STUDIES ON SOME STALK AND ROOT ROTS OF MAIZE IN U.A.R.

BY

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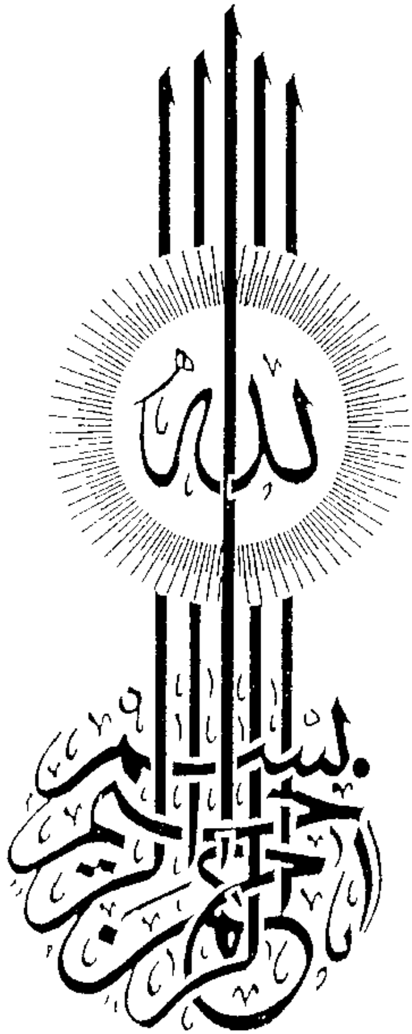
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INTRODUCTION

The first report of a stalk-rot condition in maize came with the outbreak of the bacterial stalk-rot disease in 1953 (Samra 1953). Subsequent work showed that the maize stalk-rot problem in the U.A.R. is of a complex nature in which several fungi and bacteria seem to be involved.

The writer (Abdel-Azim 1964) studied two important diseases of this complex namely charcoal stalk-rot caused by Sclerotium bataticola, and root-rot caused by a basidiomycetous fungus. With the completion of this contribution, however, it was felt that the door was still wide-open for further consideration of these diseases. The basidiomycetous fungus was left unidentified due to failure to induce sporulation. The charcoal-rot fungus was named S.bataticola because its Macrophomina stage was not observed. The interaction of these and other associated fungi, and their behaviour in culture as well as in the soil were not studied.

Survival of the pathogen is one of the most important aspects of plant disease control. In case of root-infecting fungi a pathogen to be capable of living as an active saprophyte in the soil, must have a sufficiently high degree of competitive saprophytic ability. However, it is to be noted that not all root-infecting fungi can behave as active saprophytes in the soil, but this ability seems to be confined to primitive pathogens. Therefore, it is believed that successful control of the disease should be based on profound information on the behaviour of the causal agents in the soil as the medium in which the pathogen lives, propagates and exhibits its various activities.

The present dissertation includes three parts: (i) Root-rot, caused by a basidiomycetous fungus, naturally affecting maize and sugar-cane. Several attempts were made to induce its sporophores (mushrooms) in pure culture. The macro-and microscopic characters of the fungus sporophores were studied. The fungus was identified in the relevant section of this investigation as Marasmiellus inoderma (Berk.) Sing. (ii) Charcoal stalk-or foot-rot, caused by Macrophomina phaseoli (Maubl.) Ashby. The study comprises the effect of certain cultural practices on infection. (iii) Interaction of maize rhizosphere and root-infecting fungi, in this part an attempt was made to survey fungi not only in the rhizosphere but also in maize roots.

REVIEW OF LITERATURE

Root-rot disease

Rosenfeld (1939) reported that root-rot of sugar-cane was associated with *Pythium*, *Marasmius*, or *Fusarium*. *Marasmius sacchari* occurred on old leaf sheaths and rhizomes. Singer (1946) held *Marasmius semiustus* as the cause of root-disease of sugar-cane in the Americas. It was described as being omnivorus and causing damage on crops other than sugar-cane. The same author (1955)amended the name to *Marasmiellus inoderma* (Berk.) Singer. Philipp (1959) isolated from diseased maize plants a *Marasmius* sp., propably a form of *M. graminum*, which was reported as a cause of root-and stalk-rot. Pegler (1968) reported *Marasmiellus inoderma* from Africa and stated that it grew on dead and living hosts particularly palms.

Sabet et al.(1961) reported for the first time a severe case of root-rot affecting fully grown maize plants. The symptoms (Sabet et al. 1963) included complete decay and disintegration of the whole root system of the plant followed by rapid wilting and drying of the above-ground organs. The cause of the disease was isolated and identified as a basidiomycetous fungus. Attempts made by

Sabet et al.(1968 b) to induce sporulation were unsuccessful and the identity of the fungus remained undetermined.

Sabet et al.(1968 b) also reported that the basidiomycetous fungus grew in the ground tissue of the plant crown and its hyphae accumulated around the fibro-vascular bundles with a few entring the bundles. Infection was established by soil infestation, stem inoculation failed to cause infection with the disease. The fungus had a wide host range, it was, however, most active on maize and broad-bean. It was shown that the optimum temperature for growth was about 30°C, the minimum between 8-11° and 15°C and the maximum between 35° and 37°C. The optimum pH value for growth was about 5.4. The same authors (loc. cit) found that low manuring was associated with a decrease in the number of infected plants. The calcareous sandy soil of Tahrir Province was the most suitable soil type for the disease. Infection was unfavourably affected by high soil moisture. The optimum temperature for infection was 31°C.

