EVALUATION OF SEVERAL METHODS OF TAKING DISEASE SEVERITY READINGS FOR CERCOSPORA LEAFSPOT OF PEANUTS

By

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LEAFSPOT OF PEANUTS

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CHAPTER I

INTRODUCTION

In an era moving toward extensive use of numbers and computerization, the need for quantitative measurements and description of plant diseases is becoming a reality that plant pathologists need to deal with in order to cope with the demands of the science. As such, disease situations must be quantified. Pure descriptive assessments which have been previously used need to be evaluated so that a common procedure for one disease on a given crop will give a repeatable and quantitative picture of the disease and its consequences to the plant. Rapid advances in this aspect of plant pathology have been reported in recent works on rust of wheat (Loegering and Burton, 1974; Burleigh et al., 1972a; 1972b; Browder, 1971), on leaf blotch of barley (Eyal and Siv, 1974; James, 1974), leaf blight of potatoes (James, 1974; James et al., 1971; 1972) and probably in a few other crops.

A survey of literature on Cercospora leafspot of peanut showed a variety of methods currently being used for the study of this disease. Degree of defoliation and percent infection as a measure of disease severity are widely used for leafspot and other foliar diseases. There were disagreements, however, on how these measures of severity were obtained. In most cases specification of the methods used were abbreviated resulting in difficulties in comparing data from station to station and from season to season. Such comparisons would be very valuable in comparing results of fungicide tests, varietal resistance trials and hopefully, in the near future, the comparison of prevailing races of the pathogens from one country to another. A method of disease measurement which is fast, accurate, and can be taken with a minimum of variation regardless of the training and background of the individual doing the measurement, and which will produce sufficient data for computer analysis would be an ideal goal. For the moment, however, the specification and evaluation of the methods commonly used in disease measurement of Cercospora leafspot is vitally needed.

The objectives of this study are (1) to evaluate previous and recently used methods of scoring disease severity due to leafspot; (2) to determine which of the method(s) will be most sensitive in showing correlations between disease severity and reduction in yield of peanut; (3) to establish a set of estimates of variance for different plot sizes for Cercospora leafspot studies; and (4) to develop a standard method of measuring the severity of Cercospora leafspot on peanuts based on the findings of the findings of the first three objectives.

CHAPTER II

REVIEW OF LITERATURE

Methods of Disease Measurement

The most common methods of disease measurement currently being used for Cercospora leafspot of peanuts are these: visual rating, percent defoliation, percent infection, counting of spots, weighing of the plants, and disease severity indexes. Of these methods, rating is the one that is extensively used not only for peanut leafspot but for diseases of cereals and many other crops as well. Although percent defoliation and percent infection have been used in several other ways, they were mainly confined to foliar diseases whereas the rating method can and must have been used for measurement of most plant diseases at one time or another. Melchers and Parker (1922) were probably one of the first to use the rating method to measure the severity of stem rust infection on wheat. They used a scale of 0 to 6 to measure the degree of rustiness present. James (1974) mentioned that this rating scale was later developed into standard area diagrams which are very commonly used in rust research and referred to as the modified Cobb Scale.

Horsfall and Heuberger (1942) measured a defoliation disease of tomato and quantified disease measurements by the use of three methods: (1) counting leafspots, (2) classifying leaves into two groups (sick and healthy), and (3) using McKinney's grouping method (McKinney, 1923). They reported that although counting leafspots is highly recommended because of its objectivity; it is seldom used because it is so slow that enough plants cannot be examined in an experimental plot to offset errors due to plant variability. Also, objectivity is less useful if more than one disease is prevalent or if insect punctures are present. They also observed that classifying leaves into two groups had low order of precision because the number of plants required for precision at both ends of the scale cannot be provided in any reasonably sized experimental plots. McKinney's grouping method (McKinney, 1923) was a compromise between the two previous methods. The infection categories were based on the relative proportion of total leaf area on the individual plant killed by the fungus.

Horsfall and Barrat (1945) probably based their improved grading system for measuring plant disease on McKinney's grouping method. They set the range between categories according to the Weber-Fechner law. According to this law, the human eye distinguishes according to the logarithm of the light intensity. Hence, the grades should be based on equal ability to distinguish, and not on equal disease. Below 50 percent the eye sees the amount of diseased tissue. Above 50 percent it sees the amount of disease-free tissue. The scoring system is based on a midpoint wherein the grades differ by a factor of two in both directions. The scale and its equivalent infection severity is as follows: 1 = 0; 2 = 0 to 3; 3 = 3 to 6; 4 = 6 to 12; 5 = 12 to 25; 6 = 25 to 50; 7 = 50 to 75; 8 = 75 to 87; 9 = 87 to 94; 10 = 94 to 97; 11 = 97 to 100.

Most research workers probably consider the distance between these categories too narrow and that distinction between any two groups is difficult and the ratings can frequently overlap. Kingsolver et al. (1959) used the modified Cobb Scale for their study of stem rust of wheat and rye while Rees (1972) still used a rating scale of 0 to 4 to describe rust severity on Agropyron scabrum.

Browder (1971) proposed a four-character coding system for use in coding infection-type data for cereal rust. In this system, the basic character of infection types are differentiated. Lesion size and size of sporulating area were read on a zero to nine scale such that a host-parasite relationship with a code 99 represents a typical, high infection type where large lesions which are profusely sporulating are described. A third code is used to provide descriptive information concerning the infection types. This code uses a scale of 0 to 9 to describe the presence or absence of chlorosis around the lesion, distribution pattern and nature of tissue damage to infection areas of the leaves. A fourth code is proposed to indicate the uniformity of infection types within a sample from plant to plant. A zero indicates a uniform sample and 1 to 9 represents various degrees of non-uniformity from plant to plant.

The rating method has been used in various ways for Cercospora leafspot studies to measure disease severity as a whole, degree of defoliation, infection severity and even amount of spotting on infected plants. The method has been useful to measure the effectiveness of fungicides against foliar diseases. Harrison (1969, 1973) measured peanut leafspot by an index based on a general visual inspection using a scale of 1 to 9 where 1 = complete defoliation and 9 = no defoliation or only a few occasional spots on a few leaves. He also measured the severity of peanut leaf rust on 20 randomly picked leaves of peanuts using the same scale of 1 to 0 corresponding to the average number of pustules per leaf. The same visual rating system of 1 to 5 or 1 to 10 has been used by D. H. Smith (1974).

In addition, quantitative determination of defoliation and infection was included.

The common desire to quantify disease measurements for Cercospora leafspot can be observed in other references. Percent defoliation is obtained by cutting off the main stem in a random sample of plants from the field. The total number of leaves are counted on these main stems. The number of leaves that are missing divided by the total number of leaves is then used as the measure of defoliation (Porter, 1974; Cummins and Smith, 1973; Smith and Crosby, 1972a; Smith and Crosby, 1973b; Clark, 1974; Littrell, 1974; Smith, 1974). Using the same sampling procedure, the percent infection can be determined also by counting the number of leaves on the stem with at least one leafspot and add this to the number of leaves that were missing then divide the sum by the total number of leaves produced on the stem.

Jensen and Boyle (1965) studied the effect of temperature, relative humidity, and precipitation on peanut leafspot. Their estimate of leafspot was made by cutting stems at the ground level and recording the number of leaflets produced by the plant, the number of leaflets infected, the number of spots, and the leaflets that were shed. The percentage of leaflets infected including those that had dropped was a measure of total infection. It was assumed that all leaflets that dropped were also infected. The same method was later used to gather data for forecasting Cercospora leafspot (Jensen and Boyle, 1966). Samples for their prediction were taken every seven days to follow the progress of the disease.

Wadsworth (1972) tested the effectiveness of several fungicides against Cercospora leafspot. In one test, disease severity was measured by the average amount of foliage, in inches, remaining on five main stems.

In another test, the disease severity was measured with a disease scale obtained by multiplying the number of leaflets with spots by the number of spots counted from the sample. The product was then divided by the total number of leaflets for each sample. In another season's test (Wadsworth, 1973) the same disease scale was used; in addition, percent defoliation and visual ratings were also used. A rating scale of 1 to 5 for severity was used where 1 = trace; 2 = light; 3 = moderate; 4 = severe; and 5 = very severe.

The overall effect of Cercospora leafspot on a peanut plant is apparently the reduction of photosynthetic area due to necrosis of affected areas of the leaflets eventually leading to defoliation. The reduction in yield of the plant consequent to this defoliation has been variously measured. Porter (1970) used benomyl sprays and obtained reduction in the severity of Cercospora leafspot on peanut with a decrease in plant defoliation, number of lesions per leaf and number of pods recovered from the soil after harvest. The yields of treated plots were also higher than the untreated plots. Although he obtained some significant differences in extra large kernels (ELK) and sound mature kernels (SMK), fancy pods did not seem to increase very much as a result of the treatment. Mercer (1973) used several parameters of yield to measure leafspot control in fungicide treated plots. The parameters used were scores for leafspot (scale of 0 to 5); weight of haulms (Kg/ha.); weight of leaves (g/10 plants); weight of stems (g/10 plants); stem/leaf ratio; unshelled weight of pods (kg./ha.); shelling percentage, percentage immature pods, and average weight per pod. He found that the number of pods per unit area and the number of pods per plant were increased with fungicide treatment. The average weight of pods was shown to increase particularly in a long season planting. The increased weight was largely a result of increased kernel size. Cummins and Smith (1973) also used peanut yield and forage quality and yield as parameters to measure Cercospora leafspot control. As a consequence of disease control, forage yield, in vitro digestibility, protein content, and seed yields were higher and forage fiber content was lower. In variety trials and progeny tests, a more detailed quantitative representation of host-parasite relationship is very important. This is because of the need to detect genotypic differences between individuals in terms of their phenotypic response to the presence of the disease. Browder's coding system (Browder, 1971) for wheat leaf rust is a very good example of an accomplishment in quantifying host-parasite relatibnship. Douglas and Pavek (1972) screened potatoes for field resistance to early blight using various rating scales for plant maturity, percentage of infected leaves, percentage of defoliation, severity and lesion size. Maturity was read by a scale of 1 to 5 where 1 = varieties which mature very early and 5 = those which were still dark green in bloom. Percentage of leaves infected and percent defoliation were taken at a scale of 1 to 100 while severity was scored at 0 to 5. Lesion size was rated according to a modified Horsfall-Barratt scale of 1 to 5.

Cipar and Lawrence (1972) evaluated scab resistance of haploids from two Solanum tuberosum cultivars by a scale of A to D where A meant no visual lesion of scab; B - highly resistant, where lesions were small and superficial; C - moderately resistant, where lesions were rougher, with a tendency to spread but still superficial with no external sign of pitting; D - susceptible, where lesions were large, rough, spreading, and showing definite shallow to deep pitting.

In peanuts, Yousef et al. (1974) tested various subspecies, botanical varieties and cultivars of peanuts from South America and Africa for resistance to C. personatum and C. arachidicola. The disease ratings taken two to six weeks after the first symptom were based on the number of lesions per leaflet, diameter of lesions, area of infected leaf, sporulation index and percentage of defoliation. Field resistance of 58 varieties of groundnut was evaluated by Chalal and Sandhu (1972). The intensity of the disease was estimated on three-month-old crops using infection ratings based on a scale of 0 to 5 from which an infection index was calculated by the formula of McKinney (1923). They classified varieties with 1 to 5 percent infection as resistant; 5 to 10 percent infection as tolerant; and higher than 10 percent infection as susceptible. Out of the 58 varieties tested, 12 were found resistant, 23 were tolerant, and 23 were susceptible.

In some other crops different methods of disease measurements are employed to give a quantitative picture of host-parasite relationships. Gill and Sobers (1974) studied a Cercospora leafspot of Ligustrum japonicum L., and they used the mean number of spotted leaves per plant at random from apple trees sprayed with benomyl-oil-water emulsion. He determined the percent infected leaves and scored the immature fruits in the same manner.

Cole et al. (1972) used visual rating on tuber yield of potato affected by Verticillium wilt. They used a scale of 1 to 4 to describe the amount of brown discoloration in the vascular ring of the tuber and presence of brown flecks in other areas of the tubers. Buchenauer and Erwin (1972) also described their method of assessing Verticillium wilt in cotton. They measured the effectiveness of an acidic solution of benomyl, methyl-2-benzimidazole carbamate and thiabendazole by assessing the degree of chlorosis on a scale of 0 to 4 and established a foliar symptom index in percent, from the proportion of the sum of leaf symptom values of 0 to 4 to the number of leaves scored, multiplied by four as the maximum value. The vascular browning of the stem was also assessed on a scale of 0 to 3 where 0 = white and 3 = completely brown. The vascular browning index was then calculated using the same formula as above.

Berquist (1972) tested the efficacy of fungicides for control of leafblight of Taro. He assessed severity of infection on a scale of 0 to 4 where 0 = no infection; 1 = 1 to 25 percent; 2 = 26 to 50 percent; 3 = 51 to 75 percent; and 4 - 76 to 100 percent infection, respectively. Lacey (1973) scored Septoria leafspot of celery on a scale of 1 to 5 to represent the percentage of foliage infected. Riordain (1974), on the other hand, scored the amount of powdery mildew on <u>Antirrhinum</u> sp using a scale of 0 (healthy) to 5 (severely mildewed). According to Basu (1974) severity of early blight of tomato can be reliably measured by counting the leaves with 75 to 100 percent necrotic area. Disease progress curves based on both leaves and fruit infection indicating an average of 60 percent defoliation would be necessary to obtain 10 percent infected fruits in all cultivars of tomato tested except Mini Rose.

Size of Experimental Plots

Row spacing and distance between plants for commercial planting of peanuts had been studied and established very early for most peanut growing states in the United States. These early researches were made at Agricultural Research Stations, examples of which were Alabama (Funches and Tisdale, 1924), Arkansas (McClelland, 1931), Florida (Killinger et al., 1948), Georgia (Parham, 1942), North Carolina (Gregory, 1948), Oklahoma (Foraker et al., 1967), South Carolina (Beattie et al., 1927), Texas (McNees, 1928), and Virginia (Batten, 1943). A large percentage of these studies was made on Spanish peanuts and most of the results from these experiments show that highest yields from such varieties could be obtained from seed drilled four to six inches apart in rows spaced 18 to 24 inches apart. Commercial plantings for runner or bunch varieties should be in 30 to 36-inch rows with plants six to eight inches in the row (Sturkie and Buchanan, 1973).

As with many other plant pathological studies on crops other than cereals, little is known about appropriate number of plants to be sampled and experimental plot size for studies on peanut diseases. This lack of uniformity can be observed in research results between stations, among workers on the same disease, and even the same worker between seasons. James (1974) noted that plant pathologists assessing plant diseases have not given experimental specifications and have a tendency to use the same plot size as their plant breeding colleagues. In cereals, James and Shih (1973) showed that rod row plots (three rows where 16 feet or 4.88 m of the center row is harvested) normally used by cereal pathologists is too small to allow a reasonable chance of detecting a 10 percent difference between treatments in experiments for assessing losses due to foliage disease. Kingsolver in 1971 (cited by James, 1974) showed that studies on epidemiology of stem rust required a minimum plot size of 1000 sq. ft. (1/40 acre = 93.4 m^2 = 1/100 ha.) to create an epidemic similar to that in a large field.

Experiments on chemical control of peanut leafspot in various state agricultural experiment stations and universities are usually made in plots varying from two to five rows and in length ranging from 18 to 100 feet. The distance between rows was usually not specified and when it was specified it ranged from 15 inches to 38 inches between rows. In most cases two buffer rows were used between treatments.

Harrison (1967) conducted a fungicide test against leaf rust and Cercospora leafspot of peanuts in plots consisting of five rows, the lengths of which were not specified. Two buffer rows were provided between treatments and only the middle row of the five row plot was used for gathering data. In another fungicide test for the same diseases (Harrison, 1971), he used two rows, 42 feet long in one location and 50 feet in another, both of which had two buffer rows between each treatment. In a similar study in Texas, Cummins and Smith (1973) obtained significant control of leafspot of peanut with an increase in yield and quality of forage in peanuts. They used experimental plots consisting of four rows 1.6 meters (5.25 feet) wide and 12 meters (39.3 feet) long with two buffer rows 1.6 meters wide between treatments.

