

May 27, 1957

To the Graduate Council:

I am submitting herewith a thesis written by Robert H. Gibson entitled "The Influence of Plant Populations on the Yield and Other Characteristics of Corn." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

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THE INFLUENCE OF PLANT POPULATIONS ON THE YIELD
AND OTHER CHARACTERISTICS OF CORN

A THESIS

Submitted to
The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

by

Robert H. Gibson

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CHAPTER I

INTRODUCTION

The problem of optimum stands of corn for maximum yields is not a new one, nor is there a lack of experimental evidence on the subject. Most of this evidence, however, has been obtained under midwestern "corn belt" conditions and refers to a type of corn plant different from that grown in the South, as well as to different soil and climatic conditions. Much of the experimental work done in the South has dealt with open pollinated varieties or with spacings so wide or fertility levels so low as to render it of little value to the present day farmer searching for facts relating to his conditions.

It is in light of these facts that the problem of the proper spacing for hybrid corn varieties, currently being grown by the farmers of the upper South, was chosen for this thesis.

CHAPTER II

REVIEW OF PERTINENT LITERATURE

Influence of Population Levels on Yield

Mooers (10), working with open pollinated varieties in Tennessee, concluded:

. . . the best results in practice will probably be obtained with a width of row which permits the satisfactory use of tillage implements but allows the determined number of plants to be as widely spaced as possible.

Tests in Missouri by Zuber and Grogan (15) working with single ear and prolific¹ hybrids showed that a prolific hybrid gave the higher yield with either a low or a high planting rate.

In a series of fourteen experiments in Tennessee using two hybrids and various nitrogen rates up to 120 pounds per acre, Long (8) obtained the highest yield of a full season prolific hybrid with a twelve thousand plant per acre rate and the highest yield of an early single eared hybrid with a sixteen thousand plant rate, although differences in yield were small between the two rates.

¹A type of corn having a tendency to produce more than one ear per stalk.

Yields of both types of corn were lowest at the eight thousand plant rate.

Hinkle (4) in Arkansas found that yields were higher at the twelve thousand plant rate than at the eight thousand plant rate. Likewise, significantly higher yields were obtained at the sixteen thousand than at the twelve thousand plant rate with four of the five hybrids tested. All received 180 pounds of nitrogen per acre.

Osgood (11) in Mississippi using eight, ten, twelve and sixteen thousand plants per acre found yield differences to be significant, favoring the thicker spacing, when yields were above the sixty bushel level.

Duncan (3) in Iowa found yields were increased by increasing plant populations above the twelve thousand plant level when the fertility level was adequate.

McVickar and Shear (9) in Virginia suggested that maximum yields of different varieties did not necessarily occur at the same planting rate and, therefore, this factor should be considered when comparing corn performance in a variety test.

Rounds (12) found, in seventy-five of seventy-nine comparisons in Michigan, that the best yield was obtained at the highest rate of planting up to the sixteen thousand level. He also stated that there was no significant trend

for the early hybrid to give a higher response to rate of planting than the later maturing hybrid.

Influence of Plant Population Levels on Certain Corn Plant Characteristics

Lodging

Stringfield and Thatcher (14) in Ohio stated that the most serious effect of thicker stands is the higher incidence of stalk breakage. Long (8) found that the largest percentage of plants lodged at sixteen thousand plants per acre, his highest rate. In Iowa, Bryan (1) also found lodging to be greater with closer spacings. Kohnke and Miles (7) in Indiana tests found that lodging increased with increases in populations above fifteen thousand plants per acre. Rounds (12) found that the rate of planting had no consistent effect on stalk lodging.

Ear Height

Duncan (3), working with plant populations up to 24,000, stated that the increase in ear height with higher population levels was consistent though very small. Zuber and Grogan (15) found the same trend where sixteen thousand plants was the closest spacing.

Influence of Plant Population Levels
on Certain Corn Ear Characteristics

Ear Weight

Krantz (6) in North Carolina, stated that, at any given nitrogen level, both ear weight and ear number were decreased by increasing stands, even though the total yield per acre was usually increased. In prolific corn, wide spacing appeared to increase ear number more than it decreased average ear weight.

Caldwell (2) in Minnesota reported that thicker stands resulted in an increase in the percentage of poor ears and that the best yields were not obtained from stands resulting in the largest ears. Stringfield and Thatcher (14) stated that, as the result of close spacing, the harvested crop was less attractive due to smaller ears and the higher proportion of nubbins.

