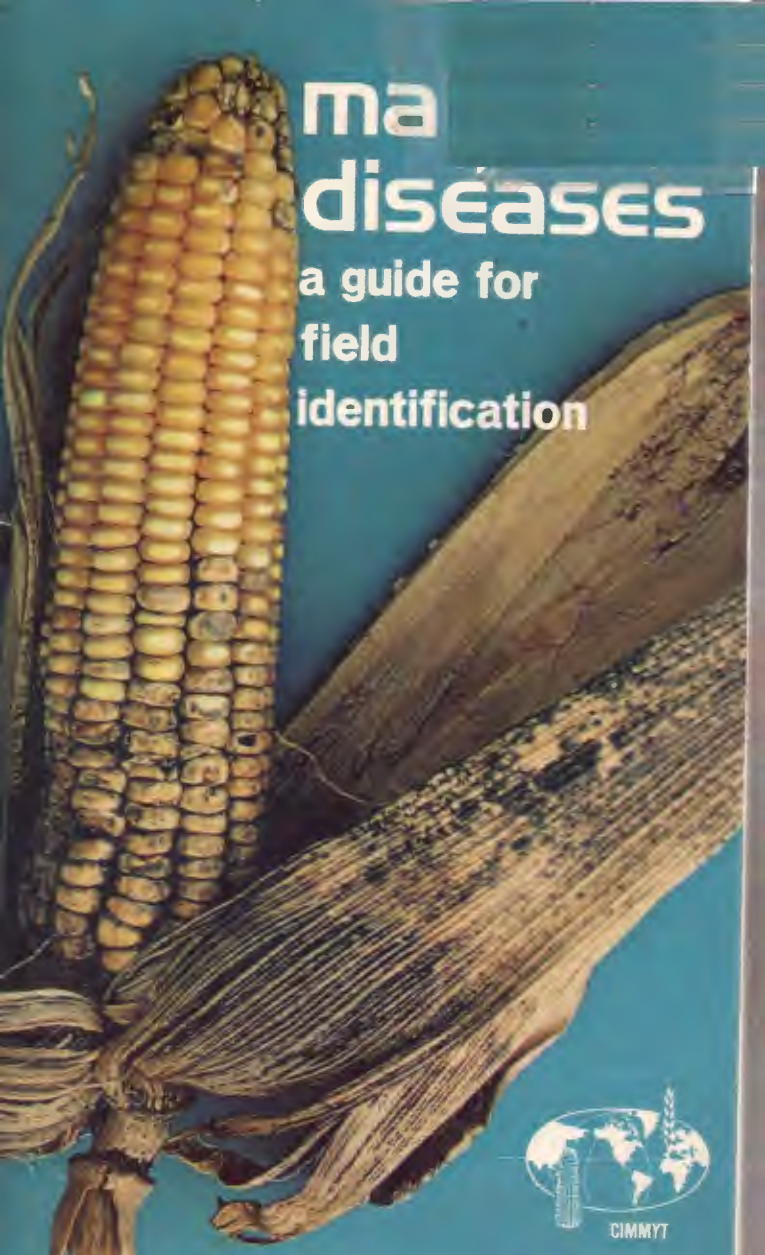
ma diseases

a guide for field identification



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maize diseases

a guide for field identification

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INTRODUCTION

This booklet is designed as a quick guide for identifying maize diseases. It is intended for field use by agricultural technicians and maize producers. The text provides a brief description of some of the principal maize diseases, their causal agents, and their symptoms. Color photos of diseased plants are included as an aid to visual identification.

The three major disease classifications are described according to causal agents: (1) fungi, (2) bacteria, and (3) viruses.

Diseases included were selected on the basis of their potential for economic damage in maize-growing countries throughout the world. In this second edition we have included some area specific diseases.

1. MAIZE DISEASES CAUSED BY FUNGI

1.1 BROWN SPOT

Physoderma maydis.

Normally the disease occurs in areas of abundant rainfall and high mean temperatures. It attacks the leaves, leaf-sheaths, stalks, and sometimes the outer ear husks.

The first noticeable symptoms develop on leaf blades and consist of small chlorotic spots, alternately arranged as bands of diseased and healthy tissues. Spots on the midribs are circular and dark-brown in color, while lesions on the laminae continue as chlorotic spots. Nodes and internodes also show brown lesions. In severe infections, these may coalesce and induce stalk rotting and lodging.