Smith and Crosby (1972a) tested foliar applications of a benomyl-oil-water emulsion on Cercospora leafspot of peanuts in Georgia. In the same year (Smith and Crosby, 1972b) they conducted spore trapping experiments for a study on aerobiology of two peanut leafspot fungi. In both tests rows 100 feet long and 38 inches apart were used. The number of rows for each treatment was not specified, however, and there was no mention of buffer rows used in either experiment.

Effective control of Cercospora leafspot with benomyl was also reported by Porter (1970) in Virginia. He obtained significant reduction in plant defoliation, number of lesions per leaflet, number of pods recovered from the soil and increased pod yield in two years of study. He used four-row plots with rows 56 feet long and 36 inches apart. Two guard rows were provided between plots. Only the two middle rows of the four-row plots were harvested and used for gathering data.

In Oklahoma, Sturgeon (1968) conducted a two-year study on chemical control of Cercospora leafspot of peanuts using plots four rows wide and 18 feet long. The distance between rows was not specified by two spreader rows were provided for each treatment. He collected only five plants from each treatment for obtaining data. Wadsworth (1972; 1973) conducted fungicide tests against leafspot of peanuts at the Oklahoma State University Experiment Station at Perkins, Oklahoma. The specifications of the experimental plots were not given in the report. Personal communication with the researcher revealed that 150-foot long rows, 36 inches apart were used in the test. The rows were divided into two equal sections (75 feet long) which were used for the different treatments. Fifty-foot sections of each half were used in disease severity and yield measurements.

The use of twin rows was not encountered in experimental plots for peanuts, and it may depend on prevailing cultural practices, availability of equipment in the locality where the experiment is being conducted.

Correlation of Yield with Disease Severity Readings

Yield and yield loss due to the disease has been mostly used to evaluate severity of the disease. Horsfall and Heuberger (1942) claim yield records are usually considered as a close approximation to objective records and express a measure of the magnitude of disease. James (1974) agreed with Chester (1950) and Large (1966) when he suggested two phases in the strategy of disease appraisal. The first is to conduct a field experiment to characterize relationship between disease and reduction in yield so that a reliable method can be developed to estimate the loss in yield associated with any severity of disease. Then a reliable method for estimating yield loss for any given amount of disease must be developed. The second phase is assessing the disease in a survey of fields using the assessment method developed in the first phase. He (James et al., 1968) developed an equation for linear regression to show the relationship between leaf blotch caused by _Rhynchosporium secalis_ and losses in grain yield of spring barley due to the disease. He obtained a linear regression where $b = -0.13 \pm 0.029$ with $P < 0.001$. He later conducted a survey of foliar diseases of barley (James, 1969) in England and Wales and studied the relationship between incidence of leaf blotch and loss in yield. His findings agreed with those of Romig and Calpouzos (1970) that yield loss in barley may be equivalent to approximately two thirds of the percentage of flagleaf area visibly infected by Rhynchosporium scald at the milky ripe growth stage. Romig and Calpouzos (1970) also reported that yield loss in wheat is equal to the square root of the percentage yellow rust at the end of the flowering growth stage.

Burleigh et al. (1972a; 1972b) used untransformed rust severities and grain losses in a stepwise multiple regression computer program with percent loss as the dependent variable. The independent variables were different stages of growth of wheat coded as X_1 to X_8. Significant variables were identified in the program by "Student's" t-test and standard errors of regressions were calculated. Coefficients of determination indicated rust severities at early dough accounted for 64 percent of the variation in crop loss. However, when severities from boot, berry, and early dough were combined in the linear regression equation, 79 percent of the variation in the loss was explained.

James et al. (1972) explored four methods of analysis to establish a quantitative relationship between late blight of potato and tuber yield. The critical point model which was successfully used by Burleigh et al. (1972a) on wheat rust failed to show a significant relationship between disease severity and loss in yield during a specific growth stage of potato. The bulking curve method used by James et al. (1971) was also unsuccessful and they reported that the method underestimated yield loss and the estimate of yield loss lacked correlation with the actual loss. The method suggested by Van der Plank (1963) that the area under the disease progress curve may be related to yield loss was also shown to be unsatisfactory since the method did not distinguish between early low infection and late severe infection which occupy the same area under the disease progress curve. Since the yield loss attributed to the former will be greater than the latter, the method was also not sensitive enough. The multiple regression analysis used by James et al. (1972) to develop an empirical equation to relate yield loss directly to an epidemic was suggested to have the most advantages based on three criteria: (1) it can distinguish between the early and late infection progress curves which reach a certain level of infection at the same time but which have different characteristics before that date; (2) it can estimate the loss from any given curve irrespective of the disease level; and (3) it allows comparison of losses from any two progress curves and also estimates the yield loss in relation to a healthy crop.

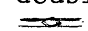
CHAPTER III

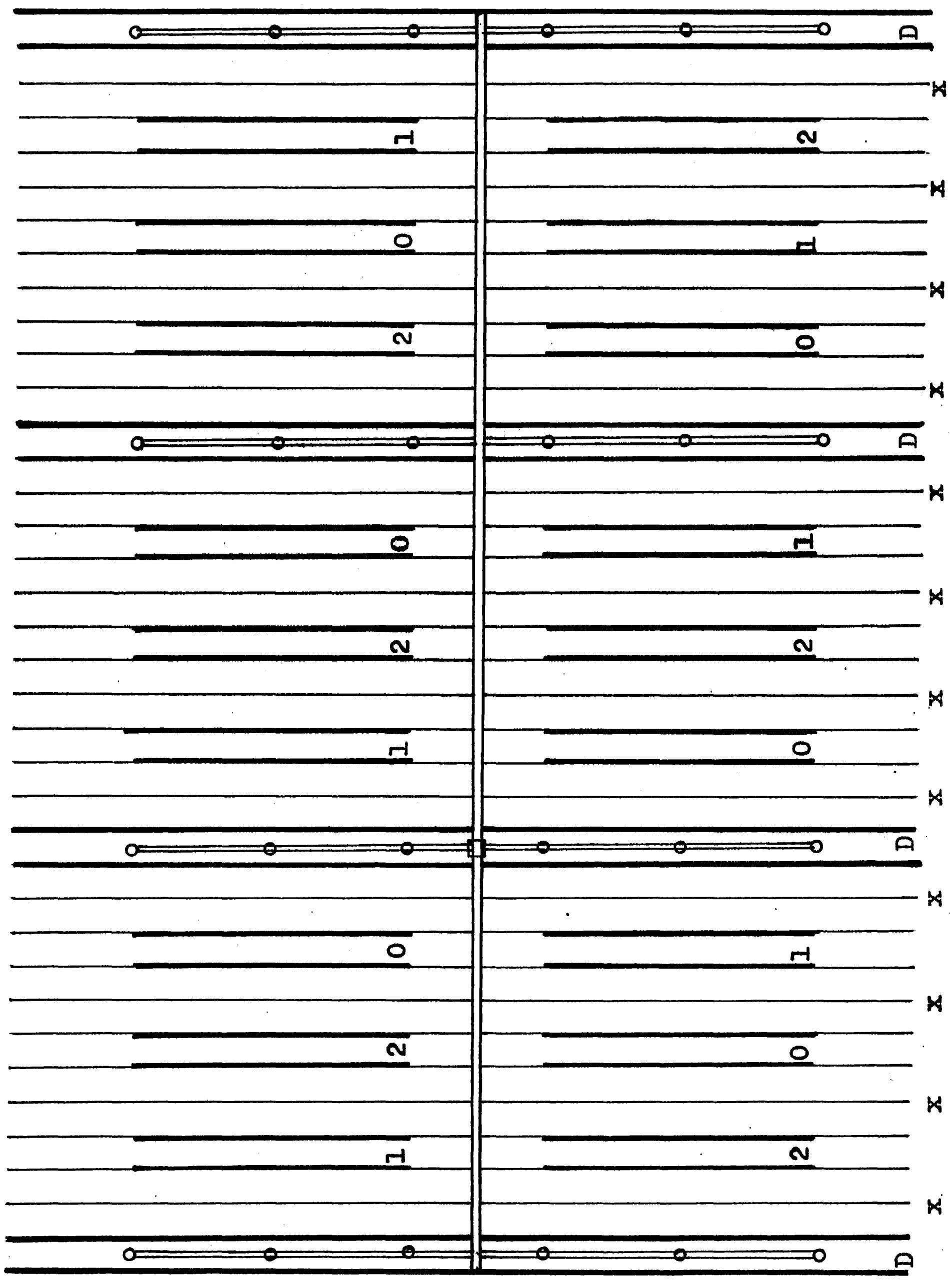
MATERIALS AND METHODS

The field experiments for this study were conducted during two peanut growing seasons in 1973 and 1974 at the Oklahoma State University Agronomy Research Station at Perkins, Oklahoma. For each season, the experimental area was thoroughly prepared using standard land preparation procedures for peanut production. Treflan (4 lbs. per gal. E.C. of a, a, a-trifluoro-2-6-dinitro-N, N-dipropyl-p-toluidine) was used as a preplant, soil-incorporated herbicide at the rate of 1.5 pints per acre five days prior to the date of planting.

Certified peanut seed (variety Comet) was planted in double rows using a two-row peanut planter spaced 36 inches between rows and calibrated to drop three to four seeds per foot row. The plant population was maintained as a density of three to four plants per foot of row and in the few cases where seeds failed to germinate, replanting of the missing plant(s) was done immediately. A double row, 60 feet long and bordered on both sides by a single spreader row comprised one treatment or plot. Each year's experiment contained six replications, each replication composed of three treatments corresponding to three disease severity levels arranged in a randomized complete block design (Figure 1).

Planting for the 1973 experiment was done on June 11 followed by stand inspection and replanting of the missing hills on June 22. Cultivation, hoeing, and hand pulling of weeds were done as a routine activity

Figure 1. Layout of the Field Experiment. x = spreader rows; D = double rows with irrigation pipes and sprinklers in between;  = irrigation lines with sprinklers. Treatment 0 = unsprayed plots; Treatment 1 = sprayed with 1/2 the recommended rate of Bravo 6F; Treatment 2 = sprayed with recommended rate of Bravo 6F.



to keep the area free of weeds. Terraclor 10G (10 percent PCNB) was applied as a band on the row at the rate of 5 lbs. active ingredient per acre to control Sclerotium rolfsii and other plant pathogenic soil fungi. Additional spot applications with Terraclor 75WP (75 percent PCNB Wettable Powder) were made with a small garden sprayer to control S. rolfsii late in the season. Insects in the experimental area were controlled by spraying with Malathion (50 percent O, O-dimethyldithiophosphate of diethyl mercaptosuccinate) at the rate of 1 pint per acre.

Irrigation with a Wade Rain overhead system was used when necessary. At locations where irrigation pipe ran along a double row, the double row was not used for the experiment to avoid differences in plant growth due to the extra water which may accumulate at the base of the sprinklers. The sprinklers were spaced 30 feet apart on all four sides to provide uniform moisture.

Although Cercospora leafspot was severe on peanuts in the same area in previous seasons, artificial inoculation was made with a pure culture of Cercospora arachidicola Hori for uniform, severe infection early in the season. The plots were irrigated to provide high humidity and enough moisture on the leaf surface to encourage spore germination and infection. When uniform initial infection was apparent on all the experimental rows, control of disease development by spraying was done such that three levels of disease severity were maintained in the designated plots. The plots for high disease severity level (treatment 0) were not sprayed with fungicide such that Cercospora leafspot progressed unarrested. The plots for medium disease severity level (treatment 1) were sprayed with 1/2 the recommended rate of Bravo 6F (3/4 pint per acre of 54 percent Tetrachloroisophthalonitrile) while plots for low disease severity level (treatment 2) were sprayed with Bravo 6F at the recommended rate of 1.5 pints per acre. Sprays were applied with a six-nozzle boom sprayer (three nozzles to a row) mounted on an Allis Chalmer HB-212 tractor and calibrated to deliver approximately 40 gallons of spray solution per acre. All six nozzles could be adjusted to insure even coverage of the double row in one passing of the sprayer. Thorough mixing and continuous agitation of the spray solution was provided by the bypass hose which cycled part of the spray preparation back to the spray tank.

The spraying schedule was tentatively set at ten-day intervals; however, this was adjusted depending on disease development in the plots. Whenever necessary, the plots were irrigated for one to two hours every night to maintain high relative humidity and cooler temperatures during hot summer days.

Ten plants from one of the double rows in each treatment were tagged two months after planting. The plants were approximately two feet from each other along and within 50 feet of the 60-foot row.

All disease measurements and individual plant data were taken five days before digging of the rows. The tagged plants were hand pulled and handled separately for individual plant measurements of disease severity. Fifty-foot sections of the experimental rows were considered for yield measurements. The rows from where the ten plants had been removed were harvested as full 50-foot sections while the rows from where no plants were removed were divided into two 25-foot sections and designated for the 25-foot row-yield measurements. The plants were dug with a one-row peanut digger. Care was practiced to prevent the yield of the rows or sections of a row from mixing with each other. The plants were carefully inverted by hand and allowed to dry in the field for three to five days after which they were threshed with a Marushin model no. 2 peanut thresher. The thresher was thoroughly cleaned every time each row or section of the row was finished and the pods were collected in individual sacks with their corresponding labels. All the yield samples were taken to the plant pathology headhouse and allowed to air dry indoors for at least four weeks after which they were passed through a constant flow air-blower for final cleaning. The weights of the pods were determined with an Homs (60 lbs. capacity) temperature compensated weighing scale.

The number of spots from four leaflets of each plant, the total diameter of the spots counted from each leaflet, area of the leaflets, height defoliated and height of the main stem were recorded for each individual plant that was tagged. The total number of spots per leaf was counted from the lowest intact leaf (with all four leaflets still attached) of the main stem. In very severe disease conditions where no intact leaf remained attached to the main stem, four representative leaflets from branches of the same plant were collected for the measurement. The diameters of the individual spots from each leaflet that were counted were also measured (in mm.) with a 15 cm. plastic ruler. The total area of the spots per leaflet, which will also correspond to the leaf area damaged per leaflet, was obtained by the formula πR^2 for each leaflet. This was made easier by the use of a leafspot area chart specially prepared for this purpose (Appendix C).

The area of the leaflets was determined by a modification of the method described by Humphries and French (1963). Each leaflet that was used for the previous measurements was traced on a stiff and transparent plastic sheet (Ful-Vu sheet protector made of 0.005 Mika-film) which was then numbered corresponding to the number of the leaflet traced. The leaf tracings were then weighed and recorded. A known area of the plastic sheet was weighed and the area of the leaf tracings were calculated based on the known area of the plastic sheet and its weight by ratio and proportion.

The height of the plant was measured by the use of a standard wooden meter stick, from the soil level to the tip of the growing point of the main stem; whereas, the height of the stem that was defoliated was measured from the soil level to the base of the petiole of the lowest leaf which had two or more leaflets still attached to it.

A modified Horsfall-Barratt method (Horsfall and Barratt, 1945) was used to assess the severity of leafspot by visual rating in the row. This method used a scale of 1 to 5 where the rows which showed only traces of leafspot infection were rated as 1 and those which showed light infection were rated as 2. Moderate infection was given a rating of 3 while severe infection was rated as 4. Very severe infection resulting in almost total defoliation of the plants was given the maximum severity rating of 5.

Ranking of the treated rows was based on a rank of 1, 2, and 3 where 1 was very good disease control in the row (low leafspot severity); 2 was good disease control (moderate leafspot severity); and 3 was poor disease control (severe leafspot infection).

