STUDIES ON SOME DISEASES OF SUGAR-CANE IN EGYPT

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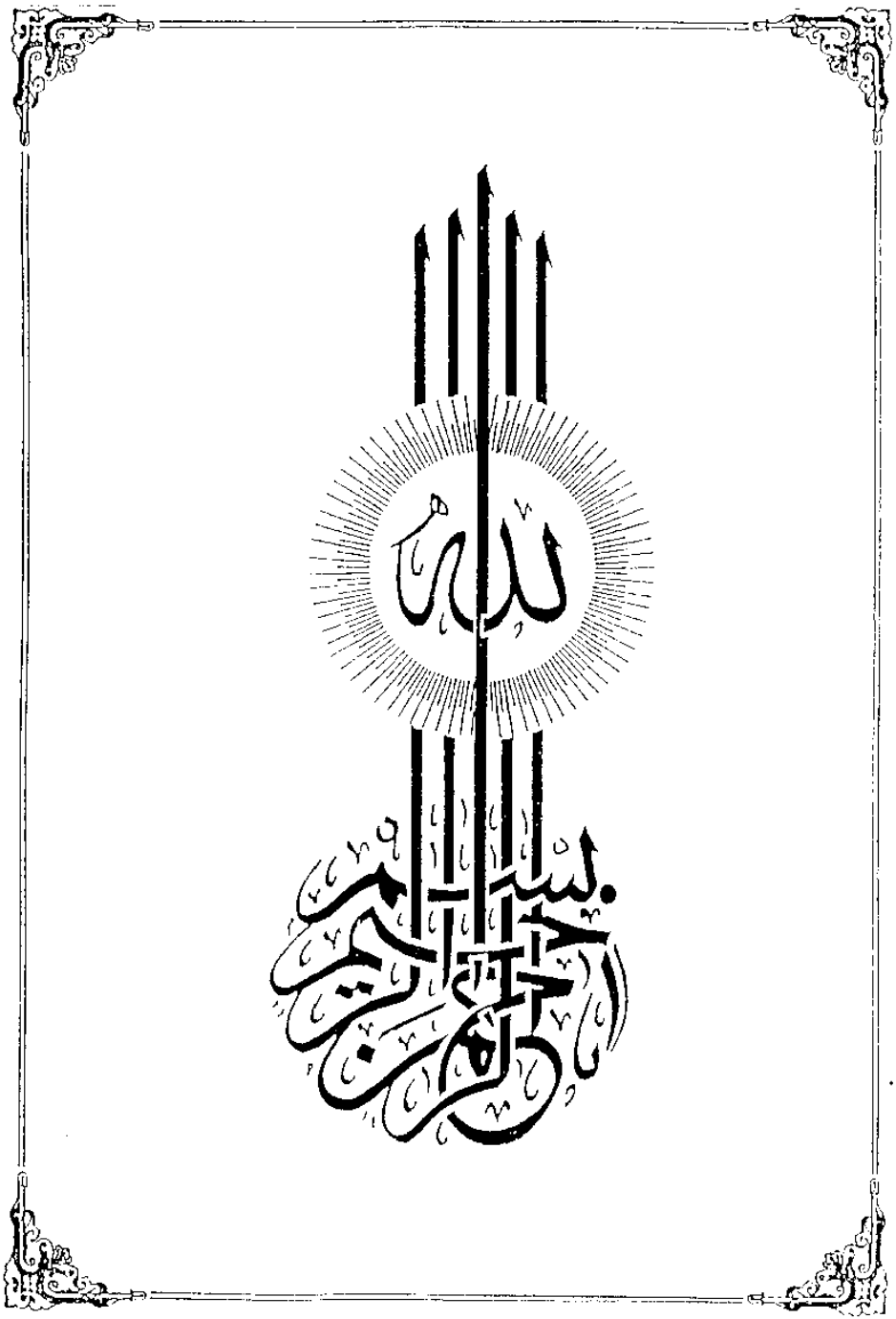

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C O N T E N T S

I N T R O D U C T I O N

Sugarcane (Saccharum officinarum J.) is one of two major sugar crops in the world i-e-sugarcane and sugar beet. It is native to the tropical and subtropical regions, while sugar beet is restricted to the temperate and cold zones. Sugarcane was recorded in India in 327 B.C. (Humbert, 1968). It spread to Persia and then to Egypt through Arab movement. It can be grown economically for sugar production in the regions between 30-32° to the North and South of the Equator. The extremes are agronomically called the marginal geographical borders.