Hinkle (4) found that close spacing reduced the weight of ears produced, but stated that this was not considered undesirable since the yield of corn per acre was greater. Huber (5) in Pennsylvania, using single eared hybrids found that a stand producing an ear weight of about 0.5 pound per plant was best. Zuber and Grogan (15) found the best yields of prolific hybrids were obtained at an ear size of 0.5 pound. Krantz (6) stated that prolific hybrids yield best when the stand has been adjusted so that the total weight of

ears per plant is about 0.6 to 0.7 pound. He found that by increasing stands from four thousand to ten thousand plants per acre, ear size decreased nineteen per cent while ear number decreased forty-one per cent.

Shelling Per Cent

Caldwell (2) stated that increasing the plant population without fertilization resulted in a lower shelling per cent but that with adequate fertilization there was no decrease in shelling per cent with higher populations.

Duncan (3) found significantly higher shelling per cent at higher populations in one of four tests and a tendency for shelling per cent to increase with increasing plant populations from eight thousand to some higher level in the other tests.

Date of Mid-silking

Kohnke (7) found that silking was delayed one day for each 3,500 to four thousand additional plants per acre at the fifteen thousand to nineteen thousand population range.

Shubeck (13) in Minnesota noted the same relationship but concluded that this delay did not generally influence ear development.

Stringfield and Thatcher (14) found the silking period of corn at sixteen thousand plants per acre was roughly two days later than for a stand of twelve thousand. He concluded that this would probably delay maturity for four or five days.

Maturity

Rounds (12) stated that maturity of corn was not affected by rate of method of planting.

Duncan (3) found that physiological maturity was delayed as plant populations were increased. Later maturing hybrids had consistently greater delay in maturity with increasing population levels than did other hybrids.

CHAPTER III

METHODS AND MATERIALS

Soils and Previous Cropping History of Experimental Fields

1955

The 1955 test was located at the University of Tennessee Agricultural Experiment Station in Blount County on Decatur silty clay loam on a B slope. Crops in previous years consisted of orchardgrass in 1954 and alfalfa the preceding four years.

1956

The 1956 test was nearby on Huntington fine sandy loam on a B slope. Lespedeza and corn had been grown in a two year rotation for the preceding five years.

Experimental Design; Plant Populations; Hybrids and Fertility Treatments

A split plot, randomized block, design was used both years. The major treatment consisted of four plant populations at a uniform fertility level. Each major treatment was subdivided to include four hybrids differing in prolificacy and maturity (table I). Treatments were replicated

TABLE I

CORN HYBRIDS TESTED AT FOUR POPULATION LEVELS
IN 1955 AND 1956

Hybrid	Color	Prolificacy	Growing Season
Tenn. 90	Yellow	Single eared	Full
Dixie 29	White	Prolific	Full
Dixie 22 ^a	Yellow	Prolific	Full
Pfister (PAG) 631 ^a	White	Single eared	Medium
Tenn. 501 ^b	White	Prolific	Medium
Pioneer 505W ^b	White	Single eared	Medium

^aTested in 1955 only.

^bTested in 1956 only.

six times. The arrangement was designed to determine optimum plant populations for the types of corn being recommended for Tennessee farmers.

In 1955, all hybrids were medium to full season types and represented both yellow and white, prolific and single eared varieties recommended by the Tennessee Agricultural Experiment Station. The test was planted on May 6 and harvested October 24. Fertilizer was applied uniformly at the rate of one hundred pounds of nitrogen and seventy-two pounds each of P_2O_5 and K_2O per acre. This was applied as six hundred pounds of 6-12-12 per acre at planting time and the remainder of the nitrogen as a sidedressing of two hundred pounds of ammonium nitrate per acre at time of thinning. This rate of fertilization was adequate for an expected yield of one hundred bushels per acre.

The 1956 test was planted May 15 and harvested October 10. An application of five hundred pounds of 6-12-12 per acre was broadcast one week before planting. At time of planting, 6-12-12 was drilled in the rows at the rate of three hundred pounds per acre. At the time of thinning, ammonium nitrate was applied at the rate of three hundred pounds per acre as a side dressing. The total fertilizer application then was: nitrogen, 144 pounds; P_2O_5 and K_2O , ninety-six pounds each. This was adequate for an expected yield of 150 bushels per acre.

In both tests seeds were hand planted thicker than required and thinned to the desired stand when the plants were eight to ten inches tall. All rows were forty-two inches apart. The distance between plants for the various population levels was approximately eighteen, fifteen, twelve, nine and eight inches. The number of plants per acre at harvest approximated eight, ten, twelve, sixteen and eighteen thousand plants per acre. The first four rates were used in 1955 and the last four in 1956 (table I). The adjustment was made for the 1956 season because of the relative productivity of the two soils.

The moisture supply was considered to be adequate each season except for the month of August when the rainfall was approximately one-half that of the long term average. Rainfall for each season is given in Appendix A.