The planting in 1974 followed the same experimental design and procedures as in 1973. The same variety of peanut was planted on May 22. Lasso (43.0 percent 2-chloro-2, 6-diethyl-N-(methoxymethyl acetanilide) was used as a soil-incorporated pre-plant herbicide five days before planting and Terraclor Super-X (10 percent PCNB + 2.5 percent 5-ethoxytrichloromethyl-1, 2, 4-thiadazole) was applied on June 18 at the rate of 5 lbs. a.i. per acre for control of S. rolfsii and other soil-borne plant pathogenic fungi.

In addition to the disease measurements used in 1973, several other measures of disease severity and two measures of yield quality were included in 1974. The measurements of individual plants included counts for the total number of nodes for each main stem, the number of remaining leaflets still attached to the main stem, the number of infected leaflets attached to the main stem, and number of un-infected leaflets attached to the main stem. Pod analysis for the ten plant yield was based on number of immature pods, intermediate pods, and mature pods. Maturity of the pods was determined using the method described by Sturgeon (1968).

Two-pound samples of pods from each row and sections of the rows were sent to the Oklahoma Federal-State Inspection Service for analysis of percent sound mature kernels. Visual rating and ranking of the rows according to treatments were also done in the same way as in the 1973 planting.

The coefficients of variation and correlation were used in the analysis of nine methods of measuring the severity of Cercospora leafspot. These measures of severity were percent defoliation by height measurement (DEFH), percent defoliation by leaflet count (DEFZ), percent leaflet area damaged (DMG), percent infection A (INFA), percent infection B (INFB), infection index (INDEX), visual rating (RATING), ranking (RANK), and number of spots per leaf (SPOTS). A stepwise multiple regression procedure was used in a computer program to select the best single and best two methods of measuring severity of Cercospora leafspot based on their effects on yield and maturity of pods from different plot sizes.

The following formulas were used to generate the data for various methods of disease measurements:

I. Infection index = $\frac{\text{TNS x TLI}}{\text{TNL}}$ x 100

Where:

TNS = Total number of spots counted from four leaflets of each of the ten peanuts.

TLI = Total number of leaflets infected out of 40 leaflets examined.

TNL = Total number of leaflets examined (=40).

II. Percent defoliation by height:

$$\text{DEFH} = \frac{\text{AHD}}{\text{AHP}} \times 100$$

Where:

AHD = Average height defoliated on ten main stems.

AHP = Average height of ten main stems.

III. Percent defoliation by leaflet count:

$$\text{DEFZ} = \frac{\text{NLD}}{\text{TNL}} \times 100$$

Where:

NLD = Average number of leaflets defoliated from ten main stems.

TNL = Average number of leaflets possible for ten main stems (number of nodes x 4).

IV. Percent infection (A):

$$\text{INFA} = \frac{\text{NLI}}{\text{NLP}} \times 100$$

Where:

NLI = Average number of leaflets from ten main stems with at least one leafspot.

NLP = Average number of leaflets possible for ten main stems (number of nodes x 4).

V. Percent infection (B):

$$INFB = \frac{NRLS}{RL} \times 100$$

Where:

NRLS = Average number of leaflets attached to ten main stems with at least one spot.

RL = Average number of leaflets that were still attached to ten main stems.

VI. Percent leaf area damaged per leaflet:

$$DMG = \frac{\text{Total spot area per leaflet}}{\text{Area of leaflet}} \times 100$$

Where:

$$\text{Area of individual spots} = \pi \left(\frac{\text{spot diameter}}{2} \right)^2$$

$$\text{Area of leaflet} = \frac{\text{wt. of leaf tracing in plastic} \times \text{know area of plastic}}{\text{wt. of known area of plastic}}$$

CHAPTER IV

RESULTS AND DISCUSSION

A set of codes and abbreviations was developed to designate the different plot sizes and measures of disease severity used in this study (Table I). These codes and abbreviations were found to facilitate collection and tabulation of data and also in programming and computer analysis.

Three levels of Cercospora leafspot severity were successfully produced in the experimental plots of peanuts during 1973 and 1974 (Figures 2 and 3). The success was further substantiated after comparing the six methods used for measuring disease severity during the two years of study. There are three distinct levels of severity that can be considered as low, medium, and high corresponding to Treatments 2, 1, and 0, respectively (Table II). The disease severity in 1974 had generally higher readings than 1973 as shown by number of spots per leaf, percent leaflet area damaged, percent defoliation, infection index, and visual rating. Ranking showed an L.S.D. and CV of zero which is also evidence that the three treatment levels produced a wide enough variation among the rows so that they were placed in the same rank for the two years of study. Except for the visual rating method, improvements were also observed in the CV when the two years were compared. Among the methods used, percent defoliation and visual rating were found to give the lowest coefficient of variability for both years.

TABLE I

CODES AND ABBREVIATIONS USED IN THE STUDY[a/]

CODES	EXPLANATION
DEFH	Percent defoliation obtained by measuring the height defoliated on ten main stems divided by the height of ten main stems.
DEFZ	Percent defoliation obtained by counting the number of leaflets defoliated from ten main stems divided by the number of leaflets produced from ten main stems.
DMG	Percent leaflet area damaged obtained by measuring the total leafspot area per leaflet divided by the area of the leaflet.
INFA	Percent infection obtained by counting the number of leaflets with at least one leafspot from ten main stems divided by the number of leaflets produced from ten main stems.
INFB	Percent infection obtained by counting the number of leaflets with at least one leafspot remaining on ten main stems divided by the number of leaflets remaining on ten main stems.
INDEX	Infection index based on counts of total number of spots from four leaflets per plant multiplied by the number of leaflets infected, then divided by the total number of leaflets examined. (The counts were made on ten plants from each treatment).
RATING	Visual rating using a scale of 1 to 5 corresponding to trace, light, moderate, severe, and very severe infection.
RANK	Ranking method where the three treatment levels were ranked as 1, 2, and 3 corresponding to very good, good, and poor disease control.
SPOTS	Number of spots per leaf obtained by counting the average number of leafspots per leaf from leaves of ten plants.
$YLDA_1$	Yield of one-half of a 50-foot row plot designated at random along the 50-foot row.
$YLDA_2$	Yield of the remaining half of a 50-foot row plot designated as above.
YLD50	Sum of the yields from two 25-foot sections of a 50-foot row plot ($YLDA_1$ + $YLDA_2$).

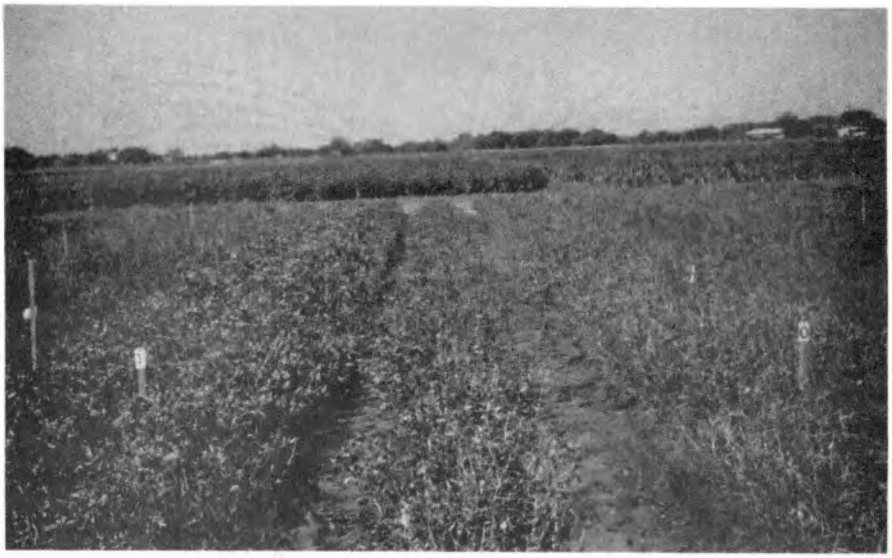
TABLE I (CONTINUED)

CODES	EXPLANATION
YLD50P	Yield of 50-foot row plot where ten plants were harvested separately and later added back to the row yield.
YLDB	Yield of a 50-foot row (above) where ten plants were removed.
YLD	Sum of two 50-foot rows (YLD50 + YLD50P).

[a] See Materials and Methods for formula of the different measures of disease severity.

Figure 2. Three Disease Severity Levels of Cercospora Leafspot on Peanuts Produced in the 1973 Experimental Plots. Treatment 0 = unsprayed plots; Treatment 1 = sprayed with 1/2 the recommended rate of Bravo 6F. A portion of the rows in Treatment 2 (sprayed with recommended rate of Bravo 6F) can be seen in the extreme left.

Figure 3. Three Disease Severity Levels of Cercospora Leafspot on Peanuts Produced in the 1974 Experimental Plots. Upper photo: Left is Treatment 1 (sprayed with 1/2 the recommended rate of Bravo 6F) and Right is Treatment 0 (unsprayed rows). Lower photo: Left is Treatment 1 (as above) and Right is Treatment 2 (sprayed with the recommended rate of Bravo 6F).



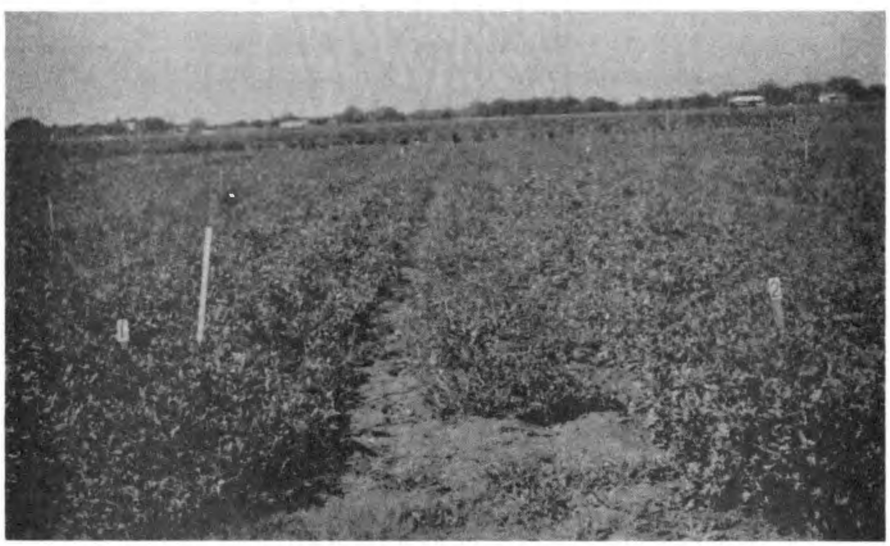


TABLE II

COMPARISON OF DISEASE SEVERITY MEASUREMENTS FOR CERCOSPORA LEAFSPOT OF PEANUTS DURING 1973 AND 1974

DISEASE SEVERITY TREATMENT LEVELS a/	NUMBER OF SPOTS PER LEAF		PERCENT LEAF-LET AREA DAMAGED		PERCENT DE-FOLIATION H		INFECTION INDEX		VISUAL RATING		RANKING	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
HIGH (Trt. 0)	21.0	68.5	22.5	31.7	74.7	97.3	249.2	674.2	3.7	4.8	3.0	3.0
MEDIUM (Trt. 1)	6.4	17.2	10.0	8.0	41.9	72.5	221.9	144.3	2.8	2.8	2.0	2.0
LOW (Trt. 2)	2.2	7.8	3.2	3.8	33.9	67.3	31.7	61.7	2.2	2.0	1.0	1.0
L.S.D. .05	3.7	8.6	4.6	3.6	7.5	3.8	b/	8.3	0.2	0.4	0.0	0.0
C.V. (Rep. x Trt.)	28.7	17.8	30.2	19.2	11.2	3.8	b/	22.3	8.5	15.0	0.0	0.0

a/ HIGH = Treatment 0 (unsprayed polots); MEDIUM = Treatment 1 (sprayed with 1/2 the recommended rate of Bravo 6F); LOW = Treatment 2 (sprayed with recommended rate of Bravo 6F). P>F were all found to be 0.0001.

b/ Treatment means were obtained but individual plot measurements were lost.

The three treatments imposed on the plots also produced significant differences in yields of plants for nearly all plot sizes tested except the yields of 25-foot row A_1 ($YLDA_1$), yield of 25-foot row A_2 ($YLDA_2$) and yield of ten plants during 1974 (Table III). It can be seen from Table III that although there was a consistent increase in yield for nearly all plot sizes and the three treatments imposed in 1973 and 1974, the CV was consistently lower in the latter year. The lowest CV for yield was obtained from the 50-foot row (A_1 + A_2) designated as YLD50, followed by $YLDA_2$ with 2.80 and 4.48 percent, respectively. The highest CV was obtained from the yields of ten plants for both years with 16.75 and 14.01 percent, respectively.

Comparison of the error mean squares (EMS) and CV's of the yield data for the two years provided some insight as to the selection of the appropriate size of plots for experiments involving peanut yield studies. Based on the results of this experiment (Tables IV and V), CV's of 16.75 and 14.00 obtained from the ten plant plots are too high for good research results. The CV's from a 25-foot row and a 50-foot row are low enough that one could use either plot size for research purposes. Data for both years showed that a single row of 50 feet long was as good as or better than two adjacent 50-foot row plots. The improvement in CV that can be achieved by using rows which are 50 feet long instead of 25 feet does not seem to compensate for the added increase in land area and labor that will be spent in the management and care of the experimental area. However, one 25-foot plot will not give flexibility in harvesting in cases of skips in some sections of the row. Therefore, the planting of two 50-foot rows for each treatment is more practical. Twenty-five-foot row sections can later be designated along the 50-foot rows for gathering data.

TABLE III

COMPARISON OF MEAN YIELDS OF PEANUTS UNDER 3 DISEASE SEVERITY TREATMENT LEVELS FOR CERCOSPORA LEAFSPOT DURING 1973 AND 1974 a/

DISEASE SEVERITY TREATMENT LEVELS	YIELD OF TEN PLANTS		YIELD OF 25 FT. ROW (A_1)		YIELD OF 25 FT. ROW (A_2)		YIELD OF 50 FT. ROW ($A_1 + A_2$)		YIELD OF 50 FT. ROW b/ (B + 10 plants)	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
HIGH (Trt. 0)	309.05	510.17	1648.67	1967.67	1685.33	2029.58	3334.00	3997.25	3389.50	4562.67
MEDIUM (Trt. 1)	405.38	570.50	2017.67	2641.83	1983.67	2630.58	4001.33	5272.42	4114.35	5099.17
LOW (Trt. 2)	385.18	635.75	1796.17	2744.00	2082.67	2717.83	3878.83	5461.83	4441.20	5478.00
L.S.D. .05	79.00	103.17	236.31	141.16	277.82	164.69	393.49	177.18	390.28	295.19
C.V. (Rep x Trt.)	16.75	14.01	10.08	4.48	11.26	5.21	8.18	2.80	7.60	4.55
$P > F$	.0492	.0626	.0181	.0001	.0241	.0001	.0083	.0001	.0007	.0003

a/ All yields are expressed in grams.

b/ Yield of 50 feet of row where ten plants were removed and added back.

TABLE IV

COMPARISON OF EMS AND CV FOR YIELD OF TEN PLANTS AND DIFFERENT PLOT SIZES FOR PEANUT YIELD STUDY DURING 1973

SOURCE OF VARIANCE	Df	YIELD OF TEN PLANTS	ROW YIELDS[a/]		ROWPLOT[b/] 25 FEET	ROW YIELDS		ROWPLOT[c/] 50 FEET
			A_1	A_2		$A_1 + A_2$	B + 10 plts.	
Replication (EMS)	5	6733.36	31266.77	80666.62	35423.76	70847.52	8510.23	132725.01
Treatment (EMS)	2	15484.44	206979.50	25667.56	378591.69	757183.39	1738311.34	2264426.02
Rep x Trt (EMS)	10	3771.29	33742.77	46641.49	46780.53	93561.06	92043.25	115669.60
C.V. (R x T)		16.75	10.09	11.26	11.57	8.18	7.60	8.81
Adjacent Plot (EMS)	6	NA	NA	NA	54018.53	NA	NA	NA
C.V. Plot (Rep)		NA	NA	NA	12.44	NA	NA	NA
Row (EMS)	6	NA	NA	NA	NA	NA	NA	100768.81
C.V. (Rep. Trt.)		NA	NA	NA	NA	NA	NA	8.22

a/ Yields from 25-foot sections of one 50-foot row. b/ AOV of two 25-foot sections along one 50-foot row.
c/ AOV of two adjacent 50-foot rows. NA = Not applicable.