Physoderma maydis

1.2 DOWNY MILDEWS

Several species of the genera *Sclerospora* and *Sclerophthora* are responsible for downy mildews:

CRAZY TOP, YELLOW WILT OF RICE.
Sclerophthora macrospora.

BROWN STRIPE DOWNY MILDEW.
Sclerophthora rayssiae var. zeae.

GRAMINICOLA DOWNY MILDEW OF MAIZE.
GREEN EAR DISEASE
Sclerospora graminicola.

JAVA DOWNY MILDEW OF MAIZE.
Sclerospora maydis.

PHILIPPINE DOWNY MILDEW OF MAIZE.
Sclerospora philippinensis.

SUGARCANE DOWNY MILDEW OF MAIZE.
Sclerospora sacchari.

SORGHUM DOWNY MILDEW OF MAIZE.
Sclerospora sorghi.

These diseases are of serious concern to maize producers in several countries of Asia and Africa. Recent information indicates their distribution is increasing throughout the American continent. Symptom expression is greatly affected by plant age, species of the pathogen, and environment. Usually, there is chlorotic striping of leaves and leaf-sheaths, and dwarfing. Downy mildew becomes conspicuous after development of a "downy growth" on or under leaf surfaces. This condition is the result of conidia formation, which commonly occurs in early morning when temperature and humidity are favorable.

Sclerophthora rayssiae var. zeae

Sclerospora philippinensis

The disease is most prevalent in warm and humid regions. Some species causing downy mildew also induce tassel malformations. Consequently, no pollen is produced; and ears, if formed at all, are nubbins. Leaves may be narrow, thick, and abnormally erect.

Sclerospora sacchari ▶

◀ *Sclerospora sorghi*

Sclerospora sorghi

Sclerospora sorghi

1.3 TAR SPOT.

Phyllachora maydis.

The disease sometimes occurs in relatively cool, humid areas of the tropics, where Northern leaf blight is prevalent. Characteristic black, raised and shiny spots are produced early. At a later stage, necrotic areas develop around the "tar spot". These necrotic lesions may coalesce and cause a complete burning of the foliage. Lesions start developing before tasseling time on lower leaves. If environment is favorable, infection continues advancing upwards on younger leaves. Affected ears are light weight with loose kernels.

Phyllachora maydis

1.4 MAIZE RUSTS.

The three major leaf rusts on maize are:

1.4.1 COMMON RUST

Puccinia sorghi.

The disease is widely distributed throughout the world.

Common rust is most conspicuous when plants approach tasseling. It may be recognized by small, powdery pustules over both surfaces of the leaves. Pustules are brown in early stages of infection; later, the epidermis is ruptured and the lesions turn black as the plant matures. Plants of the alternate host ***(Oxalis* sp.)** are frequently infected with light orange-colored pustules. This is simply another stage of the same fungus.

Puccinia sorghi
Uredial stage

Puccinia sorghi
Aecial stage on Oxalis sp.

1.4.2 SOUTHERN RUST.

Puccinia polysora.

Pustules are smaller, lighter in color, and more circular than those produced by *P. sorghi.* They are also present on both leaf surfaces, but the epidermis remains intact longer than it does in *P. sorghi* infected leaves. Pustules turn dark-brown as plants approach maturity. No alternate host of the fungus is known, Southern rust is commonly prevalent in hot and humid regions.

Puccinia polysora

1.4.3 TROPICAL RUST.

Physopella zeae.

Outbreaks of this rust are sporadic and confined to the warm, humid tropics of the American continent.

Pustules vary in shape from round to oval. They are small and found beneath the epidermis. At the center of the pustule the lesion appears white to pale-yellow and an opening develops. A black color sometimes appears around the pustule, but its center remains with a conspicuous light color. No alternate host of the fungus is known.

Physopella zeae

1.5 ZONATE LEAF SPOT.

Gloeocercospora sorghi.

Zonate leaf spot is more commonly found in sorghum plants than in maize. When environmental conditions are dry and hot, it may also be found in maize.