International sugar production, from both crops, reached its maximum during 1981 and 1982, where it amounted to 87.4 and 97.1 million tons, respectively. The total consumption during the same period was about 90.7 million tons. The total world production of beet sugar was 32,937 and 36,722 thousand tons for the years 1980-1981 and 1981-1982 respectively, while cane sugar was 54,491 and 60,466 thousand tons for the same years respectively (Annual Report of sugarcane, October 1983, issued by the Permanent Council for Sugarcane, Ministry of Agriculture.

In Egypt, sugarcane is grown in the upper governorates for sugar production. In Delta, it is grown only for chewing

and fresh juice. About 253,968 feddans were cultivated with sugarcane during 1982-1983 growing season. The area is geographicelly distributed as follows : 10,836, 38,139 and 204,993 feddans in Delta, Middle and upper Egypt respectively. The area yielded 8740467 tons cane. About 7,030,117 tons of sugarcane were crushed that produced about 690 thousand tons of sugar. This amount of sugar is about 62 % of the total consumption (Annual Report For Sugarcane, Ministry of Agriculture, Cairo, 1983).

Sugarcane varieties were previously imported either at seed-cuttings or fuzz. Now, after the success of cane flowering in Egypt, most of the fuzz is being produced locally.

In Egypt, sugarcane was relatively free of economic losses due to fungal diseases until the appearance of the culmicolous smut in 1975 and again in 1982. The work in this thesis was initiated to study the stalk-and root-rot and the culmicolous smut which affect both yield and quality, consequently sugar production per unit area, with the hope that a better understanding of sugarcane diseases and their control will aid in the production of world's most important energy-yielding food sugar.

REVIEW OF LITERATURE

I- Stalk And Root - Rots

1- Rind disease:

Rind disease of sugarcane is caused by Pleocyta sacchari (Lass.) Petr. et Syd. (Petrak and Sydow, 1926). The causal fungus is essentially a wound parasite (Martin, 1938).

Serious reduction in germination occurred in Louisiana in 1910 (Edgerton, 1910).

The causal fungus is often found on seed-cuttings that have deteriorated after planting. It may contribute to the destruction of seed cuttings initiated by more aggressive pathogens (Abbott,1935).

Martin (1938) mentioned that after penetration the fungus grows within the tissues into a cushiony mass of mycelium or stroma, later develops sufficient pressure to split the epidermis, thus forming the small pustules through which the fruiting structures emerge.

P. sacchari spores are one celled, cylindric with rounded ends, pale brown in colour, and usually have a vacuole near each end (Martin,1938). They measure 10.15 x 3.4 u.

Detailed description of the disease symptoms was reviewed by some authors (Edgerton, 1959 and Martin, 1938). External symptoms normally occur on stalk and seed cuttings. The internal tissues of affected plants are discoloured dark and have a sour odor. Symptoms may occur on leaf sheath and midrib. If leaf sheaths and midribs are affected, it may show premature yellowing and drying.

Several losses due to this disease were reported from different countries. The Bourbon cane, in West Indies was thought to be severely affected with this disease during the 1890's (Edgerton, 1959).

Martin et al., (1961) stated that the degree of injury depends on weather conditions, insect injury and susceptibility of the variety. Both soil moisture and temperature have a marked influence on the extent of infection. The disease is favoured by both excessive or greatly difficient soil moisture. Early germination of buds reduces infection even with susceptible varieties. After planting if conditions are favourable for the fungus many of the buds are killed or are unable to produce shoots. Some of shoots which do develop are killed.

Hughes et al.,(1964) mentioned that when the disease extends to the under ground portions of the stalks, death of the stool may occur.

Liu et al. , (1978) stated that during 1975/76 harvesting season in the state of Pernambuco, Brasil, investigations were carried out to determine the stalk-rotting diseases that were responsible for the greatest losses in sugar. Results showed that mills were suffering severe losses from the rind disease in some varieties, following drought and delays in the processing of harvested cane.

Liu et al., (1978) studied the physiology of P.sacchari. The results showed that the best medium for mycelial growth was cane juice agar with pH 5 to 6 at 30°C. Corn meal and oat meal agar were the best media for sporulation at 20-25°C. Normal mycelial growth was obtained on cane juice agar and water agar containing 10 - 15 % sucrose. Good germination of spores was obtained on crude sugar cane mixed juice, but not in distilled water or in sugar solutions of various concentrations. The optimum temperature for spore germination was between 30-35°C. The stimulatin effect of light upon germination was significant. Good germinations was obtained from spores 6-months old kept in sealed tubes. Spores kept in water at 4°C. for 20 days or in spore masses on sterilized stem tissues kept at 15°C for 21 days gave good germination, although the rate of germination was slower for the latter treatment. Inoculation of sterile stem tissues with a spore suspension of the fungus was found to be the most convenient for producing spores of P.sacchari for disease resistance tests.

