PLANT POPULATION

for Stripper Harvested Cotton

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The influence of plant population on plant conformation, cotton harvesting and ginning characteristics was studied at the Chickasha Cotton Research Station from 1952 through 1957. Each of these years, 5 to 12 different populations were tested. The field design was a randomized block with three or more replications.

The variety of cotton planted was Lockett No. 1 in 1952-53-54 and '55 and Parrott in 1956-57. All plots were planted with one planter although some changes in plates were made from year to year. In 1955-56 and '57, cotton was planted in the plateau profile seedbed. Acid delinted seed was used.

Each year the cotton was harvested with a commercial two-row cotton stripper. The stripper had a single steel roll stripping mechanism for each row. In 1955-56 and '57, the field plots were sufficiently large to furnish enough cotton for ginning tests.

Twenty-eight separate attributes, thought to be influenced by population, were measured in one or more years during the tests. All measurements were related to the stand count at harvest time. Each year there was some reduction between the number of plants that emerged and the number of plants at harvest time. No fertilizer was used and the crop was grown under dry land conditions.

Approximately 12 of the attributes measured in this test gave consistent results throughout the entire test. Nine of the attributes measured were less consistent in their response from year to year, but in general, established a reliable trend in performance with different populations. Seven of the attributes measured were either erratic in their response or of insignificant variation. Positive statements regarding the influence of population on these seven attributes are probably not justified.

EMERGENCE

Emergence data for five planting seasons were obtained. The planter was carefully calibrated before planting each population. The ratio, converted to percent, between the number of plants that emerged and the number of seeds planted is the percent emergence. The results from two planting seasons were so variable that no significant trend could be established. However, in two other years, there was a definite trend toward higher percent emergence as plant population increased.

There was no conclusive evidence that the percent emergence was adversely affected by increasing population. The percent emergence

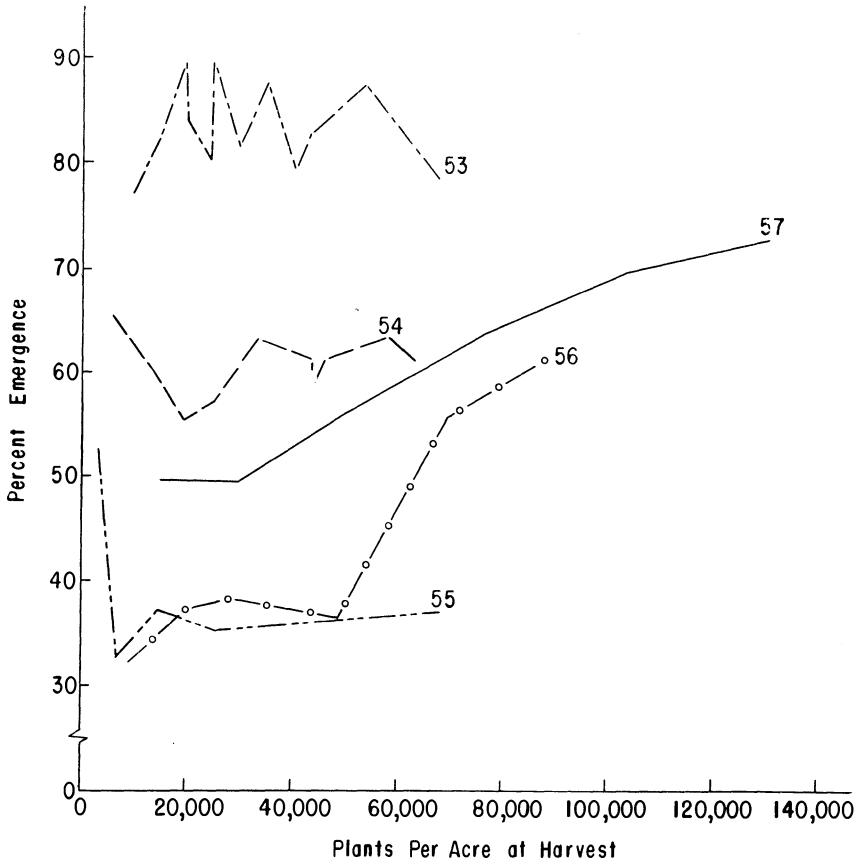

Figure 1. Percent emergence.

should probably not be a dominate factor in the selection of a particular plant population for best mechanized cotton production. The percent emergence varied from a minimum of approximately 30 percent to a maximum of nearly 90 percent. The data from five planting years gave an average emergence of approximately 60 percent.

HOEING TIME PER ACRE

Although plans were made each year to evaluate the influence of plant population on weed control, sufficient data were gathered in only one of six years to warrant analysis. During most years no early weed control problem was present and as a result, no data were gathered.