The disease is recognized by small necrotic lesions that enlarge and produce characteristic large concentric necrotic rings. Lesions may be as large as 5 to 6 cm. in diameter, and occur mainly on older leaves. Similar symptoms have been observed in ***Rhynchosporium oryzae*** infected maize leaves.

Gloeocercospora sorghi

1.6 LEPTOSPHAERIA LEAF SPOT.

Leptosphaeria michora.

This disease has been reported in high, humid areas of the Himalayas. Other species of ***Leptosphaeria*** which produce different symptoms on maize leaves are also known in other regions of the world.

Symptoms consist of small lesions that become large and concentric, covering large areas of the leaves. It is most conspicuous on lower leaves at flowering time.

Leptosphaeria michora

1.7 PHAEOSPHAERIA LEAF SPOT.

Phaeosphaeria maydis.

This minor disease is restricted to certain areas of Northern India and Brazil where ***Helminthosporium turcicum*** is also prevalent. Conditions of high rainfall and relatively low night temperatures favor development. Lesions appear as small pale green areas, which later become bleached and finally necrotic, surrounded by dark brown margins. Spots on leaves are round to elongated. Other species of ***Phaeosphaeria*** on maize leaves have been reported in other areas of the world.

Phaeosphaeria maydis

1.8 CERCOSPORA LEAF SPOT.

Cercospora zeae-maydis.

This disease may occur in temperate, humid areas. Lesions begin as small, regular elongated necrotic spots. They grow parallel to the veins. Occasionally, lesions may reach a size of 3.0 by 0.3 cm.

Cercospora zeae-maydis

1.9 CURVULARIA LEAF SPOT.

Curvularia lunata and C. pallescens.

The fungi produce small necrotic or chlorotic spots with a light colored halo. Lesions are about 0.5 cm in diameter when fully developed. The disease is prevalent in hot, humid maize growing areas and can damage crops significantly.

Curvularia lunata

1.10 MAYDIS LEAF BLIGHT.

Helminthosporium maydis.

Young lesions are small and diamond shaped. As they mature, they elongate. Growth is limited by adjacent veins, so final lesions shape is rectangular (2 to 3 cm long). Lesions may coalesce, producing a complete "burning" of large areas of the leaves.

The symptoms described above, correspond to the "O" strain of the fungus. Recently, a "T" strain caused severe damage to maize cultivars where the Texas source of male sterility had been incorporated. Lesions produced by the "T" strain are oval in shape and larger than those produced by the "O" strain. A major difference is that the "T" strain affects husks and leaf sheaths, while the "O" strain normally does not.

Maydis leaf blight (or Southern maize leaf blight) is prevalent in hot, humid, maize-growing areas. The fungus requires slightly higher temperatures for infection than ***H. turcicum;*** however, both species are often found on the same plant.

Helminthosporium maydis Race O

Helminthosporium maydis Race T

1.11 TURCICUM LEAF BLIGHT

Helminthosporium turcicum.

Early symptoms are easily recognized by the slightly oval, water-soaked, small spots produced on the leaves. These grow into elongated, spindle-shaped necrotic lesions. They appear first on the lower leaves and continue increasing in size and number as the plant develops, until a complete "burning" of the foliage is conspicuous.

This blight is of worldwide distribution, and occurs particularly in areas where high humidity and low temperatures prevail during the growing season of the host. When infection takes place at silking stage and conditions are optimum, it may cause significant economic damage.

Helminthosporium turcicum

1.12 DIPLODIA MACROSPORA LEAF STRIPE.

Diplodia macrospora.

This disease has not been reported to cause economic damage, but it can be found in commercial maize plantings in hot, humid areas. ***D. macrospora*** is mostly an ear-rotting agent, but under appropriate climatic conditions it may cause foliar damage.

Symptoms consist of necrotic lesions along the veins which resemble spotting produced by bacteria or by ***Helminthosporium turcicum*** (Northern leaf blight). However, they can be differentiated by holding them against the light. ***D. macrospora*** lesions have a distinct narrow yellow margin which those caused by the other pathogens lack.

Diplodia macrospora

1.13 LEAF ANTHRACNOSE.

Colletotrichum graminicola.

This disease is minor and seldom encountered on maize. However, some reports indicate its increasing importance in certain areas. In general, symptoms consist of small and elongated spots which may coalesce and severely damage foliage. Stalks of young plants may also be infected. (Photo courtesy of Dr. A.J. Ullstrup).

