EVALUATION OF PEANUT HYBRIDS FOR REACTION TO EARLY LEAFSPOT PATHOGEN (*CERCOSPORA ARACHIDICOLA*)

By

JOHN PALMER BEASLEY, JR.

Bachelor of Science in Agriculture

Auburn University

Auburn, Alabama

1979

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1981

EVALUATION OF PEANUT HYBRIDS FOR REACTION

TO EARLY LEAFSPOT PATHOGEN

(CERCOSPORA ARACHIDICOLA)

Thesis Approved:

James S. Kirby
Thesis Adviser

Robert L. Westerman

H. A. Melouk

Donald J. Banks

Norman N Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

The author wishes to express his sincere gratitude to his major adviser, Dr. J. S. Kirby, and thank him for all his help and guidance during this course of study. The author also wishes to thank Dr. H. A. Melouk for his advice and help and especially for the use of his lab and greenhouse area. Sincere appreciation is also extended to Dr. D. J. Banks for his service on the advisory committee and the use of his greenhouse and materials. The author also wishes to thank Dr. R. L. Westerman for serving on the advisory committee and to all of the above for their suggestions and advice in reviewing this manuscript.

The author wishes to thank Dr. Paul Santelmann and the Agronomy Department of Oklahoma State University for their financial support and for the use of their equipment and facilities.

A special thanks is extended to Camille Tindall for typing this manuscript.

The author wishes, most of all, to thank Roy Pittman for his help, friendship, and encouragement during this time.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

The peanut or groundnut (Arachis hypogaea L.) is an important cash crop in Oklahoma and other southern states (14). It is also an important source of food and energy in many parts of the world (12). The peanut is cultivated principally for the kernels which are high in protein (25-30 percent) and oil (45-50 percent).

Woodroof (26) concluded that early leafspot disease (caused by Cercospora arachidicola Hori) and late leafspot (caused by Cercosporidium personatum (Beck and Curtis) Deighton) are prevalent in all countries in which peanuts are grown commercially. Woodroof also noted that early leafspot is probably more common than late leafspot.

In Oklahoma, it was estimated that 3.75 percent of the total peanut crop in 1979 was lost to leafspot, accounting for approximately 13.5 million pounds and 2.8 million dollars (25). Yield losses due to leafspot are estimated to be from 15 percent to 50 percent in many areas of the world (8).

Although peanut leafspots are successfully controlled by fungicides in the United States, the cost is significant and may be higher, relative to other costs, in other peanut-producing areas (1). Therefore, development of resistant cultivars is a worthwhile objective.

The purpose of this study was to evaluate several crosses between an early leafspot resistant germplasm and commercially acceptable

varieties and experimental lines from Oklahoma for reaction to C. arachidicola. PI 109839 was chosen as the resistant germplasm based on trials by Sowell et al. (24) in Georgia. Release of PI 109839 as a Cercospora leafspot resistant germplasm was made in 1979 (7).

CHAPTER II

LITERATURE REVIEW

Occurrence and Symptoms of Cercospora Leafspot on Peanuts

Leafspots of peanut caused by Cercospora arachidicola Hori and Cercosporidium personatum (Beck and Curtis) Deighton occur wherever peanuts (Arachis hypogaea L.) are grown (2, 4, 6, 12, 25, 26). Woodroof (26) reported large acreages of peanuts grown in southeastern United States, South Africa, parts of South America, the West Indies, Philippine Islands, Japan, India, Australia, Java, Italy, and in China and the prevalence of Cercospora leafspots is shown by the fact that they are mentioned in literature from all of these countries.

Economic losses from Cercospora leafspot are estimated to be from 15 to 50 percent of the yield in many areas of the world (12). In Oklahoma, losses due to Cercospora leafspot in 1979 were estimated to be 3.75 percent of the yield amounting to 13.5 million pounds and 2.8 million dollars (25).

Resistance to C. arachidicola and C. personatum is apparently inherited independently. Selections, very resistant to one, are often extemely susceptible to the other (4, 9, 10). Members of the genus Arachis are the only commonly reported hosts for the two pathogens (12). The "Spanish" type is invariably recorded as susceptible or very

susceptible, whereas runner varieties show some degree of resistance (9). All known varieties of the cultivated peanut are susceptible to each pathogen although they vary in the degree of susceptibility (4).

The development of a peanut variety resistant to Cercospora leafspot should be considered an objective in a peanut breeding program because of the worldwide importance of the disease. Although peanut leafspots are successfully controlled by fungicides in the United States, the cost of fungicides and fungicide application is significantly higher relative to other costs in peanut production (2). Considerable research to develop leafspot-resistant cultivars has been done, although there are presently no cultivars with high levels of leafspot resistance (5). Sources of resistance to the leafspots have been found in certain wild species of peanuts. However, improved varieties of peanuts have not yet been derived from these sources (Banks, personal communication).

Symptoms characteristic of the diseases vary greatly depending on the host species, variety, and weather conditions following infection (12).

Initial infection of leafspot can occur as early as 16 to 22 days after the peanut seedling emerges from the soil (22). Lyle (18) reported the greatest numbers of conidia were detected during a period of abundant moisture and high minimal (72 F) and maximal (93.7 F) temperatures. Sturgeon (25) in 1979 reported that both early leafspot and late leafspot did not become a problem in most fields until late August or early September in Oklahoma. Kornegay et al. (15) reported that early leafspot usually becomes visible in mid-July and late leafspot does not appear until late August in North Carolina. When peanuts follow peanuts

in a crop rotation, it is agreed that both early and late leafspot occur earlier and are more serious (12, 22). Jenkins (13) reported that cool, humid weather during the epiphytotic months favor the spread and development of the leafspot disease. Miller (22) stated that the rapid spread of Cercospora leafspot may be correlated with periods of heavy rainfall. Miller (22) also reports that late leafspot reaches epiphytotic proportions the middle of September, or about three weeks later than early leafspot.