TABLE V

COMPARISON OF EMS AND CV'S FOR YIELD OF TEN PLANTS AND DIFFERENT PLOT SIZES FOR PEANUT YIELD STUDY DURING 1974

SOURCE OF VARIANCE	Df	YIELD OF TEN PLANTS	ROW YIELDS[a/]		ROWPLOT[b/] 25 FEET	ROW YIELDS		ROWPLOT[c/] 50 FEET
			A_1	A_2		$A_1 + A_2$	B + 10 plts.	
Replication (EMS)	5	5107.95	40607.83	46170.23	68802.25	137604.50	132861.82	100051.49
Treatment (EMS)	2	23668.85	1067632.17	842501.63	1903346.52	3806933.04	1260182.06	4634523.76
Rep x Trt (EMS)	10	6431.55	12040.15	16389.76	9484.62	18969.24	52654.96	36664.67
C.V. (R x T)		14.00	4.47	5.20	3.97	2.80	4.50	3.85
Adjacent Plot (EMS)	6	NA	NA	NA	15079.89	NA	NA	NA
C.V. Plot (Rep)		NA	NA	NA	5.00	NA	NA	NA
Row (EMS)	6	NA	NA	NA	NA	NA	NA	169801.71
C.V. (Rep Trt)		NA	NA	NA	NA	NA	NA	8.27

a/ = Yields from 25-foot sections of one 50-foot row.
b/ = AOV of two 25-foot sections along one 50-foot row.
c/ = AOV of two adjacent 50-foot rows.
NA = Not applicable.

Three additional methods of measuring Cercospora leafspot severity were included in the 1974 data. Two of these methods were for determining percent infection, and one for determining percent defoliation. A comparison of all nine methods used for measuring disease severity gave highly significant differences due to the three treatments employed in the experiment (Table VI). Comparison of the two methods of taking percent defoliation showed that measuring the height of the plants that were defoliated (DEFH) had less variability than counting the number of leaflets that were defoliated (DEFZ). Likewise, determining the percent infection based on the number of leaflets remaining attached to the stem (INFB) was less variable than using the total number of leaflets (INFA) as the basis for calculating percent infection due to Cercospora leafspot. It can also be seen from the table that the Rep. in Trt CV's were generally higher at the medium disease severity treatment level as compared with the low and high disease severity treatment levels. The procedure in taking INFA and INFB was not able to distinguish differences in the degree of infection among plants within the high disease severity treatment level, as such, the CV's for these measures of disease severity at high disease severity treatment levels were found to be zero. Ranking the rows into 1 (very good disease control), 2 (good disease control), and 3 (poor disease control) again showed that the treatments imposed on the experimental plots were successful in producing the disease conditions corresponding to the ranks intended for the rows. This is shown by CV's of zero for both Rep. in Trt and overall CV for this measure of disease severity.

The greatest variation among replications was observed in percent leaflet area damaged (DMG) with a CV of 24.75 percent, followed by number

TABLE VI

COMPARISON OF 9 METHODS OF MEASURING CERCOSPORA LEAFSPOT SEVERITY ON PEANUTS UNDER 3 DISEASE SEVERITY TREATMENT LEVELS

DISEASE SEVERITY TREATMENT LEVELS[a]	MEASURES OF DISEASE SEVERITY[b]								
	DEFH	DEFZ	INFA	INFB	DMG	INDEX	SPOTS	RATING	RANKING
HIGH									
Means	97.22	97.48	100.00	100.00	31.44	674.17	69.77	4.75	3.00
Rep in Trt CV	2.67	3.54	0.00	0.00	12.63	12.90	10.01	8.81	0.00
MEDIUM									
Means	72.55	58.92	48.71	78.63	8.04	144.28	15.92	2.75	2.00
Rep in Trt CV	5.98	13.14	7.98	10.35	41.91	39.21	41.19	15.21	0.00
LOW									
Means	67.24	55.28	35.27	69.77	3.87	61.73	7.15	1.92	1.00
Rep in Trt CV	3.90	2.95	7.80	20.68	27.06	19.94	17.44	19.64	0.00
OVERALL MEANS	79.00	70.56	61.39	82.80	14.45	293.49	30.94	3.14	2.00
REP CV	4.78	7.60	8.87	5.00	24.75	16.49	18.54	6.92	0.00
OVERALL CV (Rep x Trt)	3.81	6.73	8.11	6.15	19.22	22.32	17.75	15.02	0.00

a/ High = Treatment 0 (unsprayed plots); Medium = Treatment 1 (sprayed with 1/2 the recommended rate of Bravo 6F); Low = Treatment 2 (sprayed with recommended rate of Brave 6F).

b/ For formula of the method see Table I. All measures of disease severity showed highly significant differences among treatment levels with $P > F = 0.0001$.

of spots per leaf (SPOTS) and infection index (INDEX) with CV's of 18.54 and 16.49 percent, respectively. The lowest CV among replications was obtained from DEFH with 4.78 percent, followed by INFB and the visual rating (RATING) with 5.00 and 6.92 percent, respectively. INFA and DEFZ were in-between with 7.63 and 8.87 percent, respectively. The ranking method did not show any variation among the treated plots, within treatments, and among replications.

Cross-product analysis of yield from different plot sizes (adjusted for treatment effects) and measures of disease severity for Cercospora leafspot on peanuts showed high negative values for both years of study (Table VII). It can be observed, however, that because of the small degrees of freedom (df = 2 for the three treatments imposed on the experiment) significant correlations were obtained at $\alpha .05 = 4.303$ (r = .96) and highly significant correlation at $\alpha .01 = 9.925$ (r = .99). Values lower than /-.96/ for any combination of plot size and measure of disease severity were not significant.

Total correlation coefficients of yields (unadjusted for treatment and replication effects) from different plot sizes with nine methods of measuring disease severity used in 1974 showed highly significant negative values except in the yield of ten plants (Table VIII). After removal of the replication and treatment effects, however, the correlation of residuals among the different measures of Cercospora leafspot and yield of different plot sizes resulted in varying relationships (Table IX). Significant positive correlation (r = .54) was obtained between percent defoliation H and yield of 50-foot row plots where ten plants were removed (YLDB); percent defoliation H and yield of 50-foot row plots where ten plants were removed and later added back (YLD50P)

TABLE VII

CORRELATION COEFFICIENTS OF DISEASE MEASUREMENTS AND YIELD OF PEANUTS AFFECTED BY 3 LEVELS OF TREATMENTS TO CONTROL CERCOSPORA LEAFSPOT DURING 1973 AND 1974 a/

	NUMBER OF SPOTS PER LEAF		PERCENT LEAFLET AREA DAMAGED		PERCENT DEFOLIATION		VISUAL RATING		RANKING		INFECTION INDEX b/
YIELDS	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1974
Yield of ten plants	-.92	-.91	-.85	-.92	-.94	-.93	-.79	-.97*	-.75	-.99**	-.93
Yield of 25 feet of row (A_1)	-.66	-.99**	-.55	-.99**	-.69	-.99**	-.46	-.98*	-.40	-.92	-.99**
Yield of 25 feet of row (A_2)	-.99**	-.99**	-.99**	-.99**	-.99**	-.99**	-.98*	-.98*	-.96*	-.92	-.99**
Yield of 50 feet of row ($A_1 + A_2$)	-.93	-.99**	-.86	-.99**	-.94	-.99**	-.81	-.98*	-.77	-.92	-.99**
Yield of 50 feet of row (B + 10 plts.)	-.99**	-.96*	-.99**	-.96*	-.99**	-.99**	-.99**	-.99**	-.97*	-.99**	-.96*

a/ Unadjusted for treatment and replication effects.

b/ Data for infection index were not available for 1973.

** = Significant at .01 level; * = Significant at .05 level.

with r = .62. Percent defoliation H and yield of 100-foot rows (total of two 50-foot rows) also showed a significant positive correlation with r = .45.

Significant positive correlations were again observed when yield of ten plants was plotted against percent defoliation Z, percent infection A, and percent infection B with r values of .55, .60, and .53, respectively. These results seem to support the observation of Sturgeon (1968) claiming an increase in yield of quality of peanuts when severe defoliation due to leafspot occurs late in the season. Since disease measurements that were used in the present study were taken very shortly before harvest, the time when severe defoliation occurred could not be determined. It can also be seen in Table IX that highly significant negative correlations occurred between yield of a single 50-foot row when plotted with visual rating, number of spots per leaf, and percent defoliation Z resulting in values of -.75, -.63, and -.63, respectively. Significant negative correlations were also obtained between $YLDA_2$ and percent defoliation Z (r = -.54); $YLDA_1$ and visual rating (r = -.46); and between infection index and YLDB and YLD50P with r values of -.52 and -.54, respectively.

The possibility of using the number of pods produced from ten plants and the relative maturity of these pods as a measure of the effect of Cercospora leafspot on the infected plants was also analyzed using the 1974 data. It could be seen from Table X that the number of pods from ten plants, the percent immature, intermediate, and mature pods did not show significant differences when plants taken from three disease severity treatment levels were compared. The CV's were too high to be of practical use as a measure of the plant's response to the attack of the disease.

TABLE VIII

COEFFICIENTS OF CORRELATION BETWEEN YIELDS AND DIFFERENT METHODS OF MEASURING SEVERITY OF CERCOSPORA LEAFSPOT OF PEANUTS[a]

MEASURE OF DISEASE SEVERITY	YIELD OF TEN PLANTS	ROW YIELDS					
		25' A_1	25' A_2	50' B	50' A_1+A_2	50'[b]	100[c]
Percent defoliation H	-.52	-.90	-.89	-.65	-.92	-.70	-.90
Percent defoliation Z	-.44	-.89	-.88	-.70	-.91	-.73	-.91
Percent infection A	-.48	-.88	-.87	-.75	-.91	-.78	-.92
Percent infection B	-.41	-.83	-.82	-.73	-.85	-.75	-.87
Number of spots per leaf	-.51	-.91	-.83	-.79	-.93	-.83	-.95
Percent leaflet area damaged	-.49	-.94	-.87	-.67	-.94	-.71	-.91
Infection index	-.52	-.90	-.86	-.79	-.91	-.93	-.95
Visual rating	-.47	-.89	-.86	-.71	-.90	-.75	-.91
Ranking	-.59	-.85	-.83	-.76	-.87	-.82	-.92

a/ Correlations where yields were not adjusted for Replication and Treatment effects. (Values lower than /-.45/ are not significant and values higher than /-.56/ are highly significant.

b/ From yield of 50-foot row B plus yield of ten plants.

c/ Total of two 50-foot rows.

TABLE IX

COEFFICIENTS OF CORRELATION AMONG TEN PLANT YIELDS, ROW YIELDS AND DIFFERENT METHODS OF TAKING DISEASE SEVERITY[a/]

MEASURE OF DISEASE SEVERITY	YIELD OF TEN PLANTS	ROW YIELDS 25' A_1	25' A_2	50' B	50' A_1+A_2	50'[b/]	100[c/]
Percent defoliation H	.35	-.04	-.11	.54*	-.14	.62**	.45*
Percent defoliation Z	.55*	-.15	-.54*	.07	-.63**	.25	-.10
Percent infection A	.60**	.41	-.35	-.24	.00	-.01	-.01
Percent infection B	.53*	.18	-.37	-.07	-.20	.12	.00
Number of spots per leaf	-.06	-.15	-.54*	.07	-.63**	.25	-.10
Percent leaflet area damaged	.28	-.40	-.19	.24	-.50*	.32	.02
Infection index	-.14	.17	.33	-.52*	.45*	-.54*	-.23
Visual rating	.36	-.46*	-.41	.02	-.75**	.14	-.26
Ranking	.00	.00	.00	.00	.00	.00	.00

a/ Correlation coefficients of residuals after removing Rep and Trt effects.

b/ From yield of 50-foot row B plus yield of ten plants.

c/ Total of two 50-foot rows.

TABLE X

EFFECT OF 3 TREATMENT LEVELS TO CONTROL CERCOSPORA LEAFSPOT SEVERITY ON THE NUMBER AND MATURITY OF PODS FROM TEN PLANTS

DISEASE SEVERITY TREATMENT LEVELS[a]	NUMBER OF PODS	POD MATURITY (PERCENT)		
		IMM[b]	INT[c]	MAT[d]
LOW				
Means	703.83	54.50	27.29	18.22
Rep in Trt CV	8.85	13.36	17.31	34.93
MEDIUM				
Means	660.50	55.52	27.00	17.48
Rep in Trt CV	20.21	21.35	16.43	50.57
HIGH				
Means	577.33	61.94	25.75	12.31
Rep in Trt CV	9.60	12.63	20.64	33.58
OVERALL MEANS	647.22	57.32	26.68	16.00
REPLICATION CV	14.50	19.68	17.29	60.54
OVERALL CV (Rep x Trt)	13.80	13.93	18.55	28.58
$P > F$	.0882	.2627	.8514	.0963

[a] As in previous tables.

[b] Percent immature pods from ten plants

[c] Percent intermediate pods.

[d] Percent mature pods from ten plants.

Analysis of two-pound samples from yields of two 25-foot rows and one 50-foot row also showed that the percentage of sound mature kernels did not vary enough among the three disease severity treatment levels to show significant differences (Table XI). The low CV's that were obtained were also a consequence of the similarity in the percentage maturity of the pods whether under high or low disease treatment levels hence small variations in the values were observed.

Highly significant negative correlations were obtained from cross product analyses of percent sound mature kernels from 25-foot rows with the nine measures of disease severity (Table XII). Significant correlations were not observed when the correlations of residuals were made between the different measures of disease severity and sound mature kernels (Table XIII). It was interesting to note from the two correlation tables that there was a complete reversal in the relationship between number of pods from ten plants and the methods of taking disease severity when correlation of the residuals were run on the set of data. This shows that the negative relationships between number of pods and the different methods of taking disease severity were mostly due to treatment and replication effects and that the relationship within treatments in one replication was actually positive. The positive significant correlations are shown in Table XIII by an increase in the mature pods as percent defoliation Z, and percent infection A, and percent infection B increased. A highly significant negative correlation was obtained between number of spots per leaf and percent intermediate pods with an r value of -.61. The visual rating also showed highly significant negative correlation for percent sound mature kernels from yields of one 25-foot row plot, 50-foot row plot, and average sound mature kernels with -.59,

TABLE XI

EFFECT OF 3 TREATMENT LEVELS TO CONTROL CERCOSPORA LEAFSPOT SEVERITY ON THE PERCENTAGE OF SOUND MATURE KERNELS OF PEANUTS

DISEASE SEVERITY TREATMENT LEVELS[a]	POD ANALYSIS[b]			
	$SMKA_1$[c]	$SMKA_2$[d]	SMKB[e]	SMK[f]
LOW				
Means	71.17	71.83	68.00	70.33
Rep in Trt CV	3.13	2.70	3.95	1.50
MEDIUM				
Means	69.50	70.83	68.83	69.72
Rep in Trt CV	4.34	3.02	1.93	2.41
HIGH				
Means	68.87	68.83	68.83	68.61
Rep in Trt CV	4.29	3.89	2.50	2.76
OVERALL MEANS	69.78	70.33	68.55	69.55
REPLICATION CV	4.72	3.20	3.04	2.33
OVERALL CV (Rep x Trt)	3.48	3.23	2.84	2.15
$P > F$	.2413	.0593	.7059	.2245

a/ As in previous tables.

b/ Analysis of 2-lb. sample of pods from each row.

c/ Percent sound mature kernels from one 25-foot row (A_1).

d/ Percent sound mature kernels from another 25-foot row (A_2).

e/ Percent sound mature kernels from one 50-foot row (YLDB).

f/ Average of $SMKA_1$ + $SMKA_2$ + SMKB.

