STUDIES ON STALK ROT DISEASE OF CORN IN EGYPT

BY

HAIFAA SHEHATA ABD-EL-GHANI

B.Sc. (Plant Pathology) Alexandria Univ (1973)

M.Sc. (Plant Pathology) Alexandria Univ. (1980)

THESIS

SUBMITTED IN PARTIAL FULFILMENT

OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

AGRICULTURAL SCIENCES

IN PLANT PATHOLOGY

Department of Agricultural Botany and Plant Pathology

FACULTY OF AGRICULTURE

AIN SHAMS UNIVERSITY

CAIRO — EGYPT

1987

APPROVAL SHEET

Thesis for Ph.D. Degree entitled "Studies on Stalk rot disease of corn in Egypt"

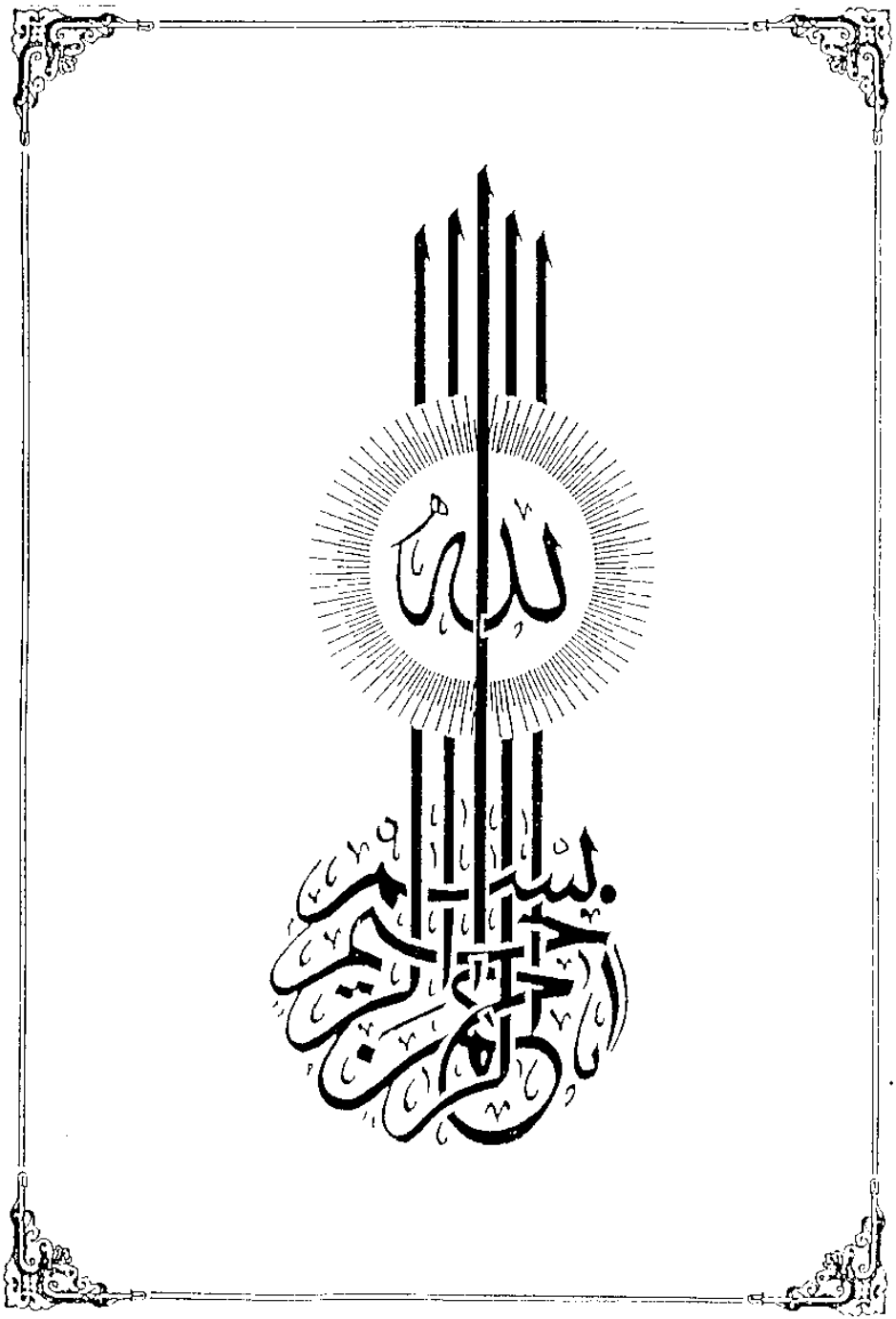
Approved by :

Prof. Dr. M. N. Shetta

Prof. Dr. M. M. Ezzat

Prof. Dr. [signature]

Date: 5 / 7 /1987



CONTENTS

Page

Page

ACKNOWLEDGEMENT

Praise and thanks be to Allah, the most mercifull, for assisting and directing me the right way.