Method of Measuring Certain Agronomic Characteristics

Yield

Each test was hand harvested, the ear corn from each plot placed in a burlap bag and weighed in the field. The harvested area of each plot consisted of $1/200$ acre in 1955 and $1/460$ acre in 1956. After the weights were recorded, moisture samples were taken from each plot of two of the six replications. This was accomplished by removing one row of

kernels from each of ten to fifteen ears. These kernels were promptly sealed in airtight containers and moved to the laboratory. Moisture determinations were made, using a Steinlite Moisture Tester. Grain yields were corrected to 15.5 per cent moisture both years and for shelling percentage in 1956.

Plant Characteristics

Lodging and ear height readings were taken at harvest. Plants broken below the point of attachment of the main ear were considered "stalk lodged." Plants leaning more than thirty degrees from the vertical were considered "root lodged". Since root lodging was negligible, subsequent references to lodging may be considered stalk lodging. Ear height readings were recorded only in 1956. Measured to the nearest six inches, the readings were taken from the node bearing the top ear.

Ear Characteristics

Shelling Per Cent

The shelling per cent was determined by shelling all ears from each plot of two replications after a six-week period of crib storage. Shelled weight divided by ear weight gave the shelling per cent.

Per Cent Good Ears

The percentage by weight of the yield represented by "good" ears was determined by removing all nubbins¹ and reweighing the good ears immediately after plot weight had been recorded. This weight divided by the plot weight gave the per cent good ears.

Weight Per Plant and Weight Per Ear

The ear weight per plant and weight per ear were determined by dividing the plot weight by the number of stalks and number of ears respectively.

Date of Mid-silking

The date of mid-silking was recorded as that stage of plant development when one-half of the plants had silks emerging. Silking counts were recorded at forty-eight hour intervals and interpolations were made as necessary (appendix B).

¹Ears that are small or imperfect.

CHAPTER IV

EXPERIMENTAL RESULTS

Results are discussed by individual characteristics studied. These groupings reflect the influences of plant populations, prolificacy and maturity and their interrelationships on (1) yield, (2) plant characteristics and (3) ear characteristics.

Yield

Yields at the various spacings did not differ significantly in 1955 (table II) and only at the ten per cent level of significance in 1956 (table III and appendix C). The analyses showed yield advantages favoring the full season hybrids in 1956 whereas there were no real differences among yields of the hybrids tested in 1955.

Plant Characteristics

Lodging

Increased lodging resulted from closer spacing in the 1956 test whereas lodging was negligible in 1955. In 1956, sixteen thousand and eighteen thousand plant populations lodged significantly more than did the ten thousand and

twelve thousand plant levels (table III and appendix D).

The hybrid Tenn. 90 lodged significantly more than did others in the test.

Ear Height

There were no significant differences in ear heights among the population rates or among the hybrids tested in 1956. Ear height was not measured in 1955.

Ears Per Plant

Wider spacing increased the number of ears per plant significantly among all population levels in 1955 and all except the higher levels in 1956 (tables II, III and appendices E and F). Ear number also varied among varieties both years, the "prolifics" having a significantly greater number of ears. Some indication of barrenness was noted in 1955 as the number of plants increased from ten thousand.

There was significant interaction between varieties and spacings in 1956 and real differences were apparent in the prolificacy between replications.

Ear Characteristics

Shelling Per Cent

Close spacings resulted in higher shelling per cent than did wide spacings (table III and appendix G). The

TABLE II

MEAN YIELD AND GENERAL CHARACTERISTICS
OF FOUR HYBRIDS AT FOUR PLANT
POPULATIONS IN 1955

Hybrid	Plant Population M/A.	Yield of Ear Corn 15.5% Moisture		
		Bu./A. 6 Reps.	Pounds/Plant 3 Reps.	Pounds/Ear 3 Reps.
Tenn. 90	16	60.4 ⁽⁴⁾	0.24	0.33
	12	66.4 ⁽²⁾	0.32	0.27
	10	66.2 ⁽³⁾	0.43	0.48
	8	69.7 ⁽¹⁾	0.55	0.48
Pfister (PAG) 631	16	70.3 ⁽³⁾	0.28	0.33
	12	67.2 ⁽⁴⁾	0.32	0.35
	10	77.9 ⁽¹⁾	0.51	0.48
	8	70.6 ⁽²⁾	0.55	0.45
Dixie 29	16	68.7 ⁽³⁾	0.27	0.30
	12	63.3 ⁽⁴⁾	0.30	0.28
	10	72.3 ⁽¹⁾	0.47	0.39
	8	71.5 ⁽²⁾	0.56	0.41
Dixie 22	16	52.0 ⁽⁴⁾	0.20	0.23
	12	70.6 ⁽²⁾	0.34	0.36
	10	70.7 ⁽¹⁾	0.46	0.40
	8	59.9 ⁽³⁾	0.47	0.40