The amount of infection and the extent to which the early infection spreads depend on the age of the plants, rate of early plant growth, methods of cultivation used to control early weed development, frequency of rainfall, and the peanut rotation cycle (22).

Leaflets that are severely infected with the Cercospora leafspot pathogens lose their vigor and usually drop from the plant (21).

Lesions on leaflets infected by C. arachidicola first appear as small chlorotic spots (12). Later, the subcircular lesions appear to enlarge, become brown to black, and range from 1 to 10 mm or more in diameter (12). While all parts of the plant are subject to attack, symptoms on the leaflets are more striking and, perhaps, more destructive (13). Jenkins (13) and Woodroof (26) reported a chlorotic halo surrounding each lesion. The halo is thought to be a characteristic feature, but it is not always present and may be a function of varietal reaction (12) or, as Jenkins (13) noted, nutrition. If halos are present, they are more distinct on the adaxial leaflet surface (12). At maturity, the leafspots appear as distinct necrotic areas, circular to irregular in shape. They range in diameter from 1 mm to 1 cm or more, with a yellow halo that may vary in width.

Jenkins (13) reported that conidia have been observed to germinate within 3 to 8 hours when moisture, oxygen, and temperature conditions were ideal. Germ-tubes emerge from the terminal cell at either or both ends of the spore, and often from other cells as well. When completely covered by water, so that oxygen supply is diminished, the spores rarely germinate at all, but often the cells become distorted through swelling (13).

Conidia of C. arachidicola and C. personatum germinate to form one to several germ-tubes which grow over the leaf surface and through open stomata (12). Hemingway (9) reported that the great majority of leaf infections originate through the upper epidermis, but germ-tube penetrations were found to have occurred through the stomata. Penetration may also occur directly through the lateral faces of epidermal cells (13).

After the germ-tubes enter a leaflet, they branch and develop inside the leaf and feed on its vital juices. The leaf tissue in the area where the fungus develops is gradually killed, and it is this dead tissue, together with the fungal mycelium and spores, that forms the characteristic brown spot on the leaf (21).

With C. arachidicola, the intercellular mycelium kills cells in advance of its growth and hyphae then become intracellular (13). C. personatum, in contrast, does not kill cells in advance of its intercellular hyphae but produces haustoria within host cells (12, 13, 26).

Abdou et al. (2) reported that there were no penetrations from the germ-tubes which were directed to the epidermal cell wall. This indicated that C. arachidicola and C. personatum normally penetrate the peanut leaflet only through open stomata.

Inoculum Production - Natural and Artificial

The source of inoculum for early infection in the field is from conidia or ascospores produced in or on peanut debris in the field (12). These spores may be carried to peanut leaves by wind, rain, animals, insects, implements, contaminated seed, and manure (21). Once they have reached the leaves, the spores germinate under moist conditions and the spores send out germ-tubes (21). Temperatures of 26 to 31 C marked by only slight diurnal variations and long periods of high relative humidity are favorable for infection (12).

A characteristic of many Cercospora species is that they sporulate sparingly, if at all, on standard laboratory media (2). Cercospora arachidicola and Cercosporidium personatum grow very slowly and produce few conidia on potato-dextrose agar (1, 16). Abdou and Cooper (1) found that C. arachidicola sporulated on peanut leaflet extract, oatmeal, lima bean, and mycophil agar media. Landers (17) developed a media composed of five percent wheat starch for large-scale production of inoculum.

Preliminary tests indicated that C. arachidicola sporulated normally in both continuous light and continuous darkness. On the other hand, C. personatum produced no conidia if grown in complete darkness, even when the medium was favorable for sporulation (1).

Smith (23) reported that 10-15 POA (Peanut Oatmeal Agar) plates produced enough conidia to inoculate all leaves of 400 three-week-old plants.

Evaluation Method

Developing peanut varieties with resistance or tolerance to Cercospora leafspot is an objective of Oklahoma State University and USDA peanut breeders (3). Melouk and Banks (19, 20) developed a method of screening peanut genotypes for resistance to Cercospora leafspot. The method involves a detached leaf technique and has many advantages. It is rapid; it conserves space, plant material, and inoculum; and it gives greater control over the environment (5). Two disadvantages of the detached leaf technique is that it is highly artificial and disease reactions obtained in the greenhouse may differ from those found in the field (5).

Foster et al. (5) reported that the performance of an entry was similar regardless of whether young or old leaves or weathered or non-weathered leaves were used. Therefore, either young or old leaves or weathered or non-weathered leaves may be used for the detached leaf technique as long as the choice of material is consistent for each genotype being compared.

According to Foster et al. (5), there was also a significant correlation between leafspot resistance measured in the field and that measured by the detached leaf method.

Resistant Germplasm

Peanut PI 109839 was resistant to C. arachidicola in greenhouse screening tests and in five field tests conducted by Sowell et al. (24). PI 109839 was released as a germplasm source of resistance to early leafspot in the southeastern United States (24).

PI 109839 is a long-season, small-seeded peanut with spreading growth habit (7). Yield of PI 109839 was significantly less than that of any United States cultivar, ranging from 50 percent that of 'Argentine' to 40 percent that of 'Florunner' (7). Low yield, late maturity and small seed size make PI 109839 unsuitable for use as a commercial variety.