TABLE XII

COEFFICIENTS OF CORRELATION BETWEEN THE DIFFERENT MEASURES OF DISEASE SEVERITY AND POD MATURITY IN PEANUTS [a/]

MEASURE OF DISEASE SEVERITY	PODS OF TEN PLANTS	POD MATURITY[b/]			SOUND MATURE KERNELS[c/]			
		IMAT	INT	MAT	A_1	A_2	B	SMK[d/]
Percent defoliation H	-.52*	.29	-.13	-.31	-.32	-.64**	.13	-.47*
Percent defoliation Z	-.44	.27	-.17	-.25	-.34	-.62**	.15	-.45*
Percent infection A	-.46*	.29	-.16	-.28	-.31	-.59**	.12	-.44
Percent infection B	-.36	.20	-.14	-.18	-.31	-.59**	.09	-.45*
Number of spots per leaf	-.44	.40	-.20	-.41	-.33	-.56**	.08	-.44
Percent leaflet area damaged	-.47*	.35	-.13	-.38	-.37	-.57**	.12	-.46*
Infection index	-.47*	.39	-.18	-.40	-.29	-.53*	.12	-.40
Visual rating	-.43	.31	-.18	-.29	-.36	-.70**	.03	-.56*
Ranking	-.53*	.34	-.14	-.36	-.38	-.56**	.18	-.44

a/ From total correlation coefficients (unadjusted for replication and treatment effects).

b/ Percent immature, intermediate, and mature pods counted from yield of ten plants.

c/ From analysis of 2-lb. sample from each row.

d/ Average of $SMKA_1 + SMKA_2 + SMKB$

** = Significant at .01 level; * = Significant at .05 level.

-.66, and -.56, respectively.

A stepwise multiple regression procedure described in SAS (Barr and Goodnight, 1972) was used to obtain the best single and best two variables for predicting yields. Yields from plots of a given size were used as the independent variables. The variables which gave the highest R^2 value for a given year for that plot size were considered as the most suitable variables for predicting the yields for such plot size and year of study. The regression equations that were developed are presented in Tables XXIV to XXVIII of Appendix A. The same stepwise procedure was used to develop the regression equations for the different estimates of yield for each plot size and disease severity treatment levels (Tables XXIX to XL in Appendix B).

A summary of tables for the best single and best two measures of Cercospora leafspot severity which can be used in estimating the yield of experimental plots of peanuts during 1973 and 1974 is presented in Table XIV. It can be seen from the table that DEFH was the best measure of severity during two years of estimating yield of ten plants. DEFH was also best for estimating $YLDA_1$ and YLD50 in 1973 whereas DMG came out as best in 1974 for the same plot sizes. DMG was observed to be the best measure for estimation of $YLDA_2$. RANK was the best for estimating YLD50P during 1973 while INDEX was best for the same plot size in 1974. The yield of two 50-foot row plots was estimated best by DEFH in 1973 but was replaced by SPOTS in 1974. The highest R^2 value for a single measure of severity was obtained by using SPOTS as a measure of disease severity for two 50-foot row plots with .9080 followed by DMG for $YLDA_1$ and YLD50 with .8829 and .8798, respectively. Very little increase in R^2 was obtained by using more than two measures of disease severity for most

TABLE XIII

COEFFICIENTS OF CORRELATION BETWEEN THE DIFFERENT MEASURES OF DISEASE SEVERITY AND POD MATURITY (ADJUSTED FOR REPLICATION AND TREATMENT EFFECTS) IN PEANUTS[a/]

MEASURE OF DISEASE SEVERITY	PODS OF TEN PLANTS	POD MATURITY[b/]			PERCENT SOUND MATURE KERNELS[c/]			
		IMM	INT	MAT	A_1	A_2	B	SMK[d/]
Percent defoliation H	.30	-.36	.26	.36	.25	-.23	-.48*	-.18
Percent defoliation Z	.65*	-.25	-.03	.47*	-.29	-.13	-.29	-.33
Percent infection A	.75**	-.18	-.20	.54*	.00	.11	-.28	-.05
Percent infection B	.70**	-.26	-.06	.52*	-.05	.02	-.31	-.14
Number of spots per leaf	.31	.37	-.61**	.00	-.39	-.16	-.33	-.40
Percent leaflet area damaged	.27	-.12	.15	.04	-.22	.09	.30	.05
Infection index	.14	.27	-.39	-.06	-.09	.09	-.15	-.06
Visual rating	.46*	.09	-.25	.12	-.21	-.59**	-.66**	-.56**
Ranking	.00	.00	.00	.00	.00	.00	.00	.00

a/ Correlation coefficients of residuals after removing Rep and Trt effects.

b/ Percentage immature, intermediate, and mature pods counted from ten plants.

c/ Based on analysis of 2-lb. samples from each row.

d/ Average of $SMKA_1$ + $SMKA_2$ + SMKB.

** = Significant at .01 level; * = significant at .05 level.

TABLE XIV

SELECTION OF THE BEST MEASURES OF CERCOSPORA LEAFSPOT FOR PREDICTING YIELD OF EXPERIMENTAL PLOTS DURING TWO YEARS OF STUDY[a/]

PLOT SIZES	NUMBER OF PREDICTOR VARIABLE	R^2	PREDICTOR VARIABLE FOR 1973	R^2	PREDICTOR VARIABLE FOR 1974
Yield of ten plants	1	.3017	DEFH	.2705	DEFH
	2	.3127	DEFH RANK	.3613	DEFH SPOTS
Yield of 25-foot row	1	.2654	DEFH	.8829	DMG
(A_1)	2	.4172	DEFH RATING	.8953	DMG SPOTS
Yield of 25-foot row	1	.3449	DMG	.7930	DEFH
(A_2)	2	.3578	DMG RANK	.8015	DEFH SPOTS
Yield of 50-foot row	1	.4004	DEFH	.8798	DMG
($A_1 + A_2$)	2	.4162	DEFH SPOTS	.8888	DMG SPOTS
Yield of 50-foot row	1	.6878	RANK	.6852	INDEX
(B + ten plants)	2	.7209	RANK RATING	.7467	INDEX SPOTS
Yield of two 50-foot rows	1	.6081	DEFH	.9080	SPOTS
(50 + 50)	2	.6540	DEFH RANK	.9115	SPOTS INDEX

a/ Based on highest R^2 values from overall stepwise multiple regression analysis.

experimental plots. The frequency of occurrence of the best single and best two measures of disease severity are presented in Table XV. It can be seen in the table that DEFH occurred the most with 12 times followed by SPOTS with eight times. DMG, RANK, INDEX, and RATING occurred in descending frequency with six, five, three, and two times, respectively. Results of the stepwise multiple regression (Tables XVI and XVII) show that none of the measures of severity used in the study came out as the best variable for all plot sizes during the two years of study. The highest R^2 value for one measure of disease severity during 1974 can be seen from prediction of YLD50P using INDEX at high disease treatment level and DEFH at low disease treatment level with .9430 and .7964, respectively. During 1973 RATING showed the highest R^2 value at medium disease treatment level with .7766. SPOTS were also best in predicting yield of two 50-foot rows and $YLDA_1$ during 1973 at high disease treatment level with .7651 and .7619, respectively. There were considerable improvements in R^2 values when two measures of disease severity were used instead of only one as predictor of yield for different plot sizes, in a disease severity treatment level, and year of study. This shows that an increase in the amount of variation in yield can be explained by using both measurements for the disease. The large increments in the R^2 values of the predictor variables were not apparent in the overall prediction equations because the number of observations (df = 35) used in the regression procedure for Table XV was much larger than the number of observations (df = 5) used for the regression procedure by disease severity treatment levels in Table XVI and XVII. A loss of one more degree of freedom because of one additional independent variable in the regression of the latter situation resulted in wider confidence interval limits.

TABLE XV

FREQUENCY OF OCCURRENCE OF THE BEST MEASURE OF CERCOSPORA LEAFSPOT FOR 2 YEARS STUDY

MEASURE OF SEVERITY	1973	1974	TOTAL
DEFH	8	4	12
SPOTS	1	7	8
DMG	2	4	6
RANK	5	0	5
INDEX	0	3	3
RATING	2	0	2

TABLE XVII

SELECTION OF THE BEST SINGLE AND BEST 2 MEASURES OF CERCOSPORA LEAFSPOT SEVERITY FOR DIFFERENT EXPERIMENTAL PLOT SIZES (BY TREATMENT LEVELS) DURING 1974[a]

DIFFERENT PLOT SIZES	NUMBER OF PREDICTOR[b]	LOW DISEASE SEVERITY LEVEL[c]		MEDIUM DISEASE SEVERITY LEVEL[c]		HIGH DISEASE SEVERITY LEVEL[c]	
		R^2	PREDICTOR VARIABLE	R^2	PREDICTOR VARIABLE	R^2	PREDICTOR VARIABLE
Yield of ten plants	1	.0938	DEFH	.5882	DMG	.4153	SPOTS
	2	.7489	DMG SPOTS	.8376	DMG SPOTS	.5273	DEFH DMG
Yield of 25-foot row	1	.3009	RATING	.2849	RATING	.7619	SPOTS
(A_1)	2	.3150	RATING DEFH	.7365	RATING SPOTS	.8059	SPOTS RATING
Yield of 25-foot row	1	.2983	SPOTS	.1756	DEFH	.4283	RATING
(A_2)	2	.5875	SPOTS DEFH	.4884	SPOTS DMG	.5015	RATING DMG
Yield of 50-foot row	1	.4622	RATING	.1969	DEFH	.5289	SPOTS
($A_1 + A_2$)	2	.6654	RATING DEFH	.5945	DEFH DMG	.6042	DMG RATING
Yield of 50-foot row	1	.3404	DEFH	.7766	RATING	.7050	DEFH
(B + ten plants)	2	.5223	DEFH DMG	.8131	DEFH DMG	.8744	DEFH SPOTS
Yield of two 50-ft. rows	1	.3171	RATING	.5265	RATING	.7651	SPOTS
(50 + 50)	2	.7959	RATING DEFH	.6978	DEFH SPOTS	.7968	SPOTS DMG

a/ See Table I for codes and abbreviations used.
b/ Selection was based on highest R^2 values from stepwise multiple regression analysis.
c/ High = Treatment 0 (unsprayed plots); Medium = Treatment 1 (sprayed with 1/2 the recommended rate of Bravo 6F); Low = Treatment 2 (sprayed with recommended rate of Bravo 6F).

TABLE XVII

SELECTION OF THE BEST SINGLE AND BEST 2 MEASURES OF CERCOSPORA LEAFSPOT SEVERITY FOR DIFFERENT EXPERIMENTAL PLOT SIZES (BY TREATMENT LEVELS) DURING 1974[a]

DIFFERENT PLOT SIZES	NUMBER OF PREDICTOR[b]	DISEASE SEVERITY LEVELS[c]					
		R^2	LOW	R^2	MEDIUM	R^2	HIGH
Yield of ten plants	1	.3439	INDEX	.5012	RATING	.2006	DEFH
	2	.8445	INDEX DEFH	.6497	RATING INFB	.4855	DEFH RATING
Yield of 25-foot row	1	.6007	DMG	.6973	INFB	.6280	RATING
(A_1)	2	.8724	DGM DEFH	.9859	INFB INDEX	.8144	RATING DMG
Yield of 25-foot row	1	.4255	INDEX	.0966	INFA	.1237	INDEX
(A_2)	2	.9182	INDEX DEFH	.2450	INFA INFB	.7863	INDEX DMG
Yield of 50-foot row	1	.6719	DMG	.6153	INFA	.3420	INDEX
($A_1 + A_2$)	2	.9280	DMG SPOTS	.8850	INFA RATING	.7955	INDEX DMG
Yield of 50-foot row	1	.7964	DEFH	.5008	DEFH	.9432	INDEX
(B + ten plants)	2	.8535	DEFH RATING	.7144	DEFH DEFZ	.9886	INDEX DMG
Yield of two 50-ft. rows	1	.6796	INDEX	.6249	DEFH	.6232	DMG
(50 + 50)	2	.8442	INDEX SPOTS	.6610	DEFH DEFZ	.8181	DMG INDEX

a/ See Table I for codes and abbreviations used.

b/ Selection was based on highest R^2 values from stepwise multiple regression analysis.

c/ As in previous tables.

The frequency of occurrence for the best measure of disease severity again showed that DEFH had occurred the most followed by DMG, RATING, SPOTS, and INDEX in descending order. INFA, INFB, and DEFZ occurred as best measures of disease severity at the medium disease severity treatment level but not at low or high disease severity treatment levels (Table XVIII). Based on the frequency of occurrence as best single and best two predictors of yield, DEFH, DMG, RATING, SPOTS, and INDEX were found to be satisfactory variables for estimating yields in plants where Cercospora leafspot was affecting peanuts. There are, however, inherent difficulties and other disadvantages that were associated with the methods of taking the measurements when some of them were put into use. With due consideration to these difficulties, SPOTS and DEFH were chosen as the best single and best two yield predictor variables because of the consistency, simplicity, and precision of data that can be collected using these two methods. The regression equations using SPOTS and DEFH and their relationships with yield of two 50-foot row plots were further analyzed.

The data for 1973 and 1974 were used in a simple linear regression procedure (Steel and Torrie, 1960) wherein YLD50P was used as the dependent variable and SPOTS, DEFH, and DEFH and SPOTS in combination as independent variables for two years of study. The regression equations (Table XIX) show that the regression lines for 1974 were far above the regression line for 1973. The R^2 values (Table XIX) for the prediction equations when year effects were ignored were very low with high CV's and large standard deviation (SD) values. The 95 percent confidence limit intervals (CLI) on future observations at the mean value for the predictor variable were also very wide. Regressions for each year

TABLE XVIII

FREQUENCY OF OCCURRENCE OF THE DIFFERENT MEASURES AS BEST SINGLE AND BEST 2 MEASURES OF DISEASE SEVERITY

MEASURE OF SEVERITY	DISEASE SEVERITY LEVELS[a/] LOW	MEDIUM	HIGH	TOTAL
DEFH	12	8	5	25
DMG	7	5	10	22
RATING	6	8	7	21
SPOTS	5	4	7	16
INDEX	6	1	7	14
INFA	0	4	0	4
INFB	0	4	0	4
DEFZ	0	2	0	2

[a/] As in previous tables.

TABLE XIX

ABSTRACTED ANALYSES OF VARIANCE FOR THE REGRESSION EQUATIONS OF YIELD OF 50-FOOT ROW PLOTS (YLD50P) AGAINST PERCENT DEFOLIATION AND NUMBER OF SPOTS PER LEAF OF CERCOSPORA INFECTED PEANUTS

YEAR	EQUATIONS	CLI[b]	S.D.[c]	C.V.[d]	R^2[e]
	Y = 4302.89 + 3.28(DEFH)[a]	± 1515	739.01	16.37	.0102
	Y = 4564.05 - 2.49(SPOTS)[a]	± 1518	740.41	16.40	.0065
1973	Y = 5008.09 - 20.57(DEFH)	± 760	341.79	8.58	.6126
1974	Y = 6923.75 - 23.75(DEFH)	± 768	345.02	6.84	.4893
1973	Y = 4450.94 - 47.53(SPOTS)	± 780	350.57	8.80	.5924
1974	Y = 5460.02 - 13.36(SPOTS)	± 605	272.01	5.39	.6826

a/ Equation from regression analysis using both years data in which year effect was ignored.

b/ 95 percent confidence limit interval at $\bar{x}$.

c/ Standard deviation for YLD50P at $\bar{x}$.

d/ Coefficient of variation of the mean.

e/ The amount of variation that is accounted for by the predictor variable in the regression equation.

resulted in better equation with higher R^2 value, lower CV, smaller SD, and narrow CLI.

