CURRENT STATUS OF THE DOWNY MILDEWS OF MAIZE IN THE AMERICAS

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Only three species of maize downy mildew (DM) pathogens are known in the Americas. These are *Sclerospora graminicola* (Sacc.) Schroet, *S. sorghi* Weston and Uppal and *Scleropthora macrospora* (Sacc.) Thirm. *et al.* Melhus *et al.* reported two natural occurrences of *S. graminicola*; one in 1925 on dent maize (*Zea mays* L.) seedings and the second in 1927 on sweet maize (23). Apparently, the pathogen never became an important factor because there have been essentially no reports of the disease in maize since then.

S. macrospora, causing crazy top of maize, was reviewed by Ullstrup in 1970 (34). To my knowledge little has been done to initiate further studies on control of crazy top in maize since then. The sporatic nature and broad host range of the disease will require adaptation of efficient techniques before a host resistance program can be initiated. Sources of genetically controlled resistance have not been described, although differences among commercial hybrids have been noted (34).

Sorghum Downy Mildew

Distribution. — In the past 15 years sorghum downy mildew (*S. sorghi*) has appeared in the United States (28), Mexico (5), Argentina (16, 25), Brazil (9, 18), Venezuela (10, 11, 29), as well as Bolivia, Guatemala, Honduras (20), El Salvador (35) and Uruguay (1). The disease is probably present in Peru, Colombia and other Central American countries but official reports or sightings are lacking. In Panama sorghum DM may have been present as early as 1958 (33). Toler (32) recollects that the DM species attacking sorghum was identified using the "Host Plant Index", which failed to list *S. sorghi* as recently as 1960 (Note: Index of Plant Diseases in the United States Agriculture Handbook No. 165). He further states that the disease developed extensively in forage fields and the symptoms and signs were characteristic of sorghum DM. Since sorghum DM has been observed in other Central American countries I believe that Toler *et al.* (33) may have observed DM in the Americas a full 3 years prior to the sightings by Reyes *et al.* in Texas (28).

At times there appears to be a careful hesitation in reporting the occurrence of the disease. DM may be observed by a commercial seed producer who wishes to remain anonymous or ignore the sightings because of the suggestion that the disease may have been seed transmitted. At other time the significance of the disease is not recognized and it remains unreported. According to Fernandez (9) sorghum DM was observed in Brazil in 1974, but Professor Perfire Costa Neto saw it as early as 1971 in Rio Grande do Sul and Dr. Alexander Grobman noted it as early as 1967 but did not report the presence of the disease until 1975 (18). Consequently, I believe we are safe in expecting that sorghum DM will be reported from additional Latin American countries in the near future.

Estimate of Damage. — Sorghum DM caused considerable alarm in Venezuela in 1975 (8). By August, the disease known as "Punta Loca" reached national prominence with the President of Venezuela calling the disease a national emergency. The disease spread from a few plants in 1973 to epidemic proportions in both maize and grain sorghum in 1975 (29). DM in South and Central America has become an expected risk. In Uruguay, we know the disease is present be-

cause differences in reaction to DM among cultivars of forage sorghums are taken into consideration (1) but no formal report on the extent of the disease or its losses have been obtained by this reviewer. In both Argentina and the U.S., where DM caused the greatest damage in grain sorghum, host resistance is available to reduce losses. Damage was estimated to be between 15 and 20% in the major grain sorghum growing areas of Argentina (17) and could have reached a 10% loss in the South Texas grain sorghum crop in 1973 (15). Today most Central and South American countries like Venezuela are justifiably concerned with the potential of DM in maize. In areas such as the Llanos of South America, where wild susceptible sorghums are prevalent, DM will continue to be a major disease problem or threat.

Research Programs

Argentina. — Frezzi *et al.* (16, 17) discuss a seven point program for control of DM in Argentina including sanitary, cultural and genetic disease control approaches. Agronomically acceptable, resistant sorghum varieties and hybrids have been indentified (27). Sorghum DM of maize is rarely observed (26).

Brazil. — Major efforts by Empresa Brasiliera Pesguisa Agropecuaria (EMBRAPA) will be toward the control of DM in maize (9). During the 1975-76 maize growing season, commercial maize lines, hybrids and populations were evaluated at Santo Antonio de Patrulha in Rio Grande do Sul (19). Furthermore, Brazil has enacted a Federal Quarantine designed to restrict the movement of susceptible sorghums and the DM pathogen (Portaria No.581, Dec. 17, 1974) (19).

Mexico. — Screening of maize of DM resistance has been done at the state level by workers at Centro de Investigations Agricolas de Tamaulipas (CIAT) the National by Instituto Nacional de Investigations Agricolas (INTA) and internationally by CIMMYT. DM has caused extensive losses in certain years in northeastern Mexico particularly in the state of Tamaulipa (5). Until 1975, when DM became widespread in maize at Poza Rica, the majority of the DM related research was carried out at CIAT located near Rio Bravo.

United States. — Basically DM research is carried out at two location: in Texas and at the Plant Disease Research Laboratory at Frederick, Maryland.

At Frederick, Dr. Chris G. Schmitt, USDA, Research Pathologist, developed DM inoculation techniques (30) and is in the process of importing exotic species of DM to carry out experiments comparing different species of DM under controlled environmental conditions.

At Texas A&M, research in DM includes basic etiology (2, 21, 22), inoculation techniques (2, 3, 4, 36), oospore germination, development of resistant hybrids and varieties of both maize and the sorghums (12, 13, 14, 24). Currently, three research pathologists, four plant breeders and three graduate students are working portions of their time on DM.

The research within Texas involves cooperative programs among state, federal (6, 7) and commercial firms. During the past 5 years essentially all of the major plant breeding firms have developed their own screening nurseries or have done work cooperatively with the Texas staff.

Venezuela. — A fairly strong program on control of sorghum DM is beginning in Venezuela (10, 29). Emphasis is being placed on basic disease etiology in Venezuela and on developing host plant resistance in tropical maize cultivars. This program will require cooperative programs among pathologist and breeders from both the regional research centers and industry.

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