CHAPTER III

MATERIALS AND METHODS

Seed of nine peanut genotypes were planted on November 29 and 30, 1979, in a soil-sand mixture in 10.16 cm clay pots and placed in the greenhouse. Six of the nine genotypes were of the Spanish botanical type and included three released cultivars, 'Chico', 'Comet', and 'Pronto' and three experimental lines, EC-5, EC-7, and O-20. The remaining three genotypes were of the Virginia botanical type and included the two cultivars 'Early Bunch' and 'Florunner' and the leafspot resistant PI 109839. On January 14, 1980, four plants of each genotype, except PI 109839, were repotted in 20.32 cm clay pots. Thirty-six of the PI 109839 plants were repotted to assure enough pollen parents and female parents for crosses with the other eight genotypes.

On January 15, 1980, all of the plants were placed in growth chambers in the CERL (Controlled Environment Research Lab). Three plants of each genotype other than PI 109839 were placed in one chamber and designated to be female parents while one plant of each genotype was placed in a separate chamber and designated to be male parents. Twenty-four of the PI 109839 plants were placed in the chamber designated for females and twelve were placed in the pollen parent chamber.

Both chambers were set with a temperature range of 20 C at night and 25.6 C during the day. The day-night schedule was 12 hours of light and 12 hours of dark. The chambers were set to have reverse

day-night schedules so that emasculating and crossing could be done in a quick and efficient manner (Banks, personal communication).

Each 20.32 cm pot in both chambers was fertilized with 0.47 l of liquid fertilizer made up of 3 g of 21-7-7 plus 0.26 ml of Peter's Trace Element Mix per liter of water. The chambers were also sprayed for spider mites, when needed, using Pentac WP Miticide at 0.65 ml per liter of water, Morestan 25 percent WP at 1.30 ml per liter of water, Orthene at 1.30 ml per liter of water, or Kelthane at 22.59 ml per liter of water. The chambers were sprayed with Malathion 25 WP at 2.61 ml per liter of water for mealy bug control.

On January 18, 1980, flowers began to appear on some of the plants. All flowers were removed at an immature stage until there were enough flowers blooming to attempt crossing. The first crossing attempts were made February 1, 1980, and continued until April 4, 1980. The following crosses and their reciprocals were made: Chico x PI 109839, Comet x PI 109839, Pronto x PI 109839, EC-5 x PI 109839, EC-7 x PI 109839, O-20 x PI 109839, Early Bunch x PI 109839, and Florunner x PI 109839. Approximately 25 to 30 attempts at crossing were made per plant during a two to four week period. After these attempts were made, any extra flowers that bloomed were removed for a period of two weeks. Each plant was allowed 60 days to mature after the last attempt at pollination.

After all plants were harvested, the pods were allowed to dry and then shelled. The seeds were packaged and treated with Captan and Ethrel to prevent seedling diseases and help break dormancy.

The F_1 seeds were planted on a Teller loam (Fine-loamy, mixed, thermic Udic Argiustoll) at the Perkins Research Station near Perkins, Oklahoma, on June 4, 1980. Sixty plots were planted consisting of

three plots each of 16 crosses, four plots of PI 109839, and one plot each of the other eight parents. Each plot was 3.05 m long and there were 10 seeds per plot, planted 30.48 cm apart in the row. There were 20 rows and three ranges with a 1.52 m alley between ranges. The entries were planted at random using a corn hand jab-planter. The rows were planted in a north-south direction and were irrigated every 10 to 14 days. The plots were cultivated as needed.

A field evaluation of Cercospora leafspot infection was to be conducted but, because of the hot, dry summer, adequate field infection did not occur. Spore sampling in the field was conducted using a seven-day volumetric suction-type drum spore trap. Concentration of spores was low in July and August, but reached moderate levels in September. It was hypothesized that the higher than normal daily temperatures reduced infection (Melouk, personal communication).

After the failure of natural field infection with leafspot, a greenhouse technique developed by Melouk and Banks (20) was used but was modified to use three-leaf shoots instead of a detached leaf. This technique involved taking peanut plant cuttings of approximately the same vegetative stage of growth and inserting them in Hoagland's solution (11) in a 1 x 14 cm test tube, inoculating them with a spore suspension of C. arachidicola, and placing them in a clear plastic chamber in the greenhouse for three weeks.

In the six Spanish x Virginia crosses (Chico, Comet, Pronto, EC-5, EC-7, and O-20 females x PI 109839 male), where the F_1 hybrid could be determined visually, four cuttings from each cross were taken at random from plants in the field and were placed in separate chambers for the greenhouse test. In the four Virginia x Virginia crosses (Early Bunch

and Florunner x PI 109839, and the two reciprocals) and the six reciprocal crosses of PI 109839 x Spanish, where the F_1 hybrid could not be determined, two cuttings were taken from each plant in the field and placed in separate chambers in the greenhouse. Sixteen cuttings of PI 109839 and four cuttings from each of the other parents were taken at random and placed in separate chambers to check parental response to infection.

Each chamber was 60.96 cm wide by 91.44 cm long x 60.96 cm high and covered with clear polyethylene plastic. A burlap bag was placed on the bottom of the chamber and wet periodically to keep the humidity above 95 percent. The chambers were placed underneath a greenhouse bench and the temperature in the chambers varied with the temperature in the greenhouse which ranged from 16 to 33 C.

The first cuttings, which included all plots in range one only, were taken on September 29, 1980. Both surfaces of each leaflet on the cuttings were sprayed with inoculum on September 30, 1980, utilizing a DeVilbiss atomizer. The inoculum, containing 20,000 conidia/ml, was obtained from infected leaflets collected from a Plant Pathology research field west of Stillwater.