TABLE II (CONTINUED)

MEAN YIELD AND GENERAL CHARACTERISTICS
OF FOUR HYBRIDS AT FOUR PLANT
POPULATIONS IN 1955

Hybrid	Plant Population M/A.	Erect Plants % 3 Reps.	Ears/100 Plants ¹ 3 Reps.	Moisture % at Harvest 2 Reps.
Tenn. 90	16	95	71	16.5
	12	95	86	16.0
	10	98	90	15.6
	8	93	115	15.5
Pfister (PAG) 631	16	93	86	14.6
	12	96	92	15.0
	10	95	106	14.7
	8	96	122	14.8
Dixie 29	16	97	89	15.0
	12	93	108	14.8
	10	99	120	14.7
	8	95	137	15.4
Dixie 22	16	96	86	15.8
	12	94	95	15.7
	10	98	116	15.5
	8	97	117	15.9

¹See Appendix E.

TABLE III

MEAN YIELD AND GENERAL CHARACTERISTICS
OF FOUR HYBRIDS AT FOUR PLANT
POPULATIONS IN 1956

Hybrid	Plant Popu- lation M/A.	Yield of Ear Corn 15.5%			Erect Plants %	Ears/100 Plants ³
		Moisture		Pounds/ Ear		
		Bu/A. ¹	Pounds/ Plant			
		6 Reps.	4 Reps.	4 Reps.	6 Reps.	4 Reps.
Tenn. 90	18	130.5 ⁽²⁾	0.47	0.50	63	98
	16	128.8 ⁽³⁾	0.57	0.55	63	104
	12	133.6 ⁽¹⁾	0.87	0.76	82	115
	10	112.6 ⁽⁴⁾	0.92	0.77	79	129
Tenn. 501	18	119.1 ⁽¹⁾	0.55	0.48	67	114
	16	110.5 ⁽³⁾	0.67	0.49	70	137
	12	116.8 ⁽²⁾	1.04	0.69	88	150
	10	93.1 ⁽⁴⁾	1.19	0.69	86	172
Dixie 29	18	143.7 ⁽¹⁾	0.77	0.56	72	137
	16	124.5 ⁽³⁾	0.68	0.54	73	126
	12	136.7 ⁽²⁾	1.32	0.79	84	167
	10	115.4 ⁽⁴⁾	1.37	0.80	84	171
Pioneer 505W	18	116.3 ⁽¹⁾	0.49	0.46	78	106
	16	101.4 ⁽³⁾	0.41	0.44	72	93
	12	116.0 ⁽²⁾	0.68	0.68	85	100
	10	96.5 ⁽⁴⁾	0.84	0.68	89	123

¹ Corrected for shelling per cent. See Appendix C.

² See Appendix D.

³ See Appendix F.

TABLE III (CONTINUED)

MEAN YIELD AND GENERAL CHARACTERISTICS
OF FOUR HYBRIDS AT FOUR PLANT
POPULATIONS IN 1956

Hybrid	Plant Popu- lation M/A.	Shelling % ¹ 2 Reps.	Good Ears by wt. 3 Reps.	Ear Ht. Ft. 3 Reps.	Days to Mid- silking ² 3 Reps.	Moisture % ³ at Harvest 2 Reps.
Tenn. 90	18	85.5	94	5.2	74	19.6
	16	84.6	90	5.2	73	19.9
	12	84.7	94	4.8	74	21.6
	10	84.2	96	4.3	72	20.1
Tenn. 501	18	82.9	91	4.3	69	15.8
	16	82.3	91	4.7	69	20.1
	12	82.2	94	4.0	71	19.8
	10	79.7	93	4.7	69	20.2
Dixie 29	18	85.4	94	5.3	75	21.5
	16	84.0	92	4.8	72	20.6
	12	83.7	92	4.5	73	23.2
	10	83.5	91	4.7	72	21.5
Pioneer 505W	18	83.8	92	4.7	72	15.5
	16	83.2	93	4.7	72	18.7
	12	82.8	97	4.8	71	18.2
	10	82.2	93	4.5	71	18.0

¹See Appendix G.

²See Appendix H.

³See Appendix I.

treatment with a population of eighteen thousand plants per acre had a shelling per cent of 84.4, whereas the ten thousand plant treatment had 82.4. The intermediate populations, sixteen thousand and twelve thousand, shelled 83.6 and 83.4 per cent respectively. The full season hybrids had a significantly higher shelling percentage than the mid season ones. Tenn. 90 and Dixie 29 shelled 84.8 and 84.2 per cent. Pioneer 505W and Tenn. 501 shelled 83.0 and 81.8 per cent respectively, significantly different from one another and both significantly lower than the full season hybrids.