An attempt to predict the yield of 1974 using the regression equation developed from the 1973 data and vice versa for each 50-foot-row plot size showed that the values predicted by the 1974 equation were consistently higher than the upper CLI's set by the 1973 data, whereas the values predicted by the 1973 equation were consistently lower than the lower CLI's set by the 1974 data. The test for parallelism of the 1973 and 1974 regression lines for YLD50P on SPOTS showed that the lines were not parallel. When the values for YLD50 on SPOTS were plotted along with the YLD50P on SPOTS, 94 percent of the values for YLD50 were inside the CLI of YLD50P for each year. In comparison all the values for YLD50P on SPOTS were inside its CLI during 1974 and 94 percent of the 1973 points were inside its own CLI (Table XX).

TABLE XX

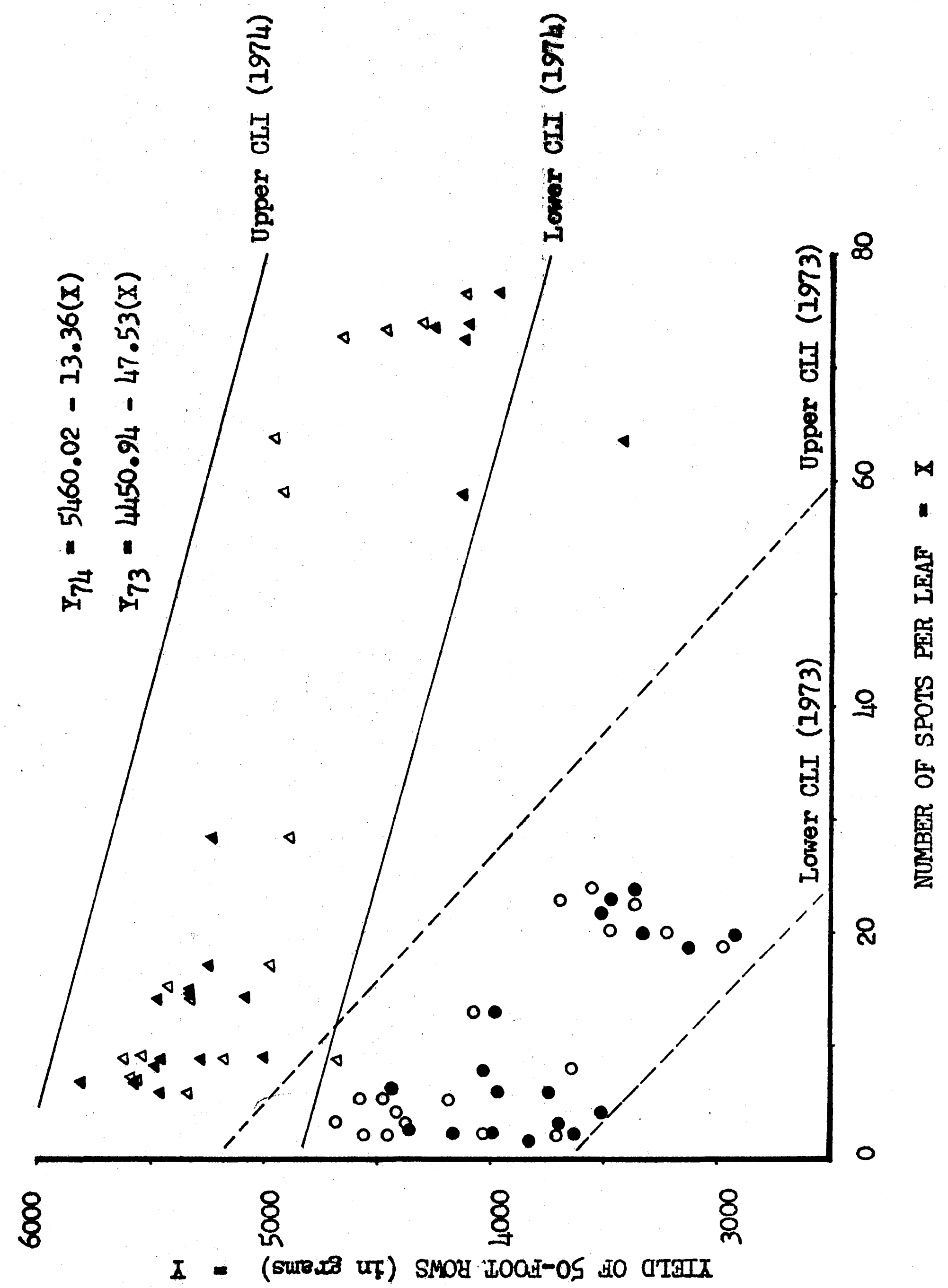
NUMBER OF OBSERVATIONS (PERCENT) WHICH FELL WITHIN THE CLI OF YLD50P ON SPOTS FOR 1973 AND 1974

YEAR	EQUATIONS	YLD50P	YLD50	TOTAL
1973	$Y = 4450.94 - 47.53(x)$	100.0	100.0	100.0
1974	$Y = 5460.02 - 13.36(x)$	94.00	94.00	94.00

Figure 4 shows the distribution of the points for the regression of yield on spots for two years of study. The CLI were set by a separate regression of YLD50P on SPOTS for 1973 data and for 1974 data. Although the data on SPOTS were obtained only from YLD50P rows, the spots on YLD50P rows can be used in the regression equation to estimate the yield on the YLD50 rows (Figure 4). Since the two 50-foot rows were from the same treatment levels and were always very close to each other in the replication, it can be assumed that plants in both rows had approximately the same number of spots per leaf and that the effect of the number of spots on the yield from either of the two rows was the same.

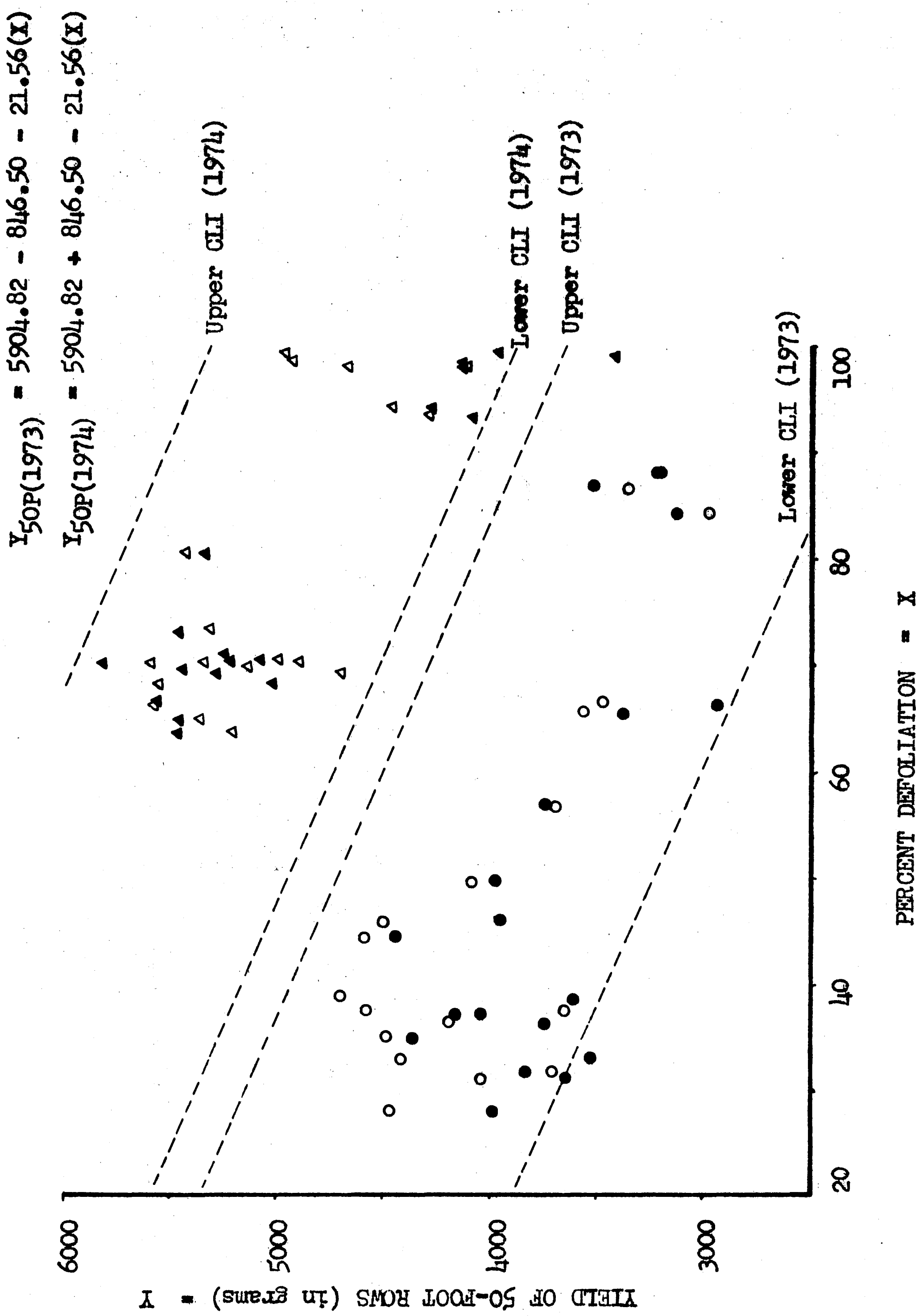
The regression of YLD50P on DEFH was studied in the same manner as YLD50P on SPOTS. The test for parallelism of the regression lines of YLD50P on DEFH during 1973 and 1974 showed that the regression lines were parallel, having a common slope of -.21.56. The F value was .1896 with 32 degrees of freedom associated with the error mean square. Plotting of the values for YLD50 into the CLI set by YLD50P were inside the CLI of YLD50P during 1973, while 94 percent of the 1974 values fell within the CLI for the 1974 equation (Table XXI). It can be seen also in Table XXI that all of the values for YLD50P on DEFH during 1973 and 1974 were within the CLI. The distribution of the values for the regression of yield on DEFH during 1973 and 1974 is shown in Figure 5. The CLI for the regression was set by an equation from YLD50P on DEFH for 1973 and 1974 data combined in which an adjustment for year effect was made. The result also shows that percent defoliation in YLD50P rows can be used to estimate the yield in YLD50 rows and that adjustments for row effects on this design of experiment is not necessary. The year adjustment is a

Figure 4. Relationship Between Yields of 50-Foot Row Plots and Number of Spots Per Leaf on Cercospora Leafspot-Infected Peanuts. The CLI represented by solid lines was set by YLD50P on SPOTS for 1974 while the broken lines was CLI set by YLD50P on SPOTS for 1973. (△ = YLD50P on SPOTS during 1974; ▲ = YLD50 on SPOTS during 1974; ○ = YLD50P on SPOTS during 1973; ● = YLD50 on SPOTS during 1973).



$Y_{74} = 5460.02 - 13.36(X)$
$Y_{73} = 4450.94 - 47.53(X)$
Upper CLI (1974)
Lower CLI (1974)
Upper CLI (1973)
Lower CLI (1973)
YIELD OF 50-FOOT ROWS (in grams) = Y
6000
5000
4000
3000
NUMBER OF SPOTS PER LEAF = X
0
20
40
60
80

Figure 5. Relationship Between Yield of 50-Foot Row Plots and Percent Defoliation on Cercospora Leafspot-Infected Peanuts. The broken lines represent the upper and lower CLI for YLD50P on DEFH during 1973 and 1974. (△ = YLD50P on DEFH during 1974; ▲ = YLD50 on DEFH during 1974; ○ = YLD50P on DEFH during 1973; ● = YLD50 on DEFH during 1973).



$Y_{50P(1973)} = 5904.82 - 846.50 - 21.56(X)$
$Y_{50P(1974)} = 5904.82 + 846.50 - 21.56(X)$
Upper CLI (1974)
Lower CLI (1974)
Upper CLI (1973)
Lower CLI (1973)
6000
5000
4000
3000
YIELD OF 50-FOOT ROWS (in grams) = Y
20
40
60
80
100
PERCENT DEFOLIATION = X

+ 846.50 for the 1974 year and a -846.50 for the 1973 year. This is indicated in Table XXI.

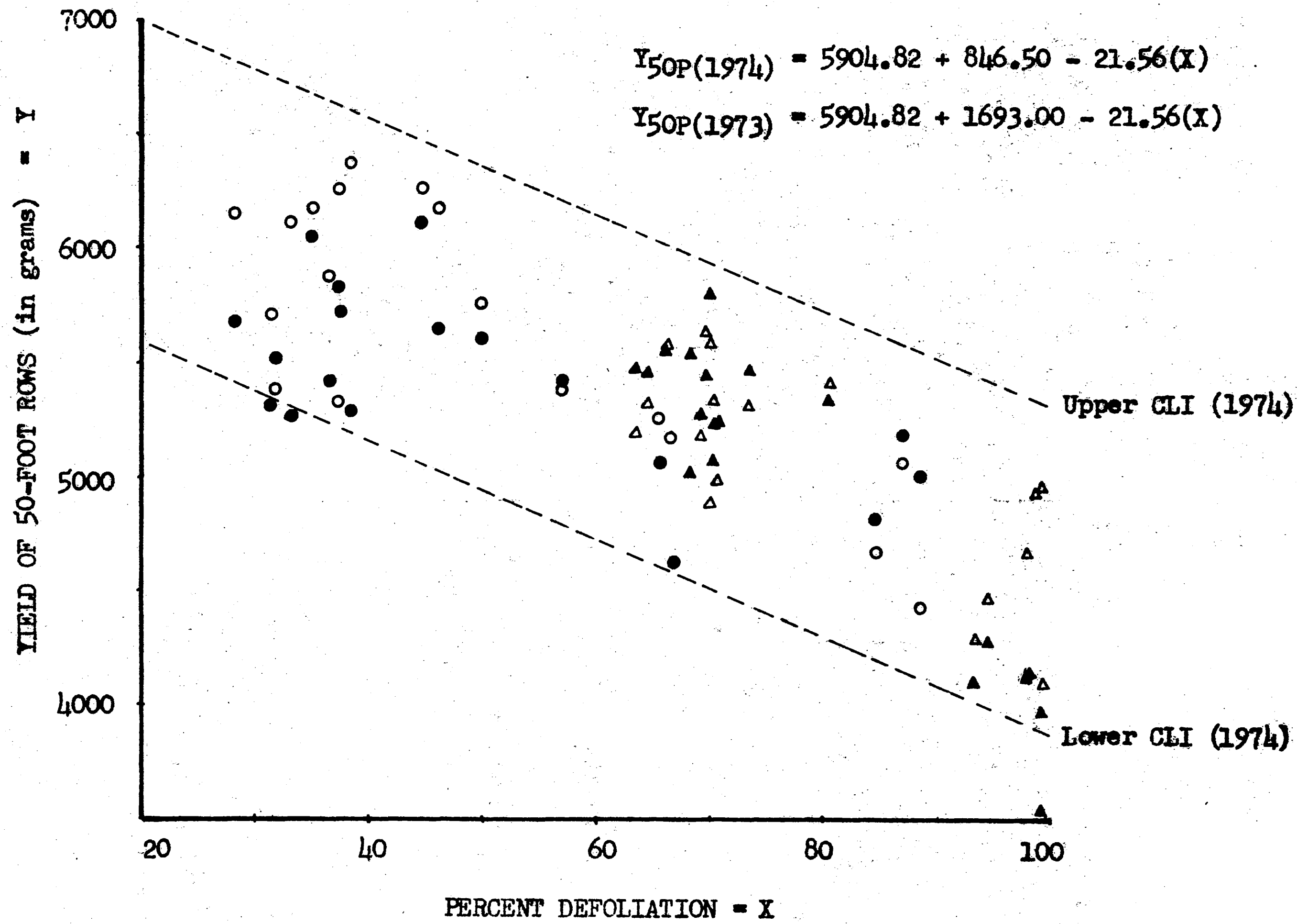
TABLE XXI

NUMBER OF OBSERVATIONS (PERCENT) WHICH FELL WITHIN THE CLI OF YLD50P ON DEFH FOR 1973 AND 1974

YEAR	EQUATIONS	YLD50P	YLD50	TOTAL
1973	Y = 5904.82 - 846.50 - 21.56(x)	100.00	88.89	94.44
1974	Y = 5904.82 + 846.50 - 21.56(x)	100.0	94.44	97.22

Assuming the variances among DEFH for 1973 and 1974 were equal and the regression lines of YLD50P on DEFH for the two years were parallel, adjustments of the 1973 data to the 1974 year were made by adding a year effect of 1693.00 gms. to the 1973 data. The adjusted values were then plotted onto the CLI set by the regression of YLD50P on DEFH for the year 1974 (Figure 6). It can be seen in Figure 6 that all of the adjusted values of YLD50P on DEFH during 1973 were inside the CLI and 89 percent of the adjusted values of YLD50 on DEFH were inside the CLI. It is also seen that all of the YLD50P and 94 percent of the YLD50 for 1974 were in the CLI. This study shows that the regression line estimates the yields by making an additive adjustment for the year effect.