To prepare the inoculum, infected leaflets were collected and placed on moist paper in a petri dish. They were placed under light for 48 hours to sporulate. The leaflets were then placed in a 1000 ml beaker and 100 ml of distilled water mixed with two drops of liquid soap were poured over the leaflets. The soap kept the spores in suspension. The leaflets and water were briskly stirred to get the spores into suspension. The water was then strained through cheese cloth into another beaker. Two drops of conidial suspension were then

placed on a hemacytometer slide to determine the number of conidia per milliliter.

The second cuttings, which included all plots in ranges two and three, were taken on October 1, 1980, and inoculated on October 6.

The leaflets were evaluated 21 days after inoculation. Evaluation of the leaflets included counting the number of lesions per leaflet and determining the percent defoliation by counting the number of detached leaflets per cutting.

On November 19th and 20th, 1980, the F_1 plants in the field were harvested individually. Each plant was put in a paper bag and placed in a low-temperature dryer. Later they were hand-threshed and the F_2 seeds were placed in storage.

CHAPTER IV

RESULTS AND DISCUSSION

Results of each genotypic reaction to the C. arachidicola pathogen are presented in Tables I - VIII. None of the 16 crosses exhibited resistance to C. arachidicola. Overall, the Chico x PI 109839 cross (Table III) looked best with an average of 4.67 lesions/leaflet and 18.75 percent defoliation. The PI 109839 x EC-7 cross (Table II) had the lowest number of lesions/leaflet with an average of 3.08. Comet x PI 109839 (Table VII) had the lowest percent defoliation with 12.50 percent.

Although Florunner x PI 109839 (Table I) had the ninth highest lesions/leaflet average (8.05) and was third in percent defoliation (25.42 percent), there was one cutting from the Florunner x PI 109839 cross that appeared to exhibit good resistance. It had an average of only 0.63 lesions/leaflet with no defoliation. This plant could either be resistant or a possible escape. During inoculation of the cuttings, it could possibly have been overlooked. F_2's from this plant will be tested for resistance in the future.

The initial objective of this study was to conduct a field evaluation using only naturally occuring inocula. Because of the severe heat and drought in the summer of 1980, little field infection occurred. Conidial spores of C. arachidicola were sampled from the air by a spore trap (Melouk, personal cummunication), but apparently the high daily

temperatures (38^{+}C) prevented infection. A greenhouse evaluation was pursued after the failure to get adequate field infection. The greenhouse evaluation technique has shown a high correlation with field studies (5).

For the greenhouse evaluation, shoot cuttings of similar vegetative stages were dipped in a bucket of water to wash off any materials already on the leaflets. The shoots may still have had some infection prior to inoculation in the greenhouse.

When the shoots were cut on September 29th and October 1st, many of the early-maturing varieties and lines had reached physiological maturity. However, in the greenhouse test, Chico, the earliest maturing parent, had the least defoliation (4.17 percent) (Table IX) while Florunner and Early Bunch, the latest maturing parents, had the seventh and ninth (out of nine parents) highest defoliation (31.25 percent and 54.17 percent), respectively. Thus, defoliation in this study apparently was not based on maturity of the plants.

The major finding in this study was that PI 109839, the resistant germplasm, did not exhibit strong resistance to C. arachidicola as had been expected. Of the nine parental lines tested, PI 109839 had the fourth lowest number of lesions/leaflet with 3.89 and second lowest percent defoliation with 8.33. Sowell et al. (24) reported PI 109839 exhibited resistance to early leafspot in field experiments in Georgia. One of the theories behind PI 109839 showing field resistance is that it produces an abundance of leaves during the growing season. Because of its late maturity, it is holding its leaves when most other varieties are not. In the present greenhouse study, PI 109839 did hold its

leaflets well even though there were more lesions/leaflet than had been expected. There is also the possibility of having different races of C. arachidicola in Georgia and Oklahoma.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objective of this study was to transfer resistance to C. arachidicola from PI 109839 to commercially acceptable varieties.

None of the 16 hybrids evaluated showed measurable resistance to C. arachidicola. In most cases the hybrid was more susceptible than the parents used in the cross.

PI 109839, the parent used as a source of resistance, did not exhibit resistance under our method of evaluation. However, researchers at the Georgia Agricultural Experiment Station (personal communication) still report PI 109839 to be resistant to early leafspot in field studies. Disease reactions of growing plants compared with detached leaves or different strains of Cercospora arachidicola in Georgia compared with Oklahoma could possibly explain the contrasting results.

The method of evaluation (19) used in this study appears to be valid based on other studies and possibly could be used to screen peanut germplasm for higher levels of resistance to early leafspot than that found in PI 109839. The method is fast and can handle a large number of entries at one time. Results obtained from using the method have been highly correlated with field results in other studies (5).

Based on this study, other plant introductions should be screened for sources of leafspot resistance. The F_2 generations from the F_1 hybrids evaluated in this study should be evaluated for leafspot

development to determine if transgressive segregates for improved C. arachidicola resistance could be identified. If possible, the evaluation should be conducted under field conditions, since field tolerance is the ultimate goal, but also under greenhouse conditions utilizing the detached cuttings as described herein to obtain additional comparisons of the two evaluation methods.

LITERATURE CITED

1. Abdou, Yousef A-M. and William Earl Cooper. 1974. Effect of culture medium and light on sporulation of two peanut leaf spotting fungi, Cercospora arachidicola Hori and Cercosporidium personatum (Beck & Curtis) Deighton. Peanut Sci. 1:11-14.

