

**THE ROLE OF HOST, ENVIRONMENT, AND FUNGICIDE USE PATTERNS IN
ALGORITHMS FOR IMPROVING CONTROL OF SCLEROTINIA BLIGHT OF
PEANUT**

by

David Barnes Langston, Jr.

Dissertation submitted to the Faculty

of the Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

the Department of Plant Pathology, Physiology and Weed Science

APPROVED:

Patrick M. Phipps, Co-chairman

R. Jay Stipes, Co-chairman

Anton B. A. M. Baudoin

Charles W. Swann

R. Walton Mozingo

Charles Hagedorn

April 9, 1998

Blacksburg, Virginia

Key Words: Disease Forecasting, Sclerotinia, Peanut

**THE ROLE OF HOST, ENVIRONMENT, AND FUNGICIDE USE PATTERNS IN
ALGORITHMS FOR IMPROVING CONTROL OF SCLEROTINIA BLIGHT OF
PEANUT**

by

David Barnes Langston, Jr.

Patrick M. Phipps, Co-chairman

R. Jay Stipes, Co-chairman

Plant Pathology, Physiology and Weed Science

(ABSTRACT)

An algorithm was developed for assessing disease risk and improving fungicide timing for control of Sclerotinia blight of peanut, caused by *Sclerotinia minor*. A 5-day index (FDI) of disease risk was calculated daily by multiplying indices of moisture, soil temperature, vine growth and canopy density and summing the values for the previous 5 days. Spray thresholds of FDI 16, 24, 32, 40, 48 were compared to a 60, 90, 120 DAP (days after planting) schedule and the standard demand program. Field trials in 1994 indicated that fluazinam (0.58 kg a.i./ha) applied at an FDI of 32 performed similarly to the demand program and was more efficient than the DAP schedule. However, the original FDI 32 algorithm triggered sprays 13 days subsequent to disease onset in 1995, indicating the need for improved vine growth and temperature parameters as well as DAP-dependent FDI thresholds. Results from 1996 and 1997 demonstrated that algorithms with new vine growth and temperature parameters coupled with DAP-dependent thresholds performed as well or better than the original FDI 32 algorithm, demand program, or DAP schedule. Protection intervals of 7 and 14 days improved the performance of iprodione (1.12 kg a.i./ha) while fluazinam provided protection for up to 21 days when applied according to the original FDI 32 algorithm. Planting date was evaluated for its effect on disease and fungicide use

patterns. Late planting (20-28 May) delayed disease onset and reduced early season disease incidence three of the four years tested. When averaged across planting dates, the original FDI 32 algorithm performed as well or better than the demand program in 1994 and 1995, as did algorithms utilizing new vine growth and temperature parameters with DAP-dependent thresholds in 1996 and 1997. Chemicals for altering plant architecture were compared to defoliation by corn earworm and leaf spot for suppression of Sclerotinia blight. Chlorimuron (8.8 g a.i./ha) and withholding fungicide for leaf spot control demonstrated the most significant disease suppression and yield improvement. Results show the importance of fungicide timing and plant growth and canopy architecture modification for control of Sclerotinia blight of peanut.

ACKNOWLEDGEMENTS

The author would like to express thanks to many people who made the completion of this Ph.D. program possible. I would first like to recognize my major advisor, Dr. Patrick M. Phipps, for giving me the opportunity to further my education and for his patience and guidance through my doctoral program. Dr. Phipps motivated and challenged me to excel beyond my own expectations. Dr. Phipps provided me with resources from his well-funded research program and with an important and challenging research project. I gained much knowledge when Dr. Phipps willingly shared his experiences with me concerning the responsibilities of the land grant university and the personnel who carry out its mission.

While attending classes in Blacksburg, VA, I had the great fortune of having Dr. R. Jay Stipes as my on-campus advisor. Dr. Stipes guided me through the rigors of my graduate studies at Blacksburg and I garnered much from our frequent discussions on life and the profession of plant pathology. When the trials and tribulations of graduate school would seem unbearable, Dr. Stipes was always there to offer support. Jean Ratliff also deserves a special thanks for the kindness and assistance she provided during my stay in Blacksburg. I would also like to recognize the other members of my graduate committee, Drs. Anton Baudoin, Charles Hagedorn, Charles Swann and Mr. Walt Mozingo for their friendship and guidance.

My sincere appreciation is extended to the faculty and staff at the Tidewater Agricultural Research and Extension Center for their friendship and assistance, and for making me feel at home. Special recognition must be given to Barron Keeling, Steve Byrum, Ed Hobbs, Dee Dee Belcher and Gail Umphlett White for their involvement with the technical aspects of my research. The completion of this Ph.D. program would not have been possible without their help. I would also like to thank my fellow graduate students for their friendship and support. Their help was instrumental to my success in many of my classes. I would also like to recognize Ms. Beth Ward for her encouragement and moral support during the writing of this dissertation.

Finally, I would like to thank my family for their encouragement, financial assistance, and their belief in my abilities. All that I am, I owe to them. A special thanks goes to my late mother, Mrs. Catherine E. Langston, to whom I have dedicated this dissertation. I would not be writing these words if it were not for her love and belief in me.

TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGEMENTS iv

CHAPTER 1. INTRODUCTION AND OBJECTIVES 1

 Literature Cited 7

CHAPTER 2. ALGORITHMS FOR PREDICTING OUTBREAKS OF SCLEROTINIA
BLIGHT OF PEANUT AND IMPROVING THE EFFICIENCY OF FUNGICIDE
SPRAYS 15

 Introduction 15

 Materials And Methods 17

 Results 21

 Discussion 34

 Literature Cited 38

CHAPER 3. THE EFFECT OF PLANTING DATE ON SCLEROTINIA BLIGHT OF
PEANUT AND PERFORMANCE OF ALGORITHMS FOR FUNGICIDE
APPLICATION 42

 Introduction 43

 Materials And Methods 44

 Results 47

 Discussion 57

 Literature Cited 60

CHAPTER 4. EFFECT OF PLANT GROWTH AND CANOPY MODIFIERS ON

SCLEROTINIA BLIGHT OF PEANUT	64
Introduction	65
Materials And Methods	66
Results	69
Discussion	80
Literature Cited	83
APPENDIX A. SUMMARY OF CROP CULTURAL AND MANAGEMENT PRACTICES	88
APPENDIX B. SUMMARY OF CROP MANAGEMENT PRODUCTS	114
VITA	117

LIST OF ILLUSTRATIONS

- Figure 1. Relationship between disease risk as determined by the original FDI algorithm to the onset and development of Sclerotinia blight of peanut at locations A and B in 1994. 23
- Figure 2. Relationship between disease risk as determined by the original FDI algorithm to the onset and development of Sclerotinia blight of peanut at locations A and B in 1995. 26
- Figure 3. Relationship between disease risk as determined by the original FDI algorithm to the onset and development of Sclerotinia blight of peanut at locations A, B, and C in 1996. 29
- Figure 4. Relationship between disease risk as determined by the original FDI algorithm to the onset and development of Sclerotinia blight of peanut at locations A, B, and C in 1997. 32
- Figure 5. Effect of planting date on the onset and progress of Sclerotinia blight of peanut. 48
- Figure 6. Relationship between disease risk (FDI), as determined by the Virginia Sclerotinia blight advisory algorithm, to the onset and development of Sclerotinia blight at the Tidewater Agricultural Research and Extension Center Farm (TAREC) in 1995. A) Untreated check and B) paraquat treated. 71
- Figure 7. The effect of plant growth/canopy modifiers with and without fluazinam and iprodione on A) disease incidence at harvest (DIH), B) area under the disease progress curve (AUDPC), and C) yield at the Tidewater Agricultural Research and Extension Center Farm (TAREC) in 1995. Bars with the same letter(s) are not significantly different at $P \leq 0.05$ according to the Waller-Duncan *k*-ratio *t* test. 73
- Figure 8. Relationship between disease risk (FDI), as determined by the Virginia Sclerotinia blight advisory algorithm, to the onset and development of Sclerotinia blight at the Tidewater Agricultural Research and Extension Center Farm (TAREC) in 1996. A) Standard leaf spot control and no plant growth/canopy modifiers, B) chlorimuron and C) paraquat and no leaf spot control. 77
- Figure 9. The effect of plant growth/canopy modifiers with and without fluazinam and iprodione on A) disease incidence at harvest (DIH), B) area under the disease progress curve (AUDPC), and C) yield at the Tidewater Agricultural Research

and Extension Center (TAREC) Farm 1996. Bars with the same letter(s) are not significantly different at $P \leq 0.05$ according to the Waller-Duncan k -ratio t test. 78

LIST OF TABLES

Table 1.	Parameters and risk indices used to calculate the risk of Sclerotinia blight of peanut.	19
Table 2.	Comparison of original FDI algorithm thresholds, DAP, and demand programs for timing sprays with fluazinam at 0.58 kg a.i./ha for control of Sclerotinia blight of peanut in 1994 and 1995.	24
Table 3.	A comparison of FDI algorithms for determining the optimum timing of fungicide sprays with fluazinam at 0.58 kg a.i./ha for control of Sclerotinia blight of peanut in 1996.	30
Table 4.	A comparison of FDI algorithms for determining the optimum timing of fungicide sprays with fluazinam at 0.58 kg a.i./ha for control of Sclerotinia blight of peanut in 1997.	33
Table 5.	Comparison of protection intervals provided by sprays of iprodione and fluazinam for control of Sclerotinia blight of peanut.	35
Table 6.	Effect of planting date on vegetative growth of peanut (1994-1997). ...	49-50
Table 7.	Effect of planting date on disease incidence at harvest (DIH), area under the disease progress curve (AUDPC), and pod yield of peanut.	51
Table 8.	Effect of fungicide spray programs on disease incidence at harvest, area under the disease progress curve, and pod yield averaged across planting dates in 1994 and 1995.	52
Table 9.	Growth stages of peanut in each planting date from 1995 to 1997.	53
Table 10.	Effect of fungicide spray program on disease incidence at harvest, area under the disease progress curve, and pod yield averaged across planting dates in 1996 and 1997.	56
Table 11.	Effect of herbicides and plant growth regulators on peanut mainstem height and the distance between vines in adjacent rows at the Tidewater Agricultural Research and Extension Center (TAREC) Farm in 1995.	72
Table 12.	Effect of herbicides and plant growth regulators on peanut mainstem height and the distance between vines in adjacent rows in 1996.	75

Table 13. Effect of plant growth/canopy modifiers on disease incidence, area under the disease progress curve (AUDPC), and yield of peanut in 1996. 79