Figure 6. Relationship Between the Adjusted Yields of 50-Foot Row Plots During 1973 and Unadjusted Yields of 50-Foot Row Plots During 1974 as Affected by Percent Defoliation on Cercospora Infected Peanuts. The broken lines represent the upper and lower CLI of YLD50P on DEFH during 1974. (△ = YLD50P on DEFH during 1974; ▲ = YLD50 on DEFH during 1974; ○ = YLD50P on DEFH during 1973; ● = YLD50 on DEFH during 1973).



$Y_{50P(1974)}$ = 5904.82 + 846.50 - 21.56(X)
$Y_{50P(1973)}$ = 5904.82 + 1693.00 - 21.56(X)
Upper CLI (1974)
Lower CLI (1974)
7000
6000
5000
4000
YIELD OF 50-FOOT ROWS (in grams) = Y
20
40
60
80
100
PERCENT DEFOLIATION = X

The regression equations that were obtained using YLD50P and combination of two predictor variables, DEFH and SPOTS during 1973 and 1974, are shown in Table XXII. Considerable improvement in the R^2 values of the equations was obtained when the regression was done for separate years and one plot size. When the prediction equation obtained from the regression of YLD50P on DEFH and SPOTS was tested, 33 percent of the values predicted by the 1973 data were within the CLI set by the regression of YLD50P on DEFH and SPOTS for 1974. On the other hand, 50 percent of the predicted values from YLD50P on DEFH and SPOTS during 1974 were inside the CLI set by YLD50P on DEFH and SPOTS for 1973.

When the values from YLD50 were plotted by using the CLI set by DEFH and SPOTS from the YLD50P rows, 94 percent of the observations from YLD50 on DEFH and SPOTS for 1973 were inside the CLI and 89 percent of the observations from YLD50 on DEFH and SPOTS for 1974 were inside 1974 CLI (Table XXIII). In comparison, 94 percent of the observations from YLD50P on DEFH and SPOTS were inside its CLI and 100 percent of the 1974 points were inside its own CLI. This result shows that amount of defoliation and number of spots in the YLD50P rows can be used to estimate the yields in the adjacent row. Since the slopes for YLD50 and YLD50P were not parallel for two years, there was no attempt to make yield adjustments for year effects.

TABLE XXII

ABSTRACTED ANALYSES OF VARIANCE FOR THE REGRESSION OF COMBINED EFFECTS OF PERCENT DEFOLIATION AND SPOTS ON YIELD OF 50-FOOT ROW PLOTS (YLD50P) OF PEANUTS

YEAR	EQUATIONS	CLI[b]	S.D.[c]	C.V.[d]	R^2[e]
	Y = 3890.07 + 13.72(DEFH) - 12.76(SPOTS)[a]	±1486	724.80	16.06	.0759
1973	Y = 4812.50 - 12.26(DEFH) - 22.03(SPOTS)	± 756	339.98	8.54	.6406
1974	Y = 3448.74 + 30.95(DEFH) - 27.38(SPOTS)	± 542	243.55	4.83	.7614

a/ Equation from regression analysis where the two years were not analyzed separately.

b/ 95 percent confidence limit interval at $\bar{x}$.

c/ Standard deviation for YLD50P at $\bar{x}$.

d/ Coefficient of variation of the means.

e/ The amount of variation that is accounted for by the predictor variable in the regression equation.

TABLE XXIII

NUMBER OF OBSERVATIONS (PERCENT) WHICH FELL WITHIN THE CLI OF YLD50P ON DEFH AND SPOTS FOR 1973 AND 1974

YEAR	EQUATION	YLD50P	YLD50	TOTAL
1973	Y = 4812.50 - 12.29(DEFH) - 22.03(SPOTS)	100	94	97.22
1974	Y = 3448.74 + 30.95(DEFH) - 27.38(SPOTS)	94	89	91.67

CHAPTER V

SUMMARY AND CONCLUSION

Three disease severity levels of Cercospora leafspot on peanuts were successfully produced by careful application of Bravo 6F on experimental plots of varying sizes during 1973 and 1974. These disease severity levels correspond with the treatment levels of 0 or no spray applied (high disease severity), 1/2 the recommended rate of Bravo 6F (medium disease severity), and the recommended rate of Bravo 6F (low disease severity). Highly significant differences in the amount of disease present among the treatment plots were shown by the different measures of disease severity which were evaluated. The imposed treatments on the plots also produced significant differences in yields of plants for nearly all plot sizes except in yields of 25-foot row plots and yield of ten plants. The tests for correlations showed that high negative correlation values were obtained between disease severity treatment levels and yields (unadjusted for replication and treatment effects). In some instances, however, positive correlations were obtained when the relationships between the variables were adjusted for replication and treatment effects (correlation of residuals).

Use of EMS and CV's for selection of appropriate plot size on yield studies for peanuts showed that yield from ten plants had very high CV. The CV of one 25-foot row plot is low enough for good research results. For reasons of practicality and flexibility in harvesting, it is recommended that two 50-foot rows for each treatment should be planted. Twenty-five-foot row sections can later be designated along the 50-foot rows for gathering data.

Comparison of nine methods of measuring the severity of Cercospora leafspot in experimental plots showed that taking percent defoliation by plant height measurement had less variability than counting number of leaflets defoliated from the main stem. Likewise, determining percent infection based on the number of leaflets attached to the main stem was less variable than using the total number of leaflets as the basis for calculating percent infection due to the disease. Although ranking showed CV's of zero and was the easiest to use in the field, the method was not recommended for critical evaluation of the disease because of its subjective nature. The same objections are brought about when using visual rating as a measure of disease severity.

The method for determining the infection index and number of spots per leaf require about the same amount of time for gathering data and the information that can be obtained using one method can be used to calculate the other. Similar CV's were also obtained from analysis of variances for these two methods. Percent leaflet area damaged was a very close approximation of the actual damage inflicted by leafspot to the plant. The method, however, was so tedious and time consuming that it was impractical for use in the field. It was also the method which gave the highest CV among the measures of disease severity used.

The correlation coefficients for nine methods of taking disease severity with yields from different plot sizes (unadjusted for treatment and replication effect) showed highly significant negative values except in the yield of ten plants. Correlation coefficients of residuals showed, however, that significant positive correlation occurred between percent defoliation H and yield of 50-foot row plots where ten plants were removed (r = .54); and between percent defoliation Z, percent infection A, percent infection B, and yield of ten plants with r values of .55, .60, and .53, respectively. Highly significant negative correlation of residuals was obtained between yield of 50-foot row (YLD50) plotted against visual rating, number of spots per leaf, and percent defoliation Z with r values of -.75, -.63, and -.63, respectively (for 17 df; r values of .45 to .55 were significant at .05 level while r values of .56 and above were highly significant at the .01 level).

The three disease severity treatment levels did not result in significant differences among number of pods from ten plants, or percent immature, intermediate, and mature pods from ten plants. Insignificant differences were also obtained for percent sound mature kernels from 2-lb. samples of pods from two 25-foot rows and one 50-foot row plots. The high negative correlation values for pod analyses and measures of disease severity were found to be due mostly to replication and treatment effects. The correlation coefficient of residuals showed positive correlations when percent mature pods from ten plants were plotted against percent defoliation Z and percent infection B. Other combinations of yield and measure of disease severity which showed significant negative correlations among residuals were between number of spots per leaf and intermediate pods (-.61); between visual rating and percent sound mature kernels from 25-foot row (-.59) and between visual rating and yield of 50-foot rows where ten plants were removed (-.66); and also between visual rating and yield of two 50-foot rows (-.56).

The stepwise multiple regression of yield from different plot sizes on nine measures of Cercospora leafspot showed that DEFH, SPOTS, DMG, RANK, and INDEX were suitable measures of disease severity on Cercospora-infected peanuts. Improvement in the R^2 values of the regression was achieved by using two good measures of disease severity compared to using only one measure of severity as predictor variable of yield for different plot sizes. Multiple regression analysis of yield for different plot size against the different measures of severity, (by treatment levels), also showed DEFH to occur most frequently as the single best predictor of yield, followed by DMG, RATING, SPOTS, INDEX, INFA, INFB, and DEFZ in descending number of occurrences. With due consideration to the disadvantages and other difficulties associated with the other methods, DEFH and SPOTS were chosen as the best single and best two yield predictor variables because of the consistency, simplicity, and precision of data that can be collected using these two methods.

When the regression equation of YLD50P on SPOTS for 1973 was used to predict YLD50P in 1974, and vice versa, the values predicted by the 1973 equation were consistently lower than the lower CLI set by the 1974 data while the values predicted by the 1974 equation were consistently higher than the upper CLI set by the 1973 data. Adjustments for year effect could not be done, however, because the test for parallelism of the regression lines for 1973 and 1974 showed that they were not parallel. When the points for YLD50 on SPOTS were plotted into the CLI of YLD50P on SPOTS during 1973 and 1974, 94 percent of the values for YLD50 were inside the CLI for each year. In comparison, all of the values for YLD50P on SPOTS during 1973 were inside its CLI and 94 percent of the values in 1974 were inside its own CLI.

The regression equation of YLD50P on DEFH during 1973 was also used to predict the yield of YLD50P during 1974 and vice versa. The regression lines for 1973 and 1974 were parallel having a common slope of -.21.56 and an F = .1896 for 32 degrees of freedom. Adjustment for year effect can be made on the 1973 data to 1974 by adding 1693.00 gm to YLD50P during 1973. When the points for YLD50 on DEFH were plotted into the CLI of YLD50P on DEFH, 89 percent of YLD50 were inside the CLI during 1973 and 94 percent were inside the CLI during 1974. In comparison, all of the values for YLD50P on DEFH were inside its own CLI for each year. Plotting the adjusted yield values for 1973 data into the CLI set by the unadjusted values of YLD50P on DEFH for 1974 data showed that all of the adjusted values of YLD50 on DEFH were inside the CLI. In comparison, 100 percent of the unadjusted YLD50P on DEFH were inside its own CLI and 94 percent of YLD50 on DEFH during 1974 were inside the CLI.

Using DEFH and SPOTS, in combination, as the predictor variable for YLD50P resulted in 33 percent success when the regression equation for 1973 was used to predict YLD50P for 1974. On the other hand, when the prediction was made by the 1974 regression equation, 50 percent of the predicted YLD50P for 1973 were inside the CLI of YLD50P on DEFH and SPOTS during 1973. Fitting of the YLD50 values into the CLI set by YLD50P on DEFH and SPOTS showed 94 percent of the observations for 1973 were inside the CLI of 1973 and 89 percent of the YLD50 observations for 1974 were inside the CLI of YLD50P on DEFH and SPOTS for 1974.

It was shown in this study that a high negative correlation existed between yield and disease severity levels of Cercospora leafspot in peanuts. The negative relationship was described best by the linear regression of YLD50P on DEFH and YLD50P on DEFH and SPOTS. High percentages of success in predicting yield of 50-foot row plots were obtained by using the prediction equation that was developed for a given year of study. It was also shown that using the regression of YLD50P on DEFH and SPOTS (in combination) resulted in better success in predicting the yield of 50-foot row plots (regardless of year effect) for future tests compared to using DEFH or SPOTS singly as a predictor variable.

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APPENDIX A

TABLE XXIV

BEST SINGLE MEASURE OF SEVERITY OF CERCOSPORA LEAFSPOT OF PEANUTS BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT YIELDS DURING 1973

YIELDS	R^2-VALUE	Y = a + bX	C.V.	P > F
Yield of ten plants	.3017	471.45 - 2.10(DEFH)	18.23	0.174
Yield of 25 feet of row (A_1)	.2654	2113.89 - 5.87(DEFH)	11.21	.0272
Yield of 25 feet of row (A_2)	.3449	2143.22 - 19.00(DMG)	12.41	.0101
Yield of 50 feet of row (A_1 + A_2)	.4004	4370.71 - 12.68(DEFH)	8.67	.0050
Yield of 50 feet of row (B + ten plants)	.6878	5033.38 - 525.85(RANK)	7.71	.0001
Yield of 100 feet of row (50 + 50)	.6081	9378.81 - 33.25(DEFH)	7.22	.0003

TABLE XXV

BEST SINGLE MEASURE OF SEVERITY OF CERCOSPORA LEAFSPOT OF PEANUTS BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT YIELDS DURING 1974

YIELDS	R^2-VALUE	Y = a + bX	C.V.	P > F
Yield of ten plants	.2705	839.76 - 3.39(DEFH)	13.82	.0250
Yield of 25 feet of row (A_1)	.8829	2854.12 - 27.89(DMG)	5.47	.0001
Yield of 25 feet of row (A_2)	.7930	4243.34 - 22.58(DEFH)	6.67	.0001
Yield of 50 feet of row (A_1 + A_2)	.8798	5658.01 - 51.74(DMG)	5.14	.0001
Yield of 50 feet of row (B + ten plants	.6852	5445.93 - 1.36(INDEX)	5.37	.0001
Yield of 100 feet of row (50 + 50)	.9089	11069.30 - 35.94(SPOTS)	3.41	.0001

TABLE XXVI

BEST SINGLE MEASURE OF SEVERITY OF CERCOSPORA LEAFSPOT OF PEANUT BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT ANALYSIS OF POD MATURITY DURING 1974

POD ANALYSIS	R^2-VALUES	Y = a + bX	C.V.	P > F
Sound mature kernels (A_1)	.1400	70.96 - .08(DMG)	3.83	.1230
Sound mature kernels (A_2)	.4902	74.81 - 1.43(RATING)	2.73	.0015
Percent sound mature kernels (SMK)[a/]	.3141	71.83 - .72(RATING)	2.03	.0149
Rowplot SMK 25 [b/]	.2715	73.53 - 1.11(RATING)	3.32	.0014
Rowplot SMK 50[c/]	.0215	67.58 + 0.01(DEFZ)	2.77	.6012[d/]

a/ SMK analysis for one 50-foot row.

b/ Average of $SMKA_1$ + $SMKA_2$.

c/ Average of $SMKA_1$ + $SMKA_2$ + SMKB.

d/ None of the variables entered into the model met the required .5000 significance level.