The auther wishes to express her appreciation and deepest gratitude to Prof. Dr. M.M. El-Zayat, Professor of Plant Pathology, Prof. Dr. H.M. El-Antably, Professor of Plant Physiology and head of Department of Agric. Botany and Plant Pathology, Faculty of Agriculture, Ain Shams University and Prof. Dr. I.E. Darrag, Prof. of Plant Pathology, Institute of Plant Pathology and director general of Agricultural Research Stations, Agricultural Research Center, for their supervision, valuable help, advice guidance and encouragement throughout the course of this study.

Sincere thanks are also due to Dr. Dorreiah E. Salem, Researcher of Plant Pathology, Bahtim Agricultural Research Station, for her advice and encouragement throughout this study.

Sincere thanks are also due to Dr. Soaad, Abd Allah, Assistant Professor of Plant Pathology, Faculty of Agriculture, Ain Shams University for her help during the Preparation of this thesis.

Sincere thanks are also due to Prof. Dr. Mohamed Abdel-Aziz Arafa Professor of Plant Pathology and director of Bahtim Agricultural Research Station for the help and encouragement and for makeing all facielities at Bahtim agriculture experimental

Station available to me during this study.

Thanks are also due to all members of Plant Pathology Res. Inst., Agric. Res. Center, for their encouragment.

INTRODUCTION

The corn (Zea mays L.) is one of the most important cereal crops in the A.R.E. The cultivated areas of maize in A.R.E in 1985 were (1, 396, 150) feddans that yielded (20, 826, 761) Ton according to the Annual Report of the Statistical Department, Ministry of Agriculture, A.R.E. (1985).

Maize crop in A.R.E is subject to the attack by many diseases. In some localized areas one or more diseases may became acute and destroy most of the crop. The stalk-rot of maize originally or primarily caused by Cephalosporium maydis may cause severe losses in grain yield of susceptible plants. These losses may be estimated at about 37% of the yield of infected plant in the average (Samra, et al, 1972). Stalk rot is a disease complex caused by several dif erent species of fungi and bacteria. It is of variable importance from region to region and season to season, occasially it becames epidemic over wide areas. Severity of stalk rot varies greatly as temperature, rainfall, soil drainage, soil type, available nutrients, and other conditions. The variety of corn planted, and agricultural practices such as the use of sound seed, time of planting crop sequence, application of fertilizers, and plant populations, have a marked influence on the severity of infection. Mechanical injuries and insect damage also tend to increase the severity of stalk rot.

Development of desirable modern corn hybrids demands considerable attention to be given to the incorporation of lodging and stalk breakage resistance, particularly in countries where mechanical harvestes are in common use. This problem is greatly complicated because plant breeders have also been emphasizing bigger and heavier ears, or more ears per stalk, to increase yields. These has also occurred a widspread of improvement in culturel practices, involving dense plant populations and the liberal use of fertilizer. All of these developments produce greater seed yields and this greatly taxes the strength of the corn stalk. Rot weakens stalks and accounts for most of the broken stalks and much of the lodging. Stalk rot must, therefore, be given due consideration in any modern corn improvement program.

Stalk rot of corn has been known for over 60 years, but during the early part of the 20th century damage was usually attributed primarily to seedling blight, root rot, and ear rot. No one knows when stalk rot of corn first became a destructive disease. Recent studies indicate that these rots may be closely interrelated.

It is rarely found alone but associated with other organisms causing wet rot. The present investigation was planned to study the following factors.

1) Causal organisms of stalk-rot.

2) Physiological studies of the causal organisms.

3) Factors affecting the growth of the plant and the organism.

4) Root exudates components of the healthy resistant and susceptible plants.

5) Effect of fungal metabolism on maize varieties.

6) Activity of cellulytic enzymes of C. maydis, C. acremonium and F. moniliforme in vitro and in vivo.

7) Effect of sugar content, hormones and morphological characters on the disease.

