MILO DISEASE AND CHARCOAL ROT OF SORGHUM: PHYSIOLOGICAL AND ECOLOGICAL STUDIES OF HOST-PARASITE RELATIONS

by

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A DISSERTATION

Presented to the Faculty of
The Graduate College in the University of Nebraska
In Partial Fullfillment of Requirements
For the Degree of Doctor of Philosophy

Department of Plant Pathology

Under the Supervision of Associate Professor Larry D. Dunkle

Lincoln, Nebraska

December, 1976

TITLE

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APPROVED	DATE
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SUPERVISORY COMMITTEE

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PREFACE

The format of this dissertation represents a departure from the conventional dissertation style. The dissertation has been divided into two sections, each of which represents a complete manuscript. Consequently, the literature review is considerably shorter than in a conventional dissertation. Sections one and two are to be submitted for publication in the near future.

ACKNOWLEDGMENTS

I express my sincere appreciation to my advisor, Dr. L. D. Dunkle, for his excellent professional guidance, personal sacrifices, patience, and understanding. I have enjoyed his ready wit and sense of humor. Dr. Dunkle commands my deepest respect as a scientist and I place great value in our friendship.

I wish to thank Dr. M. G. Boosalis for his concern and encouragement during my graduate studies in the department. I am also grateful to other members of the department for their professional advice and sacrifices of time.

The generosity of the sorghum physiology group in lending scientific equipment and use of greenhouse facilities is greatly appreciated. I offer a special thanks for the technical advice and time sacrificed by Dr. C. Y. Sullivan.

After the fire last year I was grateful for laboratory space and equipment provided by Dr. J. M. Daly and for the hospitality of the staff of the Laboratory of Biochemistry and Nutrition.

I hope that the many graduate students I have known during my graduate studies will remain friends and become close professional colleagues.

I appreciate the patience my wife, Pam, has shown, especially during the completion of my dissertation and I am grateful for my 6-month-old daughter, Tracy, even though she unknowingly tried to prevent completion of this work.

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INTRODUCTION

Sorghum bicolor (L.) Moench is an increasingly important dryland crop in Nebraska and other states with limited rainfall. Its popularity is based primarily on its ability to produce grain under drouth conditions which have become common in recent years. However, during drouth years there is an increase in stalk rots of sorghum. These diseases contribute to grain loss by increasing lodging of mature plants, but their role in decreasing grain yield directly is not well defined. While drouth stresses themselves reduce potential grain yield, the added effect of decreased yield and grain loss due to stalk rots can be devastating.

Stalk rots of sorghum are caused by numerous organisms, usually fungi, which infect and develop in susceptible sorghum hosts exposed to certain environmental stress conditions. Some organisms interact with each other to cause stalk rot and are referred to as a "stalk rot complex". The independent or collective contribution of these organisms to stalk rot development has been difficult, if not impossible, to assess, since there are a multitude of environmental and host factors which contribute to stalk rot development. Many of these factors remain unrecognized despite the vast amount of stalk rot research over the past few decades. Most stalk rot research in the field is complicated by the lack of predictable occurrence of environmental conditions conducive to stalk rot development. Greenhouse studies of stalk rot face the difficulty of reproducing the proper conditions in a controlled environment.

My research involved studies of the ecology and host-parasite

relations of two fungi associated with the stalk rot-root rot complex. Periconia circinata (Mangin) Sacc. causes milo disease, also known as Periconia root rot, and Macrophomina phaseolina (Tassi) Goid. causes charcoal stalk rot of sorghum and other crops.

Milo disease posed a serious threat to the sorghum industry in the United States during the 1920's and 30's, but the planting of resistant selections alleviated that threat. Pathogenicity and virulence of the fungus were eventually linked to a host-specific toxin produced by certain strains. The toxin was active against only the original susceptible genotypes.

In recent years there has been an increased observation of this fungus on the roots of sorghum plants. In Nebraska the fungus has usually been seen late in the growing season on roots of mature sorghum. The present role of this fungus as a pathogen has not been determined. There has been some concern that a new race of P. circinata has evolved which exhibits altered virulence and produces a toxin active against previously resistant genotypes. This and other questions were investigated by conducting an ecological study of toxin-producing and non-toxin-producing strains in one of the areas where milo disease was first reported and has been perpetuated. Information from this study may help determine the present pathogenic potential of this fungus.

Macrophomina phaseolina causes charcoal stalk rot of sorghum under heat and moisture stress (drouth). Unlike many stalk rots, there are relatively few major factors necessary for its development and they occur frequently in many sorghum growing areas. These conditions can be approximated under greenhouse conditions for induction

of charcoal rot.

One research objective was to determine some of the drouth stress-induced physiological changes which may be responsible for increased susceptibility of stalk tissue to M. phaseolina. Another objective was to elucidate other aspects of host-parasite relations affected by drouth conditions.

SECTION ONE

CHARACTERIZATION OF THE *PERICONIA CIRCINATA* POPULATION IN A MILO DISEASE NURSERY