Data Sheets on Quarantine Pests

Stenocarpella macrospora and *Stenocarpella maydis*

IDENTITY

Taxonomic position: Fungi: Ascomycetes (probable anamorph of Dothideales)

- ***Stenocarpella macrospora***

Name: *Stenocarpella macrospora* (Earle) Sutton
Synonyms: *Diplodia macrospora* Earle
Macrodiplodia macrospora (Earle) Höhnel
Macrodiplodia zeae (Schweinitz) Petrak & Sydow var. *macrospora* (Earle) Petrak & Sydow
Stenocarpella zeae Sydow
Common names: Dry rot of ears and stalks of maize (English)
Pourriture sèche du maïs (French)
Podredumbre seca del maíz (Spanish)
Bayer computer code: DIPDMC
EPPO A2 list: No. 67

- ***Stenocarpella maydis***

Name: *Stenocarpella maydis* (Berkeley) Sutton
Synonyms: *Diplodia maydis* (Berkeley) Saccardo
Diplodia zeae (Schweinitz) Léveillé
Sphaeria maydis Berkeley
Sphaeria (*Hendersonia*) *zeae* Schweinitz
Macrodiplodia zeae (Schweinitz) Petrak & Sydow
Dothiora zeae (Schweinitz) Bennett
Common names: Stalk rot, white ear rot and seedling blight of maize (English)
Pourriture sèche des épis du maïs (French)
Trockenfäule des Mais (German)
Pudrición, podredumbre del tallo del maíz (Spanish)
Bayer computer code: DIPDMA
EPPO A2 list: No. 68

HOSTS

Both species attack maize as their main host. *S. maydis* can also attack bamboos.

GEOGRAPHICAL DISTRIBUTION

- ***Stenocarpella macrospora***

EPPO region: Found but not established in Austria, Italy, Romania and Russia.
Asia: China, India, Indonesia, Malaysia, Nepal, Philippines, Taiwan.

Africa: Widespread in eastern, western and southern Africa. IAPSC (1985) reported the presence of the fungus in Benin, Côte d'Ivoire, Ethiopia, Ghana, Guinea, Malawi, Nigeria, Sierra Leone, South Africa, Tanzania, Togo, Zambia and Zimbabwe.
North America: USA (Alabama, Connecticut, Delaware, Florida, Georgia, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia).
Central America and Caribbean: Costa Rica, Cuba, El Salvador, Honduras, Jamaica.
South America: Brazil, Ecuador.
Oceania: Australia (Queensland, New South Wales).
EU: Found but not established.
Distribution map: See CMI (1984, No. 227), IAPSC (1985, No. 97).

- ***Stenocarpella maydis***

EPPO region: Locally established in Austria, Czech Republic and Italy; Portugal (unconfirmed); found but not established in France and Russia.
Asia: China (widespread), India (unconfirmed), Iran, Taiwan.
Africa: Kenya, Malawi, Nigeria, South Africa, Tanzania, Zaire, Zimbabwe.
North America: Canada, Mexico (unconfirmed), USA (Florida, Illinois, North Carolina, South Dakota).
South America: Argentina, Brazil, Colombia, Ecuador, Honduras.
Oceania: Australia (New South Wales).
EU: Present.

BIOLOGY

S. macrospora overwinters as viable pycnidia and mycelium on maize debris in the soil, or on seed. Under warm, moist conditions, spores are extruded from pycnidia in long cirrhi and disseminated by wind and rain and, probably, by insects. Maize plants are infected primarily through the crown, mesocotyl and roots and, occasionally, at the nodes between crown and ear. Following this, stalks are invaded. The development of the stalk rot phase is favoured by dry weather early in the growing season, followed by extended periods of rainfall shortly after silking. In stalk infections, injury to the vascular system disrupts translocation and, consequently, reduces grain size.

Unbalanced fertility, low K, poor drainage, mechanical and insect damage, cultivar and planting density all influence disease severity. The ear and grain rotting phase is similarly favoured by above-normal rainfall from silking to harvest, ears being most susceptible during the weeks after silking. Invasion of the ear is usually by way of the shank. Hybrids with poor husk coverage or thin pericarps are often very susceptible.

There is evidence that growth of *S. macrospora* is induced by an organic substance secreted by *S. maydis*, and that, in many instances, the former can utilize complex carbohydrates only when a growth factor required by the fungus is present. Race specialization has not been reported.

