carried out in October and November for the above company.

IV. HERBICIDES IN PLANTS

(Peder Odgaard)

Dichlorprop residues in green and ensiled barley

Previous examinations have shown that cereals, grass and legumes treated with phenoxy acids still contains detectable residues at the time of ensiling, and residues have also been found in silage.

In order to produce samples for analysis, experiments with barley were carried out at Ødum for one year and at Flakkebjerg for 3 years. Spraying took place in the last week of May and included 3 dosages of dichlorprop. At Ødum samples were ensiled (as green crop) at two dates, each time for periods of 2, 8 and 32 weeks. At Flakkebjerg samples of the growing crop (with yield determination) were taken several times during the period from spraying until about July 1st.

The analyses concerning dichlorprop were finished in 1984. The results may be summarized as follows:

At sampling before rain 7-18% of the quantity sprayed out was found in and on the barley. The concentration decreases quickly with the time. The quantity found per area unit decreases with some correlation to the precipitation, especially in the initial period. In all the years, 0.3-1% of the applied quantity was recovered in samples taken around July 1.

In accordance with previous results, the extraction method is very important for the detection of phenoxy acids bound (conjugated) to plant materials. Different methods of analysis have shown that the longer time which has passed since the spraying, the greater percentage of the dichlorprop present escapes detection unless it is liberated by hydrolytical treatment. However, the present investigation did not show any difference between green material and silage as to the extractability of dichlorprop.

On the whole, the quantities of dichlorprop in silage and in the corresponding fresh samples are the same, and no significant reduction in the content was seen during the ensiling periods in question.

Analyses for MCPA and possibly dicamba will be carried out in 1985.

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