REVIEW OF LITERATURE

Stalk rot of Zea mays L. is an important disease causing considerable losses in yield. It is a disease complex caused by several different species of fungi and bacteria. This disease has been reported from many countries of the world such as Bulgaria (Bubak, 1911); South Africa (Evans, 1912-13); Italy (Curzi, 1929); Australia (Millikan, 1943); Canada (Mckeen, 1953); New York (Boothroyed, 1955); France (Messiaen, 1955); India (Hingorani, 1959); Romania (Popescu, 1959 & 1960); Egypt (Sabet, 1961); Israel (Knorr, 1961); El Salvador (Ancalmo, 1961); Rica (Garofalo, 1961); Russia (Grikenko,1962).

The Causal Organisms and Disease Symptoms :

Holbert and Hoffer (1920), considered Gibberella zeae (Schw.) Petch, as the most harmful organism associated with root, stalk, and ear rots.

Valleau (1920), indicated that Fusarium moniliforme Sheldon, was a primary causal organism of root and stalk rot of corn in Kentuckv and other Central and Southern States of U.S.A.

Reddy and Holbert (1924), found that Cephalosporium acremonium Corda, was pathogenic by injecting spore suspension into the stalk of the plant causing black bundle condition in maize.

Porter (1927), reported that F. moniliforme invades the stalks shortly after pollination, but that it was usually not destructive.

Edwards (1935), found that inoculation tests with C. acremonium on maize seedlings with several strains under observation gave negative results; and planting diseased seed, failed to result in the establishment of the fungus in growing plants. In none of the experiments, C. acremonium was found to be an active pathogen attacking normal vascular bundles through unwounded root system.

Young (1943), demonstrated that F. moniliforme caused severe stalk rot when inoculated into the plant by the toothpick method.

Bulter (1947), found that streaking and bleaching of the grain from the tip towards the dentend, sometimes indicated internal infection by Gibberella fujikuroi Saw. but may be also due to infection by C. acremonium and other fungi.

Taylor (1952), considered that C. acremonium, F.moniliforme, bacteria and yeasts generally, Gibberella zeae, Nigrospora oryzae (Berk. & Br.) and Mucor species accasionally and Diplodia zeae Schw. rarely, were associated with rot produced in corn stalks with these organisms by toothpick and hypodermic methods resulted in various degree of rot development. Bacteria, C. acremonium, and F. moniliforme were often

reisolated from rotted tissue along with the introduced organism. Simultaneous inoculation with D. zeae and G.zeae of F. moniliforme in the same wound resulted in rot development approaching that of D. zeae alone, but when these fungi were introduced at different times, the extent of rotting approached that caused alone by the organism first introduced. More rot was produced when G. zeae and F. moniliforme were introduced simultaneously than when alone, and generally more rot was produced when F. moniliforme preceded G. zeae than in the reverse situation. The retarded development of D. zeae in wounded tissue previously infected by other organisms may account for the infrequent isolation of this fungus from rotted tissues around corn borer tunnels.

Koehler (1960), considered that C. acremonium appears to be an active parasite but aweak pathogen.

Sabet, Samra, Hingorani and Mansour (1961), gave an occurrence account of the stalk rot complex. The plants affected with late wilt conditions were found to be caused by a fungus which resembled Fusarium in growth characters, and pathogenicity.

Sabet, Samra, Hingorani and Fadl (1962), reported that the occurrence of C. acremonium in association with the black bundle condition in U.A.R. was frequently associated with the wet rot condition.

Samra, Sabet, and Hingorani (1963), named the late wilt pathogen as Cephalosporium maydis (Sabet, Samra and Hingorani).

Samra, Sabet, and Hingorani (1963), compared the morphological and cultural characters of late wilt pathogen C. maydis with an American named isolate of C. acremonium. They found that the latter fungus was unable to produce evident symptoms of disease within a reasonable length of time on petted plants.

Sabet, Samra, and Mansour (1966), found that late wilt disease of maize became severe by inoculating the fungus C. maydis into the soil, while stalk inoculation techniques failed to produce infection.

Sabet, Sam ra, and Ikbal (1966), found that C. maydis inhibits root development.

Sabet, Samra, and Dawoud (1966), inoculated C. maydis, C. acremonium, Fusarium moniliforme and Sclerotium bataticola Tanb. singly and indifferent combinations into maize plants either through the soil or into the stalks. The later three fungi may aggravate infection when injected into the stalk of plants grown in the soil inoculated with C. maydis.

Ibrahim and Kamara (1966), isolated two species of Cephalosporium, C. No. 1 having acremonium type was mild pathogenic to maize while C. No. 2 was considered to be of little importance as maize pathogen.