Charcoal stalk-rot disease

The form-species Sclerotium bataticola Taub. is generally accepted for the sclerotial stage of the charcoal fungus. The name Macrophomina phaseoli (Maubl.) Ashby is reserved for the pycnidial stage (Reichert and Hellinger 1947- after Tarr 1962). The former stage is commonly found on affected hosts and is readily produced in culture. The pycnidial stage, on the other hand, is rarely encountered on naturally infected hosts. However, Briton-Jones (1927) made an attempt to produce the pycnidial stage of Rhizoctonia (S.) bataticola with cultures of this fungus isolated from sclerotia in the cortex of a lime root in Ceylon. These produced the pycnidial stage when inoculated into wounded living stems. Goth (1965) succeeded in obtaining the pycnidial stage of M. phaseoli on fresh or dried bean and cotton leaf tissues sterilized with propylene oxide. Attia (1966) obtained pycnidia of M. phaseoli in old agar cultures, and on French beans.

West & Stuckey (1931) found that M. phaseoli could attack and kill jute seedlings in pots under very moist conditions, and cotton seedlings were infected when grown in soil deficient in humus. They also found that the fungus was not able to decompose cellulose.

Uppal et al.(1936) concluded that the fluctuation in soil temperature and moisture largely determined the incidence of the disease under Indian conditions. Semeniuk (1942 & 1944) established the parasitism of S. bataticola to maize seedlings in greenhouse inoculation experiments which resulted in severe mesocotyl and primary root necrosis, accompanied by stunting, and this developed only in seedlings raised in soil steamed for five hours at 15 lb. pressure. The disease assumed a more serious character at 25° to 30°C than at lower temperature. Hoffmaster et al.(1943) stated that the fungus was chiefly injurious to seedlings and immature plants devitalized by enviornmental extremes,wounds, or infection by other organisms. Its effects included damping off, stem rot, precocious ripening ,low yields, and premature death.

Livingston (1945) found that soil temperature of at least 35°C favoured the growth of the organism, and low soil moisture retarded the growth of the host and favoured both seedling blight and stalk rot by the fungus. In the field either moisture or temperature can limit the distribution and severity of the disease. Pady et al. (1947) indicated that the hot, dry weather favoured the development of charcoal-rot on maize. Norton (1953) found that the development of M. phaseoli in unsterilized soil was very restricted. The author suggested that the hot, dry weather was usually associated with charcoal-rot infection.

Small (1927) suggested that root-rot disease of economic and other plants in the tropics was due primarily to R. (S.) bataticola. Briton-Jones (1928 a) was not inclined to accept Small's views as to the direct responsibility of this fungus for root diseases of cultivated plants, the more so since there were definite indications that in some cases it followed a check to the host due to physiological or other causes.

Park (1928) suggested from the recent discovery of the fungus in apparently healthy roots of tea, the possibility of its being a common mycorrhizal form, and as an endophyte that produced sclerotia when some conditions caused the death of the root.

Small (1928 a) brought forward further evidence in support of his contention that root disease of various economic crops in the tropics was due to active parasitism by R. bataticola (M. phaseoli). He, (1928 b), showed that the fungus was a true parasite capable of attacking the small feeding rootlets of woody plants in the absence of any contributory factors either external, or inherent in, the hosts. Briton-Jones (1928 b) accepted that R. (S.) batataicola was a parasite on the roots of various hosts, but considered that its parasitism was dependent on other, more primary, factors which predisposed the plant to infection.

Savola et al.(1950) reported that M. phaseoli isolated from numerous samples of diverse origin, assumed an important role and was, infact, the sole agent of foot (charcoal) rot. Only M.phaseoli induced the typical symptoms of natural infection in inoculated plants. Ghaffar and Erwin (1969) reported that when cotton plants at soil temperatures of 20°-40°C were subjected to soil water stress and inoculated with the fungus via the soil, the severity of root-rot caused by M. phaseoli was much greater in those plants subjected to water stress than in those provided with sufficient soil water.

Macrophomina phaseoli (Maubl.) Ashby attacks the following hosts:- Loubia (Vigna sinensis) and beans (Phaseolus vulgaris) in Egypt (Briton-Jones 1925); maize and beans in California , U.S.A. (Mackie 1931); maize in U.A.R. (Sabet et al 1961) and sunflower (Helianthus annus), sweet potato (Ipomoea batatas), lupins (Lupinus digtatus), and sesame (Sesamum indicum) in Egypt (El-Helaly et al. 1966).

Young (1944) attributed the outbreak of maize charcoal (Macrophomina phaseoli) in east Texas to (1) abnormally heavy spring rains which packed the soil round the seedlings and delayed growth (2) leaching out of commercial fertilizers applied to the infertile soil through the same agency, and (3) the hot dry spell from June to August weakened the plants and enhanced their susceptibility to the parasite. Otto and Everett (1956) reported that severity of stalk rot (caused by several microorganisms) generally increased with increased application of N and decreased with an increased supply of K.

Sabet, Samra and Abdel-Azim (1968 a) reported that infection with S. batataticola could be effected either by the soil infestation or by stalk injection technique. The fungus had a wide host range, it was more active on French bean and maize. It was shown that the optimum temperature was about 35°C, and the optimum pH value was about 3.9 for growth. The results also showed that excess application of fertilizers especially where P and K were combined reduced, the infection in pots. The clay soil of Sakha was the most suitable soil type for the disease. The optimum temperature for infection was 31°C.

Inoculum potential

Horsfall (1932) first used the term "Inoculum potential" defined as the number of infective particles present in the environment of the uninfected host. Garrett (1956) defined inoculum potential in another sense; the energy of growth of the pathogen available for infection of the host, at the surface of the host to be infected.