Colletotrichum graminicola

1.14 SEPTORIA LEAF BLOTCH.

Septoria maydis.

The spotting affects mainly the leaves of maize grown in rather cool, humid environments.

Symptoms first appear as small, light green to yellow spots on the leaves. Lesions coalesce and produce severe blotching and necrosis of affected areas where many black pycnidia grow.

Septoria maydis

1.15 EYESPOT OF MAIZE.

Kabatiella zeae.

Commercial plantings in countries with cool, moist environment are commonly affected by eyespot.

The disease is recognized by small (1 to 4 mm), round, transluscent lesions. Tan colored centers develop, surrounded by black-to-purple rings, with a yellow halo around them, thus producing the characteristic "eyespot".

These symptoms are easily confused with physiological or genetical spots, which are non-infectious but widely observed in maize leaves. The symptoms are also similar to early spotting induced by ***Curvularia*** in some tropical areas.

Kabatiella zeae

1.16 PHYLLOSTICTA LEAF SPOT.

Phyllosticta maydis.

In 1970, the disease was associated with susceptibility in Texas male sterile cultivars, and several researchers linked this disease with yield losses and increased lodging. Humid, warm weather favors disease development.

Symptoms can be found on leaves from seedling to flowering maize plants. Diseased young plants show symptoms similar to those observed in nitrogen dificient plants.

In mature plants, lesions are narrow, necrotic, and parallel to the veins (although not limited by them). In older leaves, lesions develop and produce a characteristic blighting near the tip.

Phyllosticta maydis

1.17 BANDED LEAF AND SHEATH SPOT.

Hypochnus sasakii.
(Syn. *Corticium sasakii).*

Symptoms which develop on leaves and sheaths are characteristic concentric spots that cover large areas of infected leaves and ears husks.

The main damage in the humid tropics is a brownish rotting of ears, which show conspicuous light brown cottony mold with small round-shaped sclerotia.

Hypochnus sasakii

1.18 PYTHIUM STALK ROT.

Pythium aphanidermatum, Pythium spp.

Pythium species cause stalk rots, seed rots and seedling blights. In some hot and humid tropical areas, and in temperate regions, ***Pythium*** stalk rot may be observed.

Usually the basal internodes become soft, water-soaked and dark, causing lodging of the plants. Damaged internodes commonly twist before the plants lodge. Diseased plants can remain alive until all vascular bundles become affected.

Isolations in culture media are necessary to differentiate ***Pythium*** from ***Erwinia*** stalk rots.

Pythium aphanidermatum

1.19 HEAD SMUT.

Sphacelotheca reiliana.

Head smut may cause significant economic damage in dry, hot maize growing areas.

The infection is systemic; that is, the fungus penetrates seedlings and grows within the plant without showing symptoms until plants reach tasseling and silking stages.

The most conspicuous symptoms are: (a) abnormal development of tassels, which become malformed and excessively overgrown; (b) black masses of spores develop inside individual male florets, and (c) masses of black spores also grow instead of the normal ear leaving the vascular bundles exposed and shredded.

Sphacelotheca reiliana

1.20 BLACK BUNDLE DISEASE AND LATE WILT.

Cephalosporium acremonium, Cephalosporium maydis.

Black Bundle disease is caused by ***Cephalosporium acremonium*** and is widely distributed. The Late Wilt disease caused by ***C. maydis,*** has only been reported in Egypt and India. Both diseases produce a premature killing of the plants near pollination time. They are most common in rather humid, heavy soils in hot areas. The pathogens are soil and seed-borne.

Infected plants do not show symptoms until they reach tasseling stage and start wilting, generally beginning from the top leaves. Diseased plants produce only nubbins or ears with underdeveloped, shrunken kernels. When split, diseased stalks show brown vascular bundles starting in the underground portion of the roots. Similar symptoms may be observed in plants damaged by ***Fusarium moniliforme.*** Kernels that become infected by ***C. acremonium*** and ***F. moniliforme*** show conspicuous white streaks on the pericarp.

Cephalosporium acremonium on stalk

C. acremonium on ear

C. maydis

1.21 CHARCOAL ROT.

Macrophomina phaseoli.