Mansour (1979) reported the disease from Iraq. The disease was quite common on seed-cuttings cultivated late in the planting season and caused substantial reduction in germination. It occured on standing over-riped plants in late winter and spring. Low temperatures during winter, high soil salinity, poor drainage and mechanical damage to seed-cuttings adversely affected germination and favored disease incidence and development. The causal fungus was isolated from infected buds, bud scales and roots. Pleocyta saccheri was also obtained from the rhizosphere of infected clumps.

Mansour (1980) found that P. saccheri grows well and sporulates on a number of agar media. Variation in linear growth rate, growth density and sporulation indicates exacting nutritional requirments. Growth on mineral media is considerably enhanced by the addition of 0.1 % yeast extract. The competitive saprophytic ability (CSA) as estimated by Cambridge method, suggests that P. saccheri is a moderate competitive saprophyte. It actively decomposes cellulose of filter paper and sugarcane bagasse. The fungus does not produce pectolytic cultural filtrate. It is susceptible to antibiotics produced by soil micro-organisms. The fungus is able to survive in pure culture grown on sterile supplemented sorgnum grains and cellulosic substrates for more than 16 months.

Mansour (1980) found that the fungus produces sclerotia in cultural media. Micro-sections in these sclerotia showed that they are formed of pycnidia. Each of these pycnidia germinates singly and develops a tube from which the characteristic spores discharge. Germinating tubes are those described before as fruiting structures which emerge from the splitted rind of affected stalks or seed-cuttings.

2- Marasmiellus root-and stalk-rot:

Rosenfeld (1939) reported that root-rot of sugarcane in Egypt was associated with Pythium, Marasmius and Fusarium.

Singer (1946) reported that Marasmius semiustus was the cause of root disease of sugarcane in America. It was described as being omnivorus and causing damage to crops other than sugarcane. The same author (1955) changed the name to Marasmiellus inoderma (Berk.) Singer.

Phillip (1959) isolated from diseased maize plants a Marasmius sp., probably a form of M. graminum, which was reported as a cause of root and stalk rot.

Rands and Abbott (1964) mentioned that species of Marasmius were at one time considered among the major fungal pathogens of sugarcane. Begining with the description of M.saccheri by Wakker (1895) in Java as the cause of rhizome, or basal stem rot, and continuing until about 1925, Marasmius was considered the causal agent of root rot.

Marasmius continued to be cited as the cause of root rot, especially in the New World (Reads and Dopp, 1950). Rand and Abbott (1954) described the disease symptoms. It is recognized by the growth of white mycelium, which develops over the lower sheaths and between the sheaths and stems, and by the brown cankers on the underground portion of the stem, especially at the nodes. Roots from these nodes may be prevented or suppressed. Above ground portions of the stalk are seldom penetrated, but the underground basal portions of the stem and young shoots may be invaded. In wet weather, the mushroom fruiting structures often develop at the base of affected stems and sheaths, usually at or near the ground level. They considered the fungus as a wound or secondary parasite.

Pegler (1966) reported Marasmiellus inoderma from Africa and stated that it grows on dead and living hosts, particularly palms.

Sabet et al., (1968 b) found that the optimum temperature for the growth of the fungus was about 30°C, the minimum between 8-11°C and 15°C, and the maximum between 35 and 37°C. They studied the effect of cultural practices, soil types and conditions on infection.

Abdel-Azim (1970) reported for the first time a severe case of root rot affecting fully grown maize plants in Egypt. The symptoms included complete decay and disintegration of

the whole root system of the plant followed by rapid wilting and drying of the above ground organs. He reported that the fungus was also isolated from diseased sugercane plants grown in Assiout, Upper Egypt. This was the first record on sugarcane in Egypt. Infection could take place at any stage of plant growth.

3- Sclerotium root-rot:

Small (1927) suggested that a root rot disease of economic plants in the tropics was due primarily to Rhizoctonia (Sclerotium) bataticola Taub. Briton-Jones (1928a) was not inclined to accept Small's views as to the direct responsibility of this fungus for root disease of cultivated plants, since in some cases it followed a check to the host due to physiological or other cases. 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 (Macrophomina phaseoli (Maubl.) Small (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 host.

Briton-Jones (1928 b) accepted that R. (S.) bataticola 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.