2. _____, W. C. Gregory, and W. E. Cooper. 1974. Sources and nature of resistance to Cercospora arachidicola Hori and Cercosporidium personatum (Beck & Curtis) Deighton in Arachis species. Peanut Sci. 1:6-11.

3. Banks, D. J. and H. A. Melouk. 1977. Breeding for peanut leafspot resistance. Okla. Agric. Exp. Stn. Prog. Rep. P-755, 4 pp.

4. Cooper, W. E. and W. C. Gregory. 1960. Radiation-induced leaf spot resistant mutants in the peanut (Arachis hypogaea L.). Agron. J. 52:1-4.

5. Foster, D. J., J. C. Wynne, and M. K. Beute. 1980. Evaluation of detached leaf culture for screening peanuts for leafspot resistance. Peanut Sci. 7:98-100.

6. Gibbons, R. W. and B. E. Bailey. 1967. Resistance to Cercospora arachidicola in some species of Arachis. Rhodesia J. Agric. Res. 5:57-59.

7. Hammons, Ray O., Grover Sowell, Jr., and D. H. Smith. 1979. Notice of release of PI 109839 peanut germplasm. Georgia Agric. Exp. Stn., Experiment and Tifton, Ga. USDA, SEA, AR, Washington, D. C.

8. Hassan, Haji Nik and M. K. Beute. 1977. Evaluation of resistance to Cercospora leafspot in peanut germplasm potentially useful in a breeding program. Peanut Sci. 4:78-83.

9. Hemingway, J. S. 1957. The resistance of groundnuts to Cercospora leafspots. Empire J. Exp. Agr. 25:60-68.

10. Higgins. B. B. 1935. Breeding peanuts for disease resistance (Abstract). Phytopathology 25:971-972.

11. Hoagland, D. R. and D. I. Arnon. 1950. Calif. Agric. Exp. Stn. Circ. 374. 32 pp.

12. Jackson, Curtis R. and Durham K. Bell. 1969. Diseases of peanut (groundnut) caused by fungi. Univ. of Georgia, College of Agric. Exp. Sta. Res. Bull. 56. 137 pp.

13. Jenkins, Wilbert A. 1938. Two fungi causing leaf spot of peanut. J. Agr. Res. 56:317-332.

14. Khan, B. M. 1973. Breeding peanuts (Arachis hypogaea L.) for resistance to Verticillium wilt. Ph.D. thesis, Oklahoma State University, Stillwater, Oklahoma.

15. Kornegay, Julia L., M. K. Beute, and J. C. Wynne. 1980. Inheritance of resistance to Cercospora arachidicola and Cercosporidium personatum in six Virginia-type peanut lines. Peanut Sci. 7:4-9.

16. Landers, Kenneth E. 1964. Method for production of inoculum of Cercospora arachidicola. J. Ala. Acad. Sci. 35:17.

17. _____. 1964. Growth of Cercospora arachidicola in glucose-phosphate-asparagine-thiamine-agar medium. Phytopathology 54:1236-1239.

18. Lyle, J. A. 1964. Development of Cercospora leafspot of peanut. J. Ala. Acad. Sci. 35:9.

19. Melouk, H. A. and D. J. Banks. 1977. Screening for resistance of peanut genotypes to Cercospora leafspot by a detached leaf technique. Proc. Am. Peanut Res. and Ed. Assoc. 9:14, (Abstr.).

20. _____ and _____. 1978. A method of screening peanut genotypes for resistance to Cercospora leafspot. Peanut Sci. 5:112-114.

21. Miller, Lawrence I. 1942. Peanut leafspot and leafhopper control. Va. Agr. Exp. Sta. Bull. 338. 24 pp.

22. _____. 1946. Peanut leafspot control. Va. Agr. Exp. Sta. Tech. Bull. 104. 85 pp.

23. Smith, D. H. 1971. A simple method for producing Cercospora arachidicola conidial inoculum. Phytopathology 61:1414.

24. Sowell, Grover, Jr., D. H. Smith, and R. O. Hammons. 1976. Resistance of peanut plant introductions to Cercospora arachidicola. Plant Disease Reporter 60(6):494-498.

25. Sturgeon, R. V., Jr. 1979. Oklahoma peanut disease loss estimates for 1979. O.S.U. CR-7178.

26. Woodroof, Naomi C. 1933. Two leaf spots of the peanut (Arachis hypogaea L.). Phytopathology 23:627-640.

APPENDIX

TABLE I

LESIONS/LEAFLET AND DEFOLIATION OF FLORUNNER X PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 22-01		22	10.77	8.57	8.34
JB 22-02		23	10.39	6.01	4.17
JB 22-03		23	12.61	8.70	4.17
JB 22-04	Florunner	15	13.00	8.32	37.50
JB 22-05	x	17	10.47	7.71	29.17
JB 22-06	PI 109839	19	7.21	7.96	20.83
JB 23-01		24	0.63	1.31	0
JB 23-02		22	3.28	3.53	8.34
JB 24-01		19	7.31	5.71	20.84
JB 24-02		20	7.00	4.95	16.67
	Average		8.05		25.42
JB 46-01		21	8.38	6.88	12.50
JB 46-02		24	4.33	6.46	0
JB 46-03		23	5.57	6.20	4.17
JB 46-04		19	8.95	9.17	20.84
JB 47-01		17	13.53	7.24	25.00
JB 47-02	PI 109839	19	8.58	6.12	20.84
JB 47-03	x	16	9.00	8.74	33.33
JB 47-04	Florunner	17	5.29	2.80	29.17
JB 48-01		15	9.93	7.71	37.50
JB 48-02		19	12.26	7.79	20.84
JB 48-03		17	7.65	4.09	29.17
JB 48-04		15	9.67	6.82	37.50
	Average		8.39		25.70
JB 49-01		11	11.45	6.90	8.33
JB 49-03	Florunner	9	8.56	4.53	25.00
JB 49-06		11	5.45	4.63	8.33
JB 49-08		2	8.50	3.54	83.33
	Average		8.48		31.25
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 24 leaflets for each hybrid entry and 12 leaflets for each parental entry.