Charcoal rot is most common in hot, dry environments. Incidence increases rapidly when water stress and high temperatures prevail near tasseling stage.

The pathogen invades seedling roots. When plants approach maturity, the internal parts of stems show a black discoloration and shredding of the vascular bundles. This occurs mainly in lower stalk internodes. Careful examination of rind and vascular bundles of infected plants easily reveals small black sclerotia which can overwinter and serve as inoculum for the next crop. The fungus may also infect kernels and will cause them to blacken completely.

Macrophomina phaseoli

1.22 FALSE HEAD SMUT.

Ustilaginoidea virens.

False head smut occurs very rarely in dry or humid, hot areas in isolated parts of the world. The fungus commonly infects rice flowers more than maize.

Symptoms differ from those caused by other smuts of maize. False head smut does not produce tassel malformation or ear infection as does true head smut ***(Sphacelotheca reiliana);*** only a few isolated male florets in the tassel show dark-green masses of spores (sori). It also differs from common smut ***(Ustilago maydis)*** in that no galls are produced.

Ustilaginoidea virens

1.23 DIPLODIA STALK ROT.

Diplodia maydis.

Susceptible cultivars of maize grown in cool, humid temperate areas are commonly affected.

In infected plants, Diplodia stalk rots are characterized by browning of the pith of basal internodes. They are weakened and break easily during strong winds and rains. Late in the season, the most conspicuous symptom is abundant pycnidia formation on the surface of damaged internodes where rotting has occurred.

Diplodia maydis

1.24 GIBBERELLA AND FUSARIUM STALK ROTS.

Fusarium spp.

Two species of Fusarium are responsible for stalk rots in maize:

1.24.1 ***Fusarium moniliforme*** (perfect stage ***Gibberella fujikuroi***) is most common in dry, warm areas; it is particularly severe when plants approach tasseling.

1.24.2 ***Fusarium graminearum*** (perfect stage ***Gibberella zeae***) is prevalent in cool regions. It is one of the most potentially damaging stalk-rotting agents.

Symptoms produced by these pathogens resemble those caused by ***Diplodia*** and by ***Cephalosporium,*** and cannot be differentiated until fruiting bodies are observed. Wilted plants remain standing when dry, and small, dark-brown lesions develop in the lowest internodes. When infected stalks are split, the phloem appears dark brown and there is a general conspicuous browning of tissues.

In the final stages of infections, pith is shredded and surrounding tissues become discolored.

Fusarium moniliforme

Gibberella zeae

1.25 GIBBERELLA EAR ROTS.

Gibberella zeae (imperfect stage *Fusarium graminearum*).
Gibberella fujikuroi (imperfect stage *Fusarium moniliforme*).

In maize, these two species of fungi cause ear rots, stalk rots and seedling blights.

1.25.1 *Gibberella zeae* is most common in cool and humid areas of the world and produces a reddish-pink color in infected kernels, starting at ear tips. A cottony pink mycelium is apparent on kernels.

1.25.2 *Gibberella fujikuroi* is known as Fusarium kernel rot. It is likely the most common pathogen of maize ears throughout the world, particularly in hot and humid, or in dry weather conditions. In contrast to *G. zeae,* damage by *G. fujikuroi* occurs mainly on individual kernels, or on limited areas of the ear.

Infected kernels develop a cottony mold and they may germinate while still on the cob. Kernels infected late in the season develop streaks on the pericarp, and ears invaded by stalk borers are usually infected with *G. fujikurol.* The fungus produces organic compounds toxic to mammals and birds.

Gibberella zeae

Fusarium moniliforme and stem-borer damage

Gibberella fujikuroi

1.26 HORSES'S TOOTH, ERGOT OF MAIZE

Claviceps gigantea
(imperfect stage *Sphacelia sp.*)

This disease is endemic to certain high, cool humid areas of the Central plateau of Mexico. The pathogen is closely related to the one that causes ergot of rye and it also produces toxic alkaloids.

Claviceps gigantea

1.27 PENICILLIUM EAR ROTS.

Penicillium spp.

Damage is most frequently caused by ***Penicillium oxalicum;*** occasionally, other species may be involved. In many instances, it is associated with ear damage by insects.

A conspicuous light blue-green powder grows between kernels and on the cob surface. Kernels with fungal growth normally become bleached and streaked.