Ear Weight

The average weight per ear was reduced by about one-third in all hybrids in both tests as the populations were increased from the lowest to the highest levels (tables II and III).

The weight of ear corn per plant was reduced by from forty to fifty-five per cent among the hybrids in each test from the widest to the closest spacing (tables II and III).

The per cent by weight of total yield represented by good ears did not vary with spacings or varieties. The range was from ninety to ninety-seven per cent.

Date of Mid-silking

In each test closer spacing delayed the date of silking of varieties on an average of one and one-half days.

Tenn. 90 and Dixie 29 were approximately two days later than Pioneer 505W which in turn was two days later than Tenn. 501 (table III and appendix H).

Moisture Per Cent at Harvest

Spacings had no real effect on the moisture per cent of the grain at time of harvest in either test. Varieties differed in moisture content in 1956 (table III and appendix I). The full season hybrids had a significantly higher per cent moisture than did the mid season hybrids.

CHAPTER V

GENERAL DISCUSSION AND SUMMARY

Under test conditions in 1955 all hybrids at the various populations yielded approximately the same. In 1956 with higher levels of fertility and a soil having better water relations, yields were higher at a population of twelve thousand plants than at ten thousand. Beyond this population yields continued at a high level to eighteen thousand plants per acre. It seems important to note, however, that at both higher rates, corn lodged significantly more than at the twelve thousand rate. Zuber and Grogan (15) reported similar results. Stringfield and Thatcher (14) concluded that the most serious effect of closer spacing is the higher incidence of stalk breakage.

The problem of stalk breakage at higher populations in 1956 was so great that moisture samples were taken daily as the season of harvest approached. This was done in order that the harvest could be completed on the earliest possible day after danger of crib spoilage was past. Since two of the varieties lodged thirty seven per cent at the closest spacing, to have delayed harvest until rainy weather might have resulted in a substantial loss of corn. The low yield per plant in 1955 may have prevented severe lodging. Corn borer damage was moderate in both tests. No pest control measures were taken.

In 1955 the sixteen thousand plants per acre treatment gave only eighty-three ears per hundred plants while the eight thousand plant rate had 123. Although the 1956 test averaged more than one ear per plant at all population levels, the ten thousand population yielded approximately one-fourth more ears per plant than did eighteen thousand, or 149 ears compared to 116.

The proportion by weight of nubbins was no greater at the closer spacings although, as Caldwell (2), Stringfield and Thatcher (14) found, there was a greater number of nubbins. Ear weights were reduced by about one-third in all hybrids each year as populations were increased from the lowest to the highest rate. Average ear weights dropped in 1956 from 0.75 pound to 0.50 pound; in 1955 from 0.45 pound to 0.30 pound from the widest to the closest spacing. The ear weight at the optimum yield level, lodging considered, in each case was the higher figure, which corresponded almost identically with the ear size at the lowest plant rate. One might assume that the highest yields can be obtained with closer spacings up to the point where ear size is reduced.

Real differences were noted in shelling per cent, favoring each successively higher population rate. As a result, yields corrected for shelling per cent showed differences at the ten per cent level. Duncan (3) also found that closer spacing tended to produce ears having a higher

shelling percentage. Caldwell (2) concluded that, with adequate fertilization, there was no loss in shelling percentage with higher populations. Since full season hybrids had a higher shelling per cent than did mid season hybrids, the recommendation of testing the entries in a variety test for shelling per cent appears to be in order.

Although there was a tendency toward a delay in the date of silking at the highest plant rate over that of the lowest plant rate in both tests, the difference was not considered significant. Close spacing, therefore, did not delay maturity.

The moisture content of the ears at harvest gave some indication as to the maturity rating of each hybrid in 1956. In 1955, when harvest was delayed, all were equally dry. The earlier harvest in 1956 showed the full season hybrids to have a significantly higher moisture content than the mid season hybrids.

Major Conclusions

1. Spacing had no effect on yield at population rates above twelve thousand plants per acre.
2. Lodging became a limiting factor of production at population rates of sixteen and eighteen thousand plants

per acre where soil and other conditions favored yields up to 150 bushels per acre.

3. Wider spacing and prolific hybrids resulted in more ears per plant than did closer spacing and single eared types; however, neither spacing nor variety affected the proportion by weight of good ears.