The infection cycle and overwintering are very similar in *S. maydis*, but this fungus generally occurs in cooler regions. Conidia rapidly lose their viability at high temperatures and on exposure to sunlight. At least 24 strains have been reported from the USA; variability appears to be related to temperature requirements corresponding to geographical origin. For more information, see Koehler (1960), Dhanraj (1966), Sutton & Waterston (1966a; 1966b), Christensen & Wilcoxson (1967), Walker (1969), Shurtleff (1980).

DETECTION AND IDENTIFICATION

Symptoms

Seedlings

Infected seed gives rise to pre-emergence death in cold soils or blighted seedlings in warmer soils. Seedlings develop brown, cortical lesions on the internode between the scutellum and coleoptile, and the seminal roots are frequently destroyed.

Stalk rot

Symptoms do not usually appear until several weeks after

silking, and generally arise following root infection. Oval, irregular or elongate, single or confluent lesions, 1-10 cm long, with pale cream-brown centres and indeterminate darker borders are frequently associated with stalk rot infection. Leaves wilt, become dry and appear greyish-green, the symptoms resembling frost damage. Affected plants may die suddenly. The green colour of the internodes fades and they become brown to straw-coloured, spongy and easily crushed. The pith disintegrates and becomes discoloured, with only the vascular bundles remaining intact. Dark, sub-epidermal pycnidia may be seen clustered near the nodes, and white fungal growth may also be present on the surface.

Ear rot

Infection usually begins at the ear base, moving up from the shank. If infection occurs within 2 weeks after silking, the entire ear turns greyish-brown, shrunken and completely rotted and light. Alternatively, early infections result in bleached or straw-coloured husks. Lightweight ears usually stand upright with inner husks adhering tightly to one another or to the ear because of mycelial growth between them. Black pycnidia may be scattered on husks, floral bracts and the sides of kernels. Late-infected ears show no external symptoms, but when ears are broken and grains removed, a white mould is commonly found growing between the grains whose tips are discoloured. For more information, see Sutton & Waterston (1966a; 1966b), Christensen & Wilcoxson (1967), Walker (1969), Shurtleff (1980).

Morphology

Since a number of primary and secondary fungi may be present, microscopic observation of fruiting bodies is advisable for correct diagnosis.

Pycnidia are immersed, spherical to subglobose, 200-300 µm in diameter, with multicellular walls and a circular protruding papillate ostiole, 30-40 µm in diameter. Conidia of *S. macrospora* are straight or curved, rarely

irregular, 1 (0-3) septate, smooth-walled, pale-brown, with rounded or truncated ends and relatively large, 7.5-11.5 x 44-82 µm. Conidia in *S. maydis* are straight, curved or irregular, 1 (0-2) septate, smooth-walled and pale-brown with rounded or truncated ends, 5-8 x 15-34 µm.

Detection and inspection methods

The detection and inspection methods for *S. macrospora* and *S. maydis* are outlined in EPPO's Quarantine Procedure No. 35 (OEPP/EPPO, 1991). Seeds of maize shouldbe placed on 1% malt agar and incubated at 20°C for 7 days. Subsequent microscopical observation should then reveal the presence of the fungi. The Japanese Plant Protection Service proposed a procedure which required less time by removing the outer layers of the seeds halfway through the incubation period, with subsequent microscopic examination (Dai *et al*., 1987).

MEANS OF MOVEMENT/DISPERSAL

International spread by *S. macrospora* and *S. maydis* will most probably take place through infected maize seed. Studies showed that the mycelium of *S. maydis* is present in the endosperm and embryo of maize seeds (Zad & Ale Agha, 1985). Natural spread of the fungi can be regarded as rather limited.

PEST SIGNIFICANCE

Economic impact

- ***Stenocarpella macrospora***

Stalk and grain rots are universally important and among the most destructive diseases of maize throughout the world. In most cases, rots are caused by a complex of several species of fungi and bacteria, rather than by a single species, so it is difficult to assess the loss due to *S. macrospora* alone. Yield of maize was reduced only when necrotic lesions in the second internode above the ground involved 50% or more of the tissue, and not when lesions were smaller; thus, the maize plant can tolerate a certain level of infection. Losses due to stalk and grain rots vary from season to season and between regions, but may be greater than 50%. In the USA, 10-20% yield reductions are common. Losses arise directly from poor grain filling and indirectly from harvest losses because of lodging.