TABLE XXVII

BEST 2 MEASURES OF SEVERITY OF CERCOSPORA LEAFSPOT OF PEANUTS BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

YIELDS	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P > F
Yield of ten plants	.3127	467.02 - 2.75(DEFH) + 18.44(RANK)	18.68	.0590
Yield of 25 feet of row (A_1)	.4172	1752.54 - 12.39(DEFH) + 238.49(RATING)	10.31	.0172
Yield of 25 feet of row (A_2)	.3578	2237.96 - 10.30(DMG) - 99.14(RANK)	12.69	.0353
Yield of 50 feet of row ($A_1 + A_2$)	.4162	4258.72 - 7.94(DEFH) - 12.62(SPOTS)	8.84	.0174
Yield of 50 feet of row (B + ten plants)	.7209	4483.84 - 818.41(RANK) + 394.10(RATING)	7.52	.0002
Yield of 100 feet of row (50 + 50)	.6540	9479.55 - 18.46(DEFH) - 419.30(RANK)	7.01	.0006

TABLE XXVIII

BEST 2 MEASURES OF SEVERITY OF CERCOSPORA LEAFSPOT OF PEANUTS BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

YIELDS	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P>F
Yield of ten plants	.3613	1118.21 - 12.74(DEFH) + 6.52(DEFZ)	13.35	.0339
Yield of 25 feet of row (A_1)	.8953	2307.50 - 35.85(DMG) + 7.99(INFB)	5.35	.0001
Yield of 25 feet of row (A_2)	.8015	3785.61 - 15.37(DEFH) - 3.61(SPOTS)	6.75	.0001
Yield of 50 feet of row ($A_1 + A_2$)	.8888	6686.21 - 35.31(DMG) - 16.02(DEFH)	5.11	.0001
Yield of 50 feet of row (B + ten plants)	.7467	3448.74 - 27.38(SPOTS)+ 30.95(DEFH)	4.83	.0001
Yield of 100 feet of row (50 + 50)	.9115	11296.36 - 30.93(SPOTS)- 121.71(RATING)	3.47	.0001

APPENDIX B

TABLE XXIX

BEST SINGLE MEASURE OF CERCOSPORA LEAFSPOT OF PEANUT AT LOW LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

YIELDS	R^2-VALUE	$Y = a + bX$	C.V.	$P > F$
Yield of ten plants	.0938	154.50 + 6.81(DEFH)	23.46	.5582[a]
Yield of 25 feet of row (A_1)	.3009	604.50 + 550.00(RATING)	13.47	.2595
Yield of 25 feet of row (A_2)	.2983	2534.61 - 200.86(SPOTS)	12.32	.2620
Yield of 50 feet of row ($A_1 + A_2$)	.4622	1911.50 + 908.00(RATING)	7.29	.1366
Yield of 50 feet of row (B + ten plants)	.3404	3272.42 + 34.59(DEFH)	4.63	.2236
Yield of 100 feet of row (50 + 50)	.3171	6153.80 + 999.80(RATING)	5.09	.2442

[a] None of the variables entered into the model met the required .5000 significance level.

TABLE XXX

BEST SINGLE MEASURE OF CERCOSPORA LEAFSPOT OF PEANUT AT MEDIUM LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

PLOT SIZE	R^2-VALUE	Y = a + bX	C.V.	P > F
Yield of ten plants	.5882	497.42 - 9.22(DMG)	11.08	.0749
Yield of 25 feet of row (A_1)	.2849	1611.61 + 144.16(RATING)	3.24	.2754
Yield of 25 feet of row (A_2)	.1756	1312.89 + 16.39(DEFH)	13.70	.5891[a/]
Yield of 50 feet of row ($A_1 + A_2$)	.1969	3357.11 + 15.74(DEFH)	6.08	.6200[a/]
Yield of 50 feet of row (B + ten plants)	.7766	321.84 + 1346.45(RATING)	5.03	.0212
Yield of 100 feet of row (50 + 50)	.5265	3731.53 + 1556.50(RATING)	5.21	.1020

a/ None of the variables entered in the model met the required .5000 significant level.

TABLE XXXI

BEST SINGLE MEASURE OF CERCORPORA LEAFSPOT OF PEANUT AT HIGH LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

PLOT SIZE	R^2-VALUE	Y = a + bX	C.V.	P > F
Yield of ten plants	.4153	47.31 - 16.96(SPOTS)	15.52	.1664
Yield of 25 feet of row (A_1)	.7619	236.38 + 67.20 (SPOTS)	5.43	.0240
Yield of 25 feet of row (A_2)	.4283	3208.53 - 417.31(RATING)	8.28	.1578
Yield of 50 feet of row ($A_1 + A_2$)	.5289	1304.58 + 96.56(SPOTS)	6.52	.1009
Yield of 50 feet of row (B + ten plants)	.7050	4586.54 - 15.98(DEFH)	4.57	.0369
Yield of 100 feet of row (50 + 50)	.7651	2717.49 + 190.61(SPOTS)	3.74	.0234

TABLE XXXII

BEST SINGLE MEASURE OF CERCOSPORA LEAFSPOT OF PEANUT AT LOW LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

PLOT SIZE	R^2-VALUE	Y = a + bX	C.V.	P> F
Yield of ten plants	.3439	775.18 - 2.26(DISNDX)	6.75	.2007
Yield of 25 feet of row (A_1)	.6007	3304.78 - 144.97(DMG)	5.04	.0700
Yield of 25 feet of row (A_2)	.4255	3144.24 - 6.91(DISNDX)	4.06	.1596
Yield of 50 feet of row ($A_1 + A_2$)	.6719	6255.41 - 205.15(DMG)	3.07	.0460
Yield of 50 feet of row (B + ten plants)	.7964	1446.49 + 59.66(DEFH)	1.62	.0178
Yield of 100 feet of row (50 + 50)	.6796	12286.15 - 21.81(DISNDX)	1.89	.00438

TABLE XXXIII

BEST SINGLE MEASURE OF CERCOSPORA LEAFSPOT OF PEANUT AT MEDIUM LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

PLOT SIZE	R^2-VALUE	Y = a + bX	C.V.	P > F
Yield of ten plants	.5012	29.93 + 196.57(RATING)	16.08	.1149
Yield of 25 feet of row (A_1)	.6973	1564.11 + 13.71(INFB)	2.50	.0439
Yield of 25 feet of row (A_2)	.0966	2466.71 + 3.36(INFA)	2.20	.5521[a/]
Yield of 50 feet of row ($A_1 + A_2$)	.6153	4292.22 + 20.12(INFA)	1.70	.0646
Yield of 50 feet of row (B + ten plants)	.5008	1586.30 + 48.42(DEFH)	4.60	.1151
Yield of 100 feet of row (50 + 50)	.6249	5854.67 + 62.26(DEFH)	2.25	.0611

[a/] None of the variables entered into the model met the required .5000 significance level.

TABLE XXXIV

BEST SINGLE MEASURE OF CERCOSPORA LEAFSPOT OF PEANUT AT HIGH LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

PLOT SIZE	R^2-VALUE	Y = a + bX	C.V.	P > F
Yield of ten plants	.2006	1303.36 - 8.16(DEFH)	9.26	.3750
Yield of 25 feet of row (A_1)	.6280	3085.95 - 235.43(RATING)	4.31	.0601
Yield of 25 feet of row (A_2)	.1237	1367.45 + .98(DISNDX)	12.52	.5022[a/]
Yield of 50 feet of row (A_1 + A_2)	.3420	2635.95 + 2.02(DISNDX)	6.81	.2222
Yield of 50 feet of row (B + ten plants)	.9432	7161.07 - 3.85(DISNDX)	2.02	.0023
Yield of 100 feet of row (50 + 50)	.6232	6358.30 + 70.03(DMG)	2.82	.0618

[a/] None of the variables entered into the model met the required .50000 significance level.

TABLE XXXV

BEST 2 MEASURES OF CERCOSPORA LEAFSPOT OF PEANUT AT LOW LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

PLOT SIZE	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	$P > F$
Yield of ten plants	.7489	465.52 - 204.82(DMG) + 254.07(SPOTS)	14.26	.1263[a/]
Yield of 25 feet of row (A_1)	.3150	1048.88 + 487.17(RATING) - 9.11(DEFH)	15.40	.5682
Yield of 25 feet of row (A_2)	.5875	1282.83 - 232.93(SPOTS) + 39.11(DEFH)	10.91	.2649
Yield of 50 feet of row ($A_1 + A_2$)	.6654	3924.74 + 85.50(DMG) - 689.26(RATING)	6.89	.2490
Yield of 50 feet of row (B + ten plants)	.5223	1903.11 + 47.93(DEFH) + 422.55(RATING)	4.54	.3302
Yield of 100 feet of row (50 + 50)	.7959	1566.91 + 1648.36(RATING) + 93.99(DEFH)	3.21	.0925

[a/] None of the variables entered in the model met the .5000 significance level.

TABLE XXXVI

BEST 2 MEASURES OF CERCOSPORA LEAFSPOT OF PEANUT AT MEDIUM LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

PLOT SIZE	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P > F
Yield of ten plants	.8376	500.10 - 21.38(DMG) + 18.69(SPOTS)	4.57	.2039
Yield of 25 feet of row (A_1)	.7365	1506.36 + 211.12(RATING) - 13.12(SPOTS)	2.27	.1357
Yield of 25 feet of row (A_2)	.4884	2024.29 + 111.58(SPOTS) - 75.04(DMG)	12.46	.3662[a]
Yield of 50 feet of row ($A_1 + A_2$)	.5945	2861.10 + 37.96(DEFH) - 41.44(DMG)	4.99	.2582[a]
Yield of 50 feet of row (B + ten plants)	.8131	28.60 + 1501.12(RATING) - 16.27(DMG)	5.31	.0810
Yield of 100 feet of row (50 + 50)	.6978	4613.10 + 104.78(DEFH) - 123.84(SPOTS)	4.81	.1665

[a] None of the variables entered in the model met the .5000 significance level.

TABLE XXXVII

BEST 2 MEASURES OF CERCOSPORA LEAFSPOT OF PEANUT AT HIGH LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1973

PLOT SIZE	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P > F
Yield of ten plants	.5273	210.55 - 1.85(DEFH) + 10.54(DMG)	16.11	.3250
Yield of 25 feet of row (A_1)	.8059	-366.81 + 71.86(SPOTS) + 138.42(RATING)	5.67	.0857
Yield of 25 feet of row (A_2)	.5015	2964.55 - 475.87(RATING) + 20.33(DMG)	8.93	.3521
Yield of 50 feet of row ($A_1 + A_2$)	.6042	3924.74 + 85.50(DMG) - 689.26(RATING)	6.90	.2490
Yield of 50 feet of row (B + ten plants)	.8744	3024.50 - 11.26(DEFH) + 57.51(SPOTS)	3.44	.0442
Yield of 100 feet of row (50 + 50)	.7968	3748.20 + 167.24(SPOTS) - 7.20(DEFH)	4.02	.0919

TABLE XXXVIII

BEST 2 MEASURES OF CERCOSPORA LEAFSPOT OF PEANUT AT LOW LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

PLOT SIZE	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P > F
Yield of ten plants	.8445	1851.09 - 3.76(DISNDX) - 14.62(DEFH)	3.80	.0612
Yield of 25 feet of row (A_1)	.8724	711.92 - 158.39(DMG) + 39.34(DEFH)	3.29	.0452
Yield of 25 feet of row (A_2)	.9182	6078.85 - 11.01(DISNDX) - 39.88(DEFH)	1.77	.0227
Yield of 25 feet of row ($A_1 + A_2$)	.9280	5494.29 - 484.88(DMG) + 257.79(SPOTS)	1.66	.0186
Yield of 50 feet of row (B + ten plants)	.8535	972.76 + 70.86(DEFH) - 135.04(RATING)	1.59	.0559
Yield of 100 feet of row (50 + 50)	.8442	13115.32 - 22.91(DISNDX) - 106.49(SPOTS)	1.52	.0614

TABLE XXXIX

BEST 2 MEASURES OF CERCOSPORA LEAFSPOT OF PEANUT AT MEDIUM LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

PLOT SIZE	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P > F
Yield of ten plants	.6497	963.65 + 536.96(RATING) - 23.78(INFB)	15.56	.2075
Yield of 25 feet of row (A_1)	.9859	1728.73 + 13.49(INFB) - 1.02(DISNDX)	.60	.0016
Yield of 25 feet of row (A_2)	.2450	2779.05 + 23.06(INFA) - 16.18(INFB)	2.33	.6576[a]
Yield of 50 feet of row ($A_1 + A_2$)	.8850	3143.86 + 96.36(INFA) - 932.97(RATING)	1.07	.0385
Yield of 50 feet of row (B + ten plants)	.7144	856.71 + 78.26(DEFH) - 24.36(DEFZ)	4.02	.1530
Yield of 100 feet of row (50 + 50)	.6610	5509.64 + 76.37(DEFH) - 11.52(DEFZ)	2.48	.1976

a/ None of the variables entered into the model met the required .5000 significance level.

TABLE XL

BEST 2 MEASURES OF CERCOSPORA LEAFSPOT OF PEANUT AT HIGH LEVEL OF DISEASE SEVERITY BASED ON R^2 VALUES AND THEIR CORRESPONDING REGRESSION EQUATIONS FOR DIFFERENT PLOT SIZES DURING 1974

PLOT SIZES	R^2-VALUE	$Y = a + b_1X_1 + b_2X_2$	C.V.	P > F
Yield of ten plants	.4855	2468.48 - 26.41(DEFH) + 128.19(RATING)	8.58	.3693
Yield of 25 feet of row (A_1)	.8144	3376.29 - 204.52(RATING) - 13.91(DMG)	3.51	.0801
Yield of 25 feet of row (A_2)	.7863	-4278.91 + 4.81(DISNDX) + 97.53(DMG)	7.14	.0991[a]
Yield of 50 feet of row (A_1 + A_2)	.7955	-3139.33 + 5.93(DISNDX) + 99.76(DMG)	4.39	.0928
Yield of 50 feet of row (B + ten plants)	.9886	5061.71 - 2.43(DISNDX) + 36.26(DMG)	1.04	.0012
Yield of 100 feet of row (50 + 50)	.8181	1922.38 + 136.03(DMG) + 3.50(DISNDX)	2.27	.0777

[a] None of the variables entered in the model met the required .5000 significance level.

APPENDIX C

TABLE XLI

AREA OF INDIVIDUAL LEAFSPOTS (SQ. MM.) ON LEAVES OF CERCOSPORA INFECTED PEANUTS

NUMBER OF SPOTS	DIAMETERS OF INDIVIDUAL LEAFSPOTS[a/]								
	1.0	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
1	.0079	.0314	.0491	.0707	.0962	.1257	.1590	.1963	.2376
2	.0157	.0628	.0982	.1414	.1924	.2513	.3181	.3927	.4752
3	.0236	.0942	.1473	.2121	.2886	.3770	.4771	.5890	.7127
4	.0314	.1256	.1964	.2828	.3848	.5026	.6362	.7854	.9503
5	.0393	.1570	.2465	.3535	.4810	.6283	.7952	.9817	1.1879
6	.0471	.1884	.2946	.4242	.5772	.7540	.9543	1.1780	1.4255
7	.0550	.2198	.3437	.4949	.6734	.8796	1.1130	1.3744	1.6630
8	.0628	.2512	.3928	.5656	.7696	1.0053	1.2723	1.5707	1.9007
9	.0707	.2826	.4419	.6363	.8658	1.1309	1.4314	1.7671	2.1382
10	.0785	.3140	.4910	.7070	.9620	1.2570	1.5904	1.9635	2.3758
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.00
1	.2827	.3318	.3847	.4418	.5027	.5675	.6362	.7088	.7854
2	.5655	.6636	.7697	.8836	1.0053	1.1349	1.2723	1.4176	1.5708
3	.8482	.9955	1.1545	1.3254	1.5080	1.7024	1.9085	2.1265	2.3562
4	1.1309	1.3273	1.5393	1.7671	2.0106	2.2698	2.5447	2.8353	3.1416
5	1.4137	1.6592	1.9242	2.2089	2.5133	2.8373	3.1809	3.5441	3.9270
6	1.6964	1.9909	2.3090	2.6507	3.0159	3.4047	3.8170	4.2529	4.7124
7	1.9792	2.3228	2.6939	3.0925	3.5186	3.9722	4.4532	4.9618	5.4978
8	2.2619	2.6546	3.0787	3.5343	4.0212	4.5396	5.0894	5.6706	6.2834
9	2.5447	2.9865	3.4636	3.9761	4.5239	5.1071	5.7256	6.3794	7.0686
10	2.8274	3.3183	3.8485	4.4179	5.0265	5.6745	6.3617	7.0882	7.8540

a/ mm.

VITA

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