4. The shelling percentage of ear corn increased with closer spacing; hybrids differed in shelling percentage.

5. Spacing had negligible effects on ear height, date of silking or per cent moisture of grain at harvest.

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APPENDICES



APPENDIX A

PRECIPITATION DURING GROWING SEASONS
 (from U. S. Department of Commerce
 Weather Bureau Reports)

Month	Inches Rainfall at Knoxville Weather Bureau, Airport, 1955		Inches Rainfall at Knox- ville; University of Tenn- essee, 1956	
	Departure from Long-term Mean		Departure from Long-term Mean	
May	3.51	-0.70	3.22	-0.53
June	3.65	0.18	3.58	-0.52
July	3.97	-0.75	6.07	1.71
August	1.93	-1.50	1.93	-1.99
September	2.48	-0.05	1.82	-0.86

APPENDIX B

DETERMINING THE NUMBER OF DAYS TO MID-SILKING
 (After Meyers, M. T. in Jour. A. S. A.
 22:280-283. 1930)

The number of plants in each plot is recorded. When about half of the plants in a plot are in silk, the number is counted and the percentage is computed. This provides a percentage of plants in silk on a given date or on a given number of days since planting. If this percentage is within 42-58, it provides a satisfactory estimate of the median, or mid-date of silking. Percentages outside the range 42-58 are adjusted as follows:

Add to or subtract from the number of days of record	When the percentage of plants silked is	
	Below	Above
1 day	42	58
2 days	29	71
3 days	19	81
4 days	11	89

APPENDIX C

YIELDS IN POUNDS PER PLOT CORRECTED FOR SHELLING
 PERCENTAGE AND TO 15.5 PER CENT MOISTURE
 FOR FOUR CORN HYBRIDS AT FOUR
 PLANT POPULATIONS IN 1956

Hybrid	Plant Popu- lation M/A.	Replication						Mean
		1	2	3	4	5	6	
Tenn. 90	18	26.9	15.2	19.3	20.8	24.6	16.2	20.5
	16	26.1	17.9	17.4	18.5	24.2	14.8	19.8
	12	23.6	23.1	20.2	20.0	19.0	21.4	21.2
	10	15.6	17.2	15.6	20.9	16.5	20.0	17.6
Tenn. 501	18	23.6	13.5	21.5	18.4	24.7	13.0	19.1
	16	19.9	18.9	16.2	16.5	18.9	13.9	17.4
	12	22.3	20.5	18.8	19.1	15.3	16.7	18.8
	10	14.7	18.1	13.5	14.7	13.8	18.7	15.6
Dixie 29	18	28.7	16.7	21.1	21.5	25.3	21.2	22.4
	16	24.2	20.3	19.3	17.1	18.7	15.4	19.2
	12	26.7	25.2	18.5	18.9	20.2	19.5	21.5
	10	19.4	15.6	16.8	17.3	16.4	22.6	18.0
Pioneer 505W	18	20.0	14.8	17.0	16.6	22.4	19.3	18.4
	16	19.1	13.0	15.4	11.3	18.5	14.2	15.3
	12	23.2	18.0	19.5	15.9	16.9	17.0	18.4
	10	17.2	14.6	13.3	14.1	12.8	19.1	15.2

APPENDIX C (CONTINUED)

33

YIELDS IN POUNDS PER PLOT CORRECTED FOR SHELLING
PERCENTAGE AND TO 15.5 PER CENT MOISTURE
FOR FOUR CORN HYBRIDS AT FOUR
PLANT POPULATIONS IN 1956

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacing	3	206.37 ^a
Replications	5	242.37
Error (a)	15	395.55
Varieties	3	197.70 ^{**}
Var. x Spa.	9	17.03
Error (b)	60	189.56
Total	95	1,249.58

MULTIPLE RANGE TEST¹

Varieties				
Number of Means	2	3	4	
S. S. Range ² .01	3.2	3.3	3.4	
Varieties	D.29	T.90	T.501	P.505 ^W
Mean Yields ³ lbs./plot	20.3	19.8	17.7	<u>16.8</u>

^aSignificant at the ten per cent level.

^{**}Significant at the one per cent level.

¹As derived by D. B. Duncan.

²Shortest significant range (corresponds to l.s.d.).

³Any two means not underscored by the same line are significantly different.

Any two means underscored by the same line are not significantly different.