- ***Stenocarpella maydis***

S. maydis has been shown to cause between 5 and 37% loss in germination (Nwigwe, 1974), as well as being a serious pathogen of maturing plants. Furthermore, infected grain has been reported to cause mycotoxicosis when fed to cattle and sheep.

Control

Flint cultivars are more resistant than dent, and resistance breeding offers promise for control, although no maize lines appear immune. Seed treatments are fairly effective in controlling seedling blight, but once the fungus is established in the soil, crop rotation is necessary to eliminate it.

Phytosanitary risk

S. macrospora and *S. maydis* are A2 quarantine organisms for EPPO (OEPP/EPPO, 1982). Maize is an important silage and grain crop in the EPPO region, and *S. macrospora* could have a considerable economic impact in warm, humid regions. North American isolates of *S. maydis* have generally proved most pathogenic in the state of origin; in the USSR, an isolate from North America proved more pathogenic to seeds and plants than a local one. Nevertheless, it can be questioned whether the risk of establishment and spread of these fungi in the EPPO region is really very high. They certainly occur on imported maize seed, since very few EPPO countries are making any phytosanitary requirements for maize seed. They have been repeatedly found in certain countries in the EPPO region, without having established. Probably, seed certification would be as effective in limiting their spread as phytosanitary measures.

PHYTOSANITARY MEASURES

According to the EPPO specific quarantine procedure (OEPP/EPPO, 1990), seeds of *Zea mays* from countries where *S. macrospora* or *S. maydis* occur should come from a crop found free, during the growing season, from *S. macrospora* and *S. maydis* or representative samples from the seed lots should have been tested according to EPPO Quarantine Procedure No. 35 (OEPP/EPPO, 1991).

BIBLIOGRAPHY

Christensen, J.J.; Wilcoxson, R.D. (1967) Stalk rot of corn. *Monograph of the American Phytopathological Society* No. 3, 59 pp.

CMI (1984) *Distribution Maps of Plant Diseases* No. 227 (edition 4). CAB International, Wallingford, UK.

Dai, K.; Nagai, M.; Sasaki, H.; Nakamura, H.; Takechi, K.; Warabi, M. (1987) Detection of *Diplodia maydis* from imported corn seed. *Research Bulletin of the Plant Protection Service of Japan* No. 23, pp. 1-6.

Dhanraj, K.S. (1966) Dry rot of maize caused by *Diplodia macrospora*. *Indian Phytopathology* **19**, 120.

Interafrican Phytosanitary Council (IAPSC) (1985) *Stenocarpella macrospora*. *Distribution Maps of Major Crop Pests and Diseases in Africa* No. 97.

Koehler, B. (1960) Corn stalk rots in Illinois. *Bulletin, University of Illinois Agricultural Experiment Station* No. 658.

Nwigwe, C. (1974) Effect of *Diplodia zeae* and *B-Phomopsis* on the germination of seeds of maize (*Zea mays*). *Plant Disease Reporter* **58**, 414-415.

OEPP/EPPO (1982) Data sheets on quarantine organisms No. 67, *Diplodia macrospora* & *D. maydis*. *Bulletin OEPP/EPPO Bulletin* **12** (1).

OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.

OEPP/EPPO (1991) Quarantine procedures No. 35, *Cochliobolus carbonum*, *Stenocarpella macrospora* & *S. maydis*. Inspection and test methods for maize seeds. *Bulletin OEPP/EPPO Bulletin* **21**, 261-262.

Shurtleff, M.C. (1980) *A compendium of corn diseases*, pp. 27, 44-45, 51-52. American Phytopathological Society, St Paul, Minnesota, USA.

Sutton, B.C.; Waterston, J.M. (1966a) *Diplodia macrospora*. *CMI Descriptions of Pathogenic Fungi and Bacteria* No. 83. CAB International, Wallingford, UK.

Sutton, B.C.; Waterston, J.M. (1966b) *Diplodia maydis*. *CMI Descriptions of Pathogenic Fungi and Bacteria* No. 84. CAB International, Wallingford, UK.

Walker, J.C. (1969) *Plant pathology* (3rd edition), pp. 335, 341. McGraw-Hill, New York, USA.

Zad, J.; Ale Agha, N. (1985) A note on the mycoflora of maize in Iran. *Mededelingen van de Faculteit Landbouwwetenschappen Rijksuniversiteit Gent* **50**, 1149-1151.