TABLE II

LESIONS/LEAFLET AND DEFOLIATION OF EC-7 X PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 16-03	EC-7	10	1.10	0.74	16.67
JB 16-04	x	4	4.00	1.41	66.67
JB 17-02	PI 109839	9	0.89	0.60	25.00
JB 18-09		12	6.08	5.30	0
	Average		3.09		27.09
JB 40-01		6	9.17	5.19	75.00
JB 40-02		18	2.89	4.63	25.00
JB 40-03		17	2.41	3.41	29.17
JB 40-04		14	3.13	4.52	41.67
JB 40-05		17	2.59	3.10	29.17
JB 40-06		15	2.80	2.68	37.50
JB 40-07		17	1.88	1.27	29.17
JB 41-01		18	3.71	2.81	25.00
JB 41-02	PI 109839	17	3.59	3.89	29.17
JB 41-03	x	23	5.09	3.73	4.17
JB 41-04	EC-7	9	9.33	3.64	62.50
JB 41-05		21	3.76	3.35	12.50
JB 42-01		17	1.76	1.79	29.17
JB 42-02		15	1.93	1.79	37.50
JB 42-03		20	1.55	2.48	16.67
JB 42-04		24	4.08	3.17	0
JB 42-05		24	2.79	2.34	0
JB 42-06		23	0.43	0.90	4.17
	Average		3.08		27.09
JB 55-01		11	13.28	9.89	8.33
JB 55-03	EC-7	12	1.67	1.83	0
JB 55-04		12	7.42	5.18	0
JB 55-05		4	5.50	1.73	66.67
	Average		7.10		18.75
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 12 leaflets for each parental entry and for each hybrid entry with EC-7 as female; 24 leaflets for hybrid entries with PI 109839 as female.

TABLE III

LESIONS/LEAFLET AND DEFOLIATION OF CHICO X PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 08-01	Chico	8	6.75	7.19	33.33
JB 08-02	x	11	6.45	5.37	8.33
JB 09-01	PI 109839	12	2.42	2.07	0
JB 09-06		8	3.50	2.27	33.33
	Average		4.67		18.75
JB 31-01		23	3.64	3.32	4.67
JB 31-02		16	2.69	2.52	33.34
JB 31-03		15	3.20	2.93	37.50
JB 31-04		20	4.30	4.91	16.67
JB 31-05		12	0.50	1.17	50.00
JB 31-06		10	3.10	2.69	58.34
JB 31-07		16	3.13	2.22	33.33
JB 31-08	PI 109839	16	2.38	2.96	33.33
JB 31-09	x	16	3.25	4.20	33.33
JB 33-01	Chico	22	9.18	5.10	8.33
JB 33-02		23	9.96	6.71	4.17
JB 33-03		18	11.94	16.66	25.00
JB 33-04		15	11.33	9.47	37.50
JB 33-05		11	4.09	3.41	54.17
JB 33-06		7	20.86	11.85	70.83
JB 33-07		13	6.92	5.96	45.83
	Average		5.54		36.46
JB 52-01		12	3.08	3.42	0
JB 52-03	Chico	12	2.33	2.50	0
JB 52-04		11	7.18	4.64	8.33
JB 52-07		11	9.64	4.34	8.33
	Average		5.34		4.17
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 12 leaflets for each parental entry and for each hybrid entry with Chico as female; 24 leaflets for hybrid entries with PI 109839 as female.

TABLE IV

LESIONS/LEAFLET AND DEFOLIATION OF EARLY BUNCH X PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 19-01		15	7.27	4.64	37.50
JB 19-02		8	9.25	5.28	66.67
JB 19-03		18	6.00	4.39	25.00
JB 19-04		6	10.00	6.36	75.00
JB 19-05		18	6.61	3.07	25.00
JB 19-06		18	7.33	3.07	25.00
JB 19-07		14	4.79	2.22	41.67
JB 20-01		11	8.64	3.00	54.17
JB 20-02		16	10.00	7.06	33.33
JB 20-03	Early Bunch	17	3.65	4.05	29.17
JB 20-04	x	17	5.76	4.73	29.17
JB 20-05	PI 109839	15	3.53	1.60	37.50
JB 20-06		19	7.47	5.16	20.83
JB 20-07		22	6.59	3.32	8.33
JB 20-08		15	6.73	4.59	37.50
JB 20-09		17	7.12	4.88	29.17
JB 21-01		24	3.21	3.45	0
JB 21-02		12	10.42	8.66	50.00
JB 21-03		18	10.44	8.89	25.00
JB 21-04		24	4.67	5.67	0
JB 21-05		8	12.00	6.50	66.67
JB 21-06		13	6.84	5.11	45.84
	Average		6.76		34.66
JB 43-01		23	4.91	4.84	4.17
JB 43-02		11	0.91	1.30	54.17
JB 43-03		23	4.17	4.68	4.17
JB 43-04		24	4.08	4.10	0
JB 43-05		14	1.36	1.00	41.67
JB 43-06		20	4.55	3.66	16.67
JB 43-07		13	3.08	3.57	45.84
JB 43-08		18	2.53	2.35	25.00
JB 43-09		20	4.55	4.99	16.67
JB 44-01	PI 109839	24	5.21	6/94	0
JB 44-02	x	22	7.45	6.71	8.33
JB 45-01	Early Bunch	21	5.90	4.35	12.50
JB 45-02		16	4.94	4.19	33.33
JB 45-03		20	4.75	3.63	16.67
JB 45-04		22	8.45	5.33	8.33
JB 45-05		11	6.55	3.75	54.17
JB 45-06		12	6.08	3.58	50.00
JB 45-07		12	5.58	5.73	50.00
JB 45-08		12	6.83	3.69	50.00