Penicillium spp

1.28 ASPERGILLUS EAR ROT.

Aspergillus spp.

The disease may be a serious problem when infected ears are stored with a high moisture content. In the field, several species of ***Aspergillus*** can infect maize. ***A. niger*** is the most common; it produces black powdery masses of spores covering both kernels and cob. In contrast, ***A. glaucus*** and ***A. ochraceus*** normally form yellow-green masses of spores.

Most ***Aspergillus*** species produce organic compounds known as aflatoxins, which are toxic to birds and mammals.

Aspergillus flavus

1.29 GRAY EAR ROT.

Physalospora zeae.

Hot, humid weather for several weeks after pollination favors development of this ear rot. Early symptoms are very similar to those caused by Diplodia ear rot; a white-gray mold develops between kernels, and husks become bleached and glued together. In later stages of infection, the two fungi can be readily identified:

(a) Gray ear rot. Ears have a distinct black color; mold is also dark and develops small sclerotia (specks) scattered throughout the cob.

(b) Diplodia ear rot (see 1.33). Ear is gray-brown and mold white, with small black pycnidia covering cob and kernels.

(Photo courtesy of Dr. A.J. Ullstrup).

Physalospora zeae

1.30 COMMON SMUT.

Ustilago maydis.

Although the disease does not produce substantial crop losses, when environmental conditions are favorable it may become severe and lower yields appreciably. Common smut occurs throughout most maize growing regions, but can be more severe in humid, temperate environments, than in hot, humid areas.

The fungus attacks stalks, leaves, ears and tassels. Conspicuous closed white galls replace individual kernels. In time, the galls break down and release black masses of spores which will infect maize plants the following season. The disease is most severe in young, actively growing plants and may stunt plant growth or kill them.

Ustilago maydis

1.31 COB ROT.

Nigrospora oryzae.

The problem is widely distributed and the causal fungus normally overwinters on plant refuse.

Infected ears are chaffy and lightweight. Kernels are discolored and can easily be removed from the cob. Under close examination, cob tissues and kernel tips show small black masses of spores.

Nigrospora oryzae

1.32 CLADOSPORIUM EAR ROT.

Cladosporim herbarum (Syn. *Hormodendrum cladosporoides*)

The disease has not been reported of economic importance.

Dark brown-green streaks are apparent on kernels. These sympoms start at kernel and cob bases. When damage is complete, ears look dark and lightweight. In some instances, fungal penetration is associated with mechanical injury to kernel tips.

Cladosporium herbarum

1.33 DIPLODIA EAR ROT.

Diplodia maydis, D. macrospora.

Diplodia ear rots are commonly found in hot, humid maize-growing areas.

Maize ears show characteristic development of irregular bleached areas on husks that enlarge until they become completely dried, althought the plant is still green. If husks are torn apart, ears appear chaffy and bleached, with a white cottony growth between the kernels. Late in the season, many small black pycnidia form on kernels and cob tissues. These pycnidia serve as sources of inoculum for the following crop.

Diplodia maydis

2. DISEASES CAUSED BY BACTERIA.

2.1 STALK ROT.

Erwinia carotovora f. sp. *zeae*.

The pathogen spreads rapidly and quickly kills the host plant in areas with high relative humidity and temperature.

Infected plants show dark color and water-soaking at the base of the stalk. Plants die shortly after tasseling.

The bacterial decomposition produces an unpleasant odor.

Erwinia carotovora
f. sp. zeae

2.2 STEWART'S WILT.

Xanthomonas stewartii.

The pathogen is transmitted by seed and by certain maize beetles *(Chaetocnema pulicaria).* Infection occurs in early stages of plant development; affected plants do not grow normally and often die shortly after tasseling.

Feeding wounds from the insect vectors serve as pathogen points of entry. Watersoaked, oval lesions develop on leaves around these entry points. Water-soaking continues along the veins, and lesions coalesce and cause complete leaf necrosis. Damage may spread into stems and cause a general wilting of the plant.

Xanthomonas stewartii

2.3 BACTERIAL LEAF STRIPE.

Pseudomonas rubrilineans.

No substantial crop damage has been reported from this disease, although it may be of concern where susceptible germplasm is being utilized. The disease develops in certain hot and humid areas of the world.