APPENDIX D

PER CENT ERECT PLANTS OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS IN
1956

Hybrid	Plant Popu- lation M/A.	Replication						Mean
		1	2	3	4	5	6	
Tenn. 90	18	47	36	70	82	78	63	63
	16	66	64	50	60	71	66	67
	12	88	85	84	85	78	69	72
	10	62	81	76	90	81	85	78
Tenn. 501	18	68	82	77	53	57	67	63
	16	71	74	54	62	71	89	70
	12	85	78	91	93	89	89	73
	10	95	71	76	100	80	91	72
Dixie 29	18	68	58	86	79	69	74	82
	16	78	79	77	72	60	72	88
	12	89	93	83	92	63	85	84
	10	85	55	81	88	95	100	85
Pioneer 505W	18	67	74	87	86	67	85	79
	16	69	68	75	62	83	77	86
	12	93	79	77	89	78	92	84
	10	82	84	90	100	81	95	89

PER CENT ERECT PLANTS OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS IN
1956

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacings	3	5,121.04**
Replications	5	910.22
Error (a)	15	2,268.15
Varieties	3	1,121.62**
Var. x Spa.	9	410.33
Error (b)	60	5,408.80
Total	95	15,240.16

MULTIPLE RANGE TESTS

	Plant Population M/A.			
	12	10	18	16
No. Means	2	3	4	
S. S. Range .01	7.6	7.9	8.2	
Mean % Erect Plants	84.5	84.3	70.0	69.6
	Varieties			
	P.505W	D.29	T.501	T.90
No. Means	2	3	4	
S. S. Range .01	5.5	5.8	6.0	
Mean % Erect Plants	80.9	78.4	77.7	71.6

APPENDIX E

EARS PER HUNDRED PLANTS OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1955

Hybrid	Plant Popu- lation M/A.	Replication			Mean
		1	3	5	
Tenn. 90	16	82	66	62	70
	12	93	82	80	85
	10	84	104	84	91
	8	105	128	115	116
Pfister (PAG) 631	16	88	80	90	86
	12	93	88	93	91
	10	96	112	108	105
	8	125	110	130	122
Dixie 29	16	88	90	88	89
	12	126	103	93	107
	10	116	122	120	119
	8	140	152	120	137
Dixie 22	16	82	96	80	86
	12	97	95	93	95
	10	124	136	88	116
	8	125	118	110	118

APPENDIX E (CONTINUED)

EARS PER HUNDRED PLANTS OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1955

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacings	3	10,915.00**
Replications	2	600.17
Error (a)	6	676.50
Varieties	3	3,149.50**
Var. x Spa.	9	655.17
Error (b)	24	2,643.33
Total	47	18,639.67

MULTIPLE RANGE TESTS

	Plant Population M/A.			
	8	10	12	16
No. Means	2	3	4	
S. S. Range .01	11.3	11.7	11.9	
Mean No. Ears/100 Plants	<u>123.2</u>	<u>107.8</u>	<u>94.7</u>	<u>82.7</u>
	Varieties			
	D.29	D.22	P.631	T.90
No. Means	2	3	4	
S. S. Range .01	8.8	9.3	9.5	
Mean No. Ears/100 Plants	<u>113.2</u>	<u>103.7</u>	<u>101.1</u>	<u>90.4</u>

APPENDIX F

EARS PER HUNDRED PLANTS OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1956

Hybrid	Plant Popu- lation M/A.	Replication				Mean
		1	2	4	6	
Tenn. 90	18	111	90	95	97	98
	16	111	100	100	103	104
	12	123	100	104	135	116
	10	110	143	128	135	129
Tenn. 501	18	122	121	117	95	114
	16	155	126	140	128	137
	12	177	137	144	141	150
	10	165	167	182	177	173
Dixie 29	18	147	150	120	132	137
	16	143	141	114	106	126
	12	174	174	162	159	167
	10	190	160	162	174	172
Pioneer 505W	18	100	94	103	124	105
	16	103	88	84	97	93
	12	104	96	96	104	100
	10	132	116	95	150	123

APPENDIX F (CONTINUED)

39

EARS PER HUNDRED PLANTS OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1956

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacings	3	12,638.29**
Replications	3	2,278.92*
Error (a)	9	1,165.02
Varieties	3	23,288.54**
Var. x Spa.	9	4,163.90*
Error (b)	36	7,239.81
Total	63	50,774.48

MULTIPLE RANGE TESTS

	Plant Population M/A.			
	10	12	18	16
No. Means	2	3	4	
S. S. Range .01	9.7	10.2	10.4	
Mean No. Ears/100 Plants	<u>149.1</u>	<u>133.1</u>	<u>115.9</u>	<u>114.9</u>
	Varieties			
	D.29	T.501	T.90	P.505W
No. Means	2	3	4	
S. S. Range .01	15.4	16.2	16.7	
Mean No. Ears/100 Plants	<u>150.5</u>	<u>143.4</u>	<u>113.8</u>	<u>105.4</u>

*Significant at the five per cent level.