TABLE IV (Continued)

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 45-09		18	8.55	4.85	25.00
JB 45-10		5	8.60	6.54	79.17
	Average		5.03		28.38
JB 50-02		4	10.50	3.42	66.67
JB 50-02	Early Bunch	4	23.25	6.95	66.67
JB 50-03		11	7.00	3.44	8.33
JB 50-03		3	15.33	3.79	75.00
	Average		11.73		54.17
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 24 leaflets for each hybrid entry and 12 leaflets for each parental entry.

TABLE V

LESIONS/LEAFLET AND DEFOLIATION OF PRONTO X PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 04-05	Pronto	7	4.00	2.23	41.67
JB 04-06	x	4	1.00	1.41	66.67
JB 05-04	PI 109839	11	3.00	3.49	8.33
JB 06-07		8	23.00	12.78	33.33
	Average		8.30		37.50
JB 28-01		17	4.12	4.06	29.17
JB 28-02		16	3.75	3.07	33.34
JB 28-03		21	2.38	2.31	12.50
JB 28-04		9	3.44	2.07	62.50
JB 28-05		5	3.00	0.71	79.17
JB 28-06		17	8.59	5.42	29.17
JB 28-07		11	2.81	1.83	54.17
JB 29-01		21	8.38	8.20	12.50
JB 29-02		19	10.42	6.85	20.83
JB 29-03		17	9.76	4.33	29.17
JB 29-04	PI 109839	12	4.83	3.21	50.00
JB 29-05	x	21	7.14	5.88	12.50
JB 29-06	Pronto	10	5.60	4.09	58.34
JB 29-07		13	4.23	3.47	45.84
JB 29-08		14	6.64	3.60	41.67
JB 29-09		17	8.82	5.57	29.17
JB 29-10		22	10.59	6.91	8.34
JB 30-01		21	11.38	6.96	12.50
JB 30-02		20	6.81	5.02	16.67
JB 30-03		18	10.61	5.44	25.00
JB 30-04		16	2.31	2.55	33.33
JB 30-05		13	10.31	8.64	45.83
JB 30-06		12	3.83	2.89	50.00
JB 30-07		14	6.50	8,65	41.67
	Average		6.88		34.72
JB 53-01		9	2.33	2.87	25.00
JB 53-04	Pronto	12	4.00	2.89	0
JB 53-05		10	10.60	10.85	16.67
JB 53-06		8	4.50	1.19	33.33
	Average		5.41		18.75

TABLE V (Continued)

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 12 leaflets for each parental entry and for each hybrid entry with Pronto as female; 24 leaflets for hybrid entries with PI 109839 as female.

TABLE VI

LESIONS/LEAFLET AND DEFOLIATION OF EC-5 X PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 10-04	EC-5	8	3.12	3.76	33.33
JB 11-02	x	12	15.08	5.50	0
JB 11-03	PI 109839	10	12.80	7.89	16.67
JB 12-07		4	4.50	3.11	66.67
	Average		10.35		29.17
JB 34-01		23	3.74	4.12	4.17
JB 34-02		19	4.79	4.43	20.84
JB 34-03		14	8.07	6.62	41.67
JB 34-04		11	15.00	7.86	54.17
JB 34-05		15	11.67	8.61	37.50
JB 35-01		15	10.87	8.68	37.50
JB 35-02		18	7.28	6.48	25.00
JB 35-03		9	8.33	2.78	62.50
JB 35-04	PI 109839	14	8.07	4.97	41.67
JB 35-05	x	18	9.39	6.49	25.00
JB 35-06	EC-5	17	6.82	4.46	29.17
JB 35-07		18	5.94	5.31	25.00
JB 35-08		19	10.52	5.88	20.83
JB 35-09		18	3.56	2.93	25.00
JB 35-10		1	9.00	--	95.84
JB 36-01		20	9.20	5.82	16.67
JB 36-02		20	11.90	7.25	16.67
JB 36-03		5	4.60	2.61	79.17
JB 36-04		20	9.55	7.17	16.67
JB 36-05		22	13.68	9.67	8.33
JB 36-06		10	8.50	4.09	58.33
JB 36-07		20	13.52	9.91	16.67
JB 36-08		18	8.06	6.02	25.00
JB 36-09		17	9.65	3.23	29.17
	Average		8.85		33.86
JB 54-03		6	1.83	1.33	50.00
JB 54-05	EC-5	3	0.67	1.15	75.00
JB 54-06		12	5.33	7.82	0
JB 54-07		10	1.50	1.90	16.67
	Average		2.97		35.42

TABLE VI (Continued)

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 12 leaflets for each parental entry and for each hybrid entry with EC-5 as female; 24 leaflets for hybrid entries with PI 109839 as female.