In susceptible maize plants, bacterial stripe affects from seedling to post-pollination stages. Leaves develop several small, pale-green lesions. Under optimum weather conditions, lesions expand along veins producing a conspicuous striping, mainly in the youngest leaves; stripes later dry and brown. Severe damage of the top leaves results in tassel rotting because the tassel is enclosed by dead leaves.

Pseudomonas rubrilineans

3. DISEASES CAUSED BY VIRUSES.

3.1 MAIZE DWARF MOSAIC.

The virus is transmitted mechanically and by aphids. The pathogen is closely related to Sugar Cane Mosaic Virus and affects other grass and cereal hosts, such as: maize, sorghum, Johnson grass and sugarcane. No infection occurs on broad-leaf plants. Infected plants develop a distinct mosaic (irregularities in the distribution of normal green color) on the youngest leaf bases. Sometimes the mosaic appearance is enhanced by narrow chlorotic streaks extending parallel to the veins. Later on, the youngest leaves show a general chlorosis, and streaks are larger and more abundant. As plants approach maturity, the foliage turns purple or purple-red. Depending on time of infection, there may be severe stunting of the plant. Plants infected early may produce nubbins or be totally barren. Axillary buds proliferate in some cases.

Rhopalosiphum maidis aphid-vectors

Maize Dwarf Mosaic Virus

3.2 MAIZE MOSAIC VIRUS I.

The disease has been found in Cuba, Hawaii, Trinidad, Venezùela and Puerto Rico. ***Peregrinus maidis,*** a leafhopper, transmits the virus to maize and a few other graminaceous hosts. Plants are more susceptible when inoculated 4 to 6 weeks after emergence. The most conspicuous symptom is dwarfing of infected plants and striping along the veins.

Degree of dwarfing depends on plant age when infection occurred. Because internodes are shortened, leaves appear "crowded" and erect. Fine continuous stripes develop along the veins at leaf bases. Later symptoms include shorter than normal leaves with a rough and fleshy appearance. Stripes may be dark-yellow in color and finally become necrotic. Prior to total necrosis of the tissues, foliage turns red or dark-purple.

Maize Mosaic Virus I.

3.3 FINE STRIPE VIRUS.

"Rayado Fino", or Fine Stripe, is caused by a virus transmitted by the leafhopper ***Dalbulus maidis*** (which is also vector of Corn Stunt disease). It has been observed in countries of Central America reducing yields up to 43%.

Symptoms develop about 2 weeks after plants have been inoculated. They begin as small isolated chlorotic spots easily observed by holding leaves against the light. Later, the spots become more numerous and fuse together, forming 5 to 10 cm stripes which advance along the veins. If infected at tasseling time, plants may not show symptoms.

Fine Stripe Virus

3.4 CORN STREAK VIRUS.

The disease, reported first from East Africa, has now extended to many other African countries. The virus is transmitted by *Cicadullina* spp. leafhoppers; *C. mbila* is the most prevalent vector. Early disease symptoms consist of very small, round, scattered spots in the youngest leaves. Number of spots increases with plant growth; they enlarge parallel to the leaf veins. Soon spots become more profuse at leaf bases, they are particularly conspicuous in the youngest leaves. Fully elongated leaves develop a chlorosis with broken yellow streaks along the veins, contrasting with the dark-green color of normal foliage.

Corn streak virus

3.5 CORN STUNT DISEASE.

Corn Stunt was originally reported from California, U.S.A., in 1942. Since then it has been observed in Mexico, Central America and some South American countries. The disease is transmitted by several species of leafhoppers, which vary in their efficiency of transmission; the most common vector throughout the Americas is *Dalbulus maidis*. The pathogen is not mechanically transmitted.

Until recently, two strains of the pathogen were incorrectly known:

(a) The Mesa Central strain, now known to be caused by a mycoplasm-like organism, produces yellowing of young leaves, most of which become red.

(b) The Rio Grande strain, which initially induces yellowish stripes in young leaves, is caused by *Spiroplasma* sp. Broad yellow streaks develop at the leaf base. The foliage turns yellow and red.

Both pathogens produce a shortening of internodes, proliferation of stems, development of axillary buds, malformation and excessive root branching. In severe cases, plants are barren and ears may have poor seed set. Plants die prematurely.

Corn stunt

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