APPENDIX G

SHELLING PER CENT OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1956

Hybrid	Plant Popu- lation M/A.	Replication		Mean
		3	5	
Tenn. 90	18	85.5	85.5	85.5
	16	84.6	84.6	84.6
	12	85.4	84.0	84.7
	10	84.0	84.5	84.2
Tenn. 501	18	82.1	83.7	82.9
	16	83.1	81.5	82.3
	12	83.3	81.1	82.2
	10	79.4	80.0	79.7
Dixie 29	18	85.9	85.0	85.4
	16	84.1	84.0	84.0
	12	83.3	84.1	83.7
	10	83.7	83.3	83.5
Pioneer 505W	18	84.4	83.2	83.8
	16	82.9	83.6	83.2
	12	82.8	82.9	82.8
	10	83.5	81.0	82.2

APPENDIX G (CONTINUED)

SHELLING PER CENT OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1956

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacings	3	15.96**
Replications	1	1.13
Error (a)	3	0.34
Varieties	3	41.79**
Var. x Spa.	9	4.98
Error (b)	12	9.70
Total	31	73.90

MULTIPLE RANGE TESTS

	Plant Population M/A.			
	18	16	12	10
No. Means	2	3	4	
S. S. Range .01	0.54	0.54	0.54	
Mean Shelling %	<u>84.41</u>	<u>83.55</u>	<u>83.36</u>	<u>82.42</u>
	Varieties			
	T.90	D.29	P.505W	T.501
No. Means	2	3	4	
S. S. Range .01	1.0	1.0	1.1	
Mean Shelling %	<u>84.8</u>	<u>84.2</u>	<u>83.0</u>	<u>81.8</u>

APPENDIX H

DAYS TO MID-SILKING¹ OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1956

Hybrid	Plant Popu- lation N/A.	Replication			Mean
		1	2	3	
Tenn. 90	18	25	29	29	28
	16	26	28	28	27
	12	27	28	28	28
	10	27	28	24	26
Tenn. 501	18	22	23	23	23
	16	23	23	23	23
	12	22	25	24	24
	10	24	21	23	23
Dixie 29	18	27	28	31	29
	16	25	25	27	26
	12	27	26	29	27
	10	28	28	23	26
Pioneer 505W	18	25	25	27	26
	16	26	27	26	26
	12	23	25	26	25
	10	27	23	24	25

¹Figured from July 1 for purpose of analysis.

APPENDIX H (CONTINUED)

DAYS TO MID-SILKING OF FOUR CORN HYBRIDS
AT FOUR PLANT POPULATIONS
IN 1956

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacing	3	8.73
Replication	2	4.04
Error (a)	6	39.71
Varieties	3	138.06**
Var. x Spa.	9	18.19
Error (b)	24	38.25
Total	47	246.98

MULTIPLE RANGE TEST

Varieties				
No. of Means	2	3	4	
S. S. Range .01	1.1	1.1	1.1	
Varieties	T.90	D.29	P.505W	T.501
Days to Mid-silking	<u>27.2</u>	<u>27.0</u>	<u>25.3</u>	<u>23.0</u>

APPENDIX I

MOISTURE PER CENT OF GRAIN AT HARVEST OF FOUR
CORN HYBRIDS AT FOUR PLANT POPULATIONS
IN 1956

Hybrid	Plant Popu- lation M/A.	Replication		Mean
		1	2	
Tenn. 90	18	19.4	19.8	19.6
	16	20.7	19.1	19.9
	12	21.7	21.6	21.6
	10	20.7	19.5	20.1
Tenn. 501	18	16.5	15.1	15.8
	16	20.7	19.5	20.1
	12	19.4	20.3	19.8
	10	19.0	21.4	20.2
Dixie 29	18	23.6	19.4	21.5
	16	22.0	19.3	20.6
	12	24.1	22.4	23.2
	10	22.1	20.9	21.5
Pioneer 505W	18	16.8	14.2	15.5
	16	19.7	17.8	18.8
	12	17.9	18.4	18.2
	10	20.9	15.0	18.0

APPENDIX I (CONTINUED)

MOISTURE PER CENT OF GRAIN AT HARVEST OF FOUR
CORN HYBRIDS AT FOUR PLANT POPULATIONS
IN 1956

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Mean Squares
Spacings	3	29.45
Replications	1	14.45
Error (a)	3	4.37
Varieties	3	75.50**
Var. x Spa.	9	22.28
Error (b)	12	25.59
Total	31	171.64

MULTIPLE RANGE TEST

Varieties				
No of Means	2	3	4	
S. S. Range .01	1.5	1.6	1.6	
Varieties	D.29	T.90	T.501	P505W
Per Cent Moisture	21.7	20.3	19.0	17.6