TABLE VII

LESIONS/LEAFLET AND DEFOLIATION OF COMET X
PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 01-02	Comet	11	18.91	9.43	8.33
JB 02-04	x	9	6.89	4.23	25.00
JB 02-07	PI 109839	10	10.10	7.52	16.67
JB 03-04		12	7.92	6.80	0
	Average		11.09		12.50
JB 25-01		22	10.00	7.86	8.33
JB 25-02		21	9.38	7.12	12.50
JB 25-03		18	6.22	4.99	25.00
JB 25-04		22	6.09	4.61	8.33
JB 25-05		22	4.79	3.61	8.33
JB 25-07	PI 109839	10	6.00	3.27	58.34
JB 26-01	x	18	5.72	5.98	25.00
JB 26-02	Comet	20	4.05	4.83	16.67
JB 26-03		12	3.57	5.79	50.00
JB 26-04		8	3.63	3.89	66.67
JB 26-05		14	3.43	4.52	41.67
JB 27-01		20	10.50	8.57	16.67
	Average		6.45		28.21
JB 51-03		11	2.90	3.51	8.33
JB 51-05	Comet	8	2.00	2.33	33.33
JB 51-06		11	2.64	2.16	8.33
JB 51-07		12	3.50	3.61	0
	Average		2.83		12.50
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

† Based on 12 leaflets for each parental entry and for each hybrid entry with Comet as female; 24 leaflets for hybrid entries with PI 109839 as female.

TABLE VIII

LESIONS/LEAFLET AND DEFOLIATION OF O-20 X
PI 109839, ITS RECIPROCAL, AND PARENTS

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 13-05	O-20	8	16.00	8.49	33.33
JB 14-07	x	9	2.33	1.58	25.00
JB 15-01	PI 109839	12	9.42	7.44	0
JB 15-03		4	31.50	9.88	66.67
	Average		11.76		31.25
JB 37-01		21	8.86	6.73	12.50
JB 37-02		15	5.87	5.59	37.50
JB 37-03		19	7.05	4.12	20.83
JB 37-04		19	7.37	3.76	20.83
JB 37-05		14	11.50	7.52	41.67
JB 37-06		19	9.84	5.16	20.83
JB 37-07		19	7.68	4.66	20.83
JB 37-08		19	10.63	3.96	20.83
JB 38-01		24	3.79	2.96	0
JB 38-02	PI 109839	18	3.61	4.90	25.00
JB 38-03	x	14	3.64	2.06	41.67
JB 38-04	O-20	22	4.95	3.21	8.33
JB 38-05		23	2.83	3.07	4.17
JB 38-06		13	2.92	2.50	45.84
JB 38-07		13	6.62	3.97	45.84
JB 38-08		19	5.16	2.97	20.83
JB 39-01		22	12.90	6.40	8.33
JB 39-02		22	16.59	11.39	8.33
JB 39-03		17	10.59	6.11	29.17
JB 39-04		9	4.11	3.48	62.50
JB 39-05		19	10.68	6.68	20.83
JB 39-06		3	6.00	1.00	87.50
JB 39-07		20	15.95	9.54	16.68
	Average		9.01		26.99
JB 56-01		12	1.00	1.21	0
JB 56-02	O-20	12	2.67	2.53	0
JB 56-03		8	5.25	3.41	33.33
JB 56-05		12	5.17	3.97	0
	Average		3.36		8.33

TABLE VIII (Continued)

Entry	Genotype	Number of Leaflets	Average Lesions/Leaflet (No.)	Standard Deviation (No.)	Average Defoliation† (%)
JB 58-03		10	10.00	5.06	16.67
JB 58-04	PI 109839	11	0.27	0.47	8.33
JB 59-03		12	1.75	1.48	0
JB 59-06		11	4.27	4.27	8.33
	Average		3.89		8.33

†Based on 12 leaflets for each parental entry and for each hybrid entry with O-20 as female; 24 leaflets for hybrid entries with PI 109839 as female.

TABLE IX

PARENTS REACTION TO EARLY LEAFSPOT

Parent	Lesions/Leaflet (No.)	Rank	Defoliation (%)	Rank	Combined Rank
O-20	3.36	3	8.33	2	1/2
Comet	2.83	1	12.50	4	1/2
PI 109839	3.89	4	8.33	2	3
Chico	5.43	6	4.17	1	4
EC-5	2.97	2	35.42	8	5/6
Pronto	5.41	5	18.75	5	5/6
EC-7	7.10	7	18.75	5	7
Florunner	8.48	8	31.25	7	8
Early Bunch	11.73	9	54.17	9	9

VITA

John Palmer Beasley, Jr.

Candidate for the Degree of

Master of Science

Thesis: EVALUATION OF PEANUT HYBRIDS FOR REACTION TO EARLY LEAFSPOT PATHOGEN (CERCOSPORA ARACHIDICOLA)

Major Field: Agronomy

Biographical:

Personal Data: Born in Dothan, Alabama, January 15, 1956, the son of John and Barbara Beasley.

Education: Graduated from Houston County High School, Columbia, Alabama, in June, 1974; received the Bachelor of Science in Agriculture degree from Auburn University, Auburn, Alabama, in June, 1979; and completed the requirement for the Master of Science degree in Agronomy from Oklahoma State University, Stillwater, Oklahoma, in May, 1981.

Professional Experience: Pest Management Scout, Alabama Cooperative Extension Service, Houston County, Alabama, from June through September, 1975 through 1978; Scout supervisor, Cooperative Extension Service, Houston County, Alabama, from June through August 1979; and graduate research assistant in the Department of Agronomy, Oklahoma State University, Stillwater, Oklahoma, from September, 1979 through May, 1981.

Member: American Peanut Research and Education Society, American Society of Agronomy, and Crop Science Society of America.