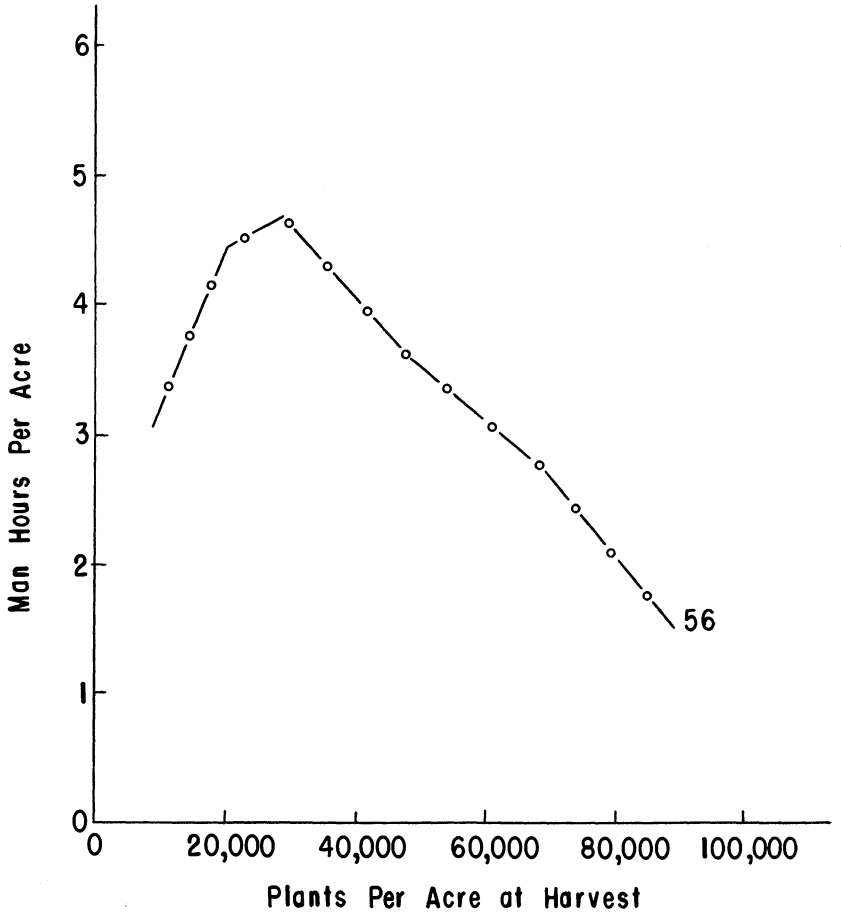

Figure 2. Hoeing time required per acre.

In 1956, the weed situation after planting was such that a measurement of weed control in terms of hoe labor was possible. Greatest weed populations existed among low plant populations.

To effectively hoe weeds without removing cotton plants, it took more time to remove a given number of weeds in a cotton row having a high population than in one having a low population. The lowest population, 1956, had the most weeds, but the workmen removed the weeds more easily since they did not have to avoid so many cotton plants. One year's data does not warrant recommending a given plant population most suitable for effective and low cost hand hoeing.

PLANT MEASUREMENTS

Root Depth

The root depth of cotton plants from various population densities was measured for two years. The results obtained were consistent for both years. There was a definite trend for root depth to decrease as population increased. Root depth was measured by sampling each replication of each population and measuring the distance from the ground surface to the tip of the root. The difference in root depth between low and high populations was not large. Ordinarily root depth would not be a major factor in selecting a particular population. The conclusion from these results was that as plant population increased, root depth decreased.

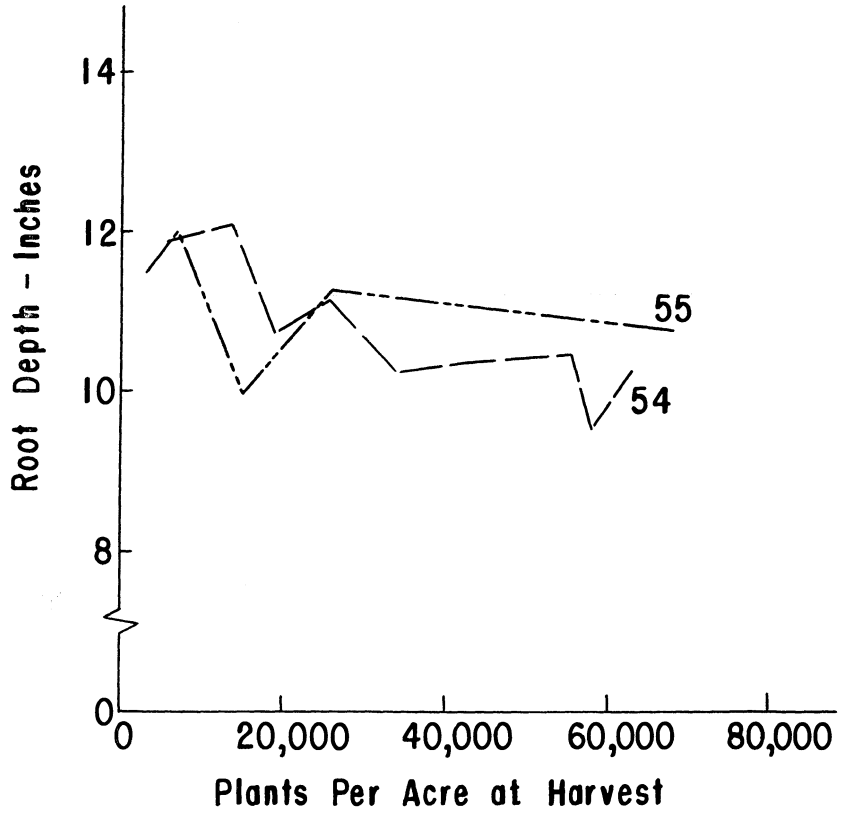

Figure 3. Root depth—inches.

Plant Height

Plant height was measured for 5 years. The method of measuring plant height was to measure from the ground surface to the highest point on the plant. There was a consistent and definite trend for plant height to decrease as plant population increased. Because of uniformity of the trend during 5 years, the conclusion was that as plant population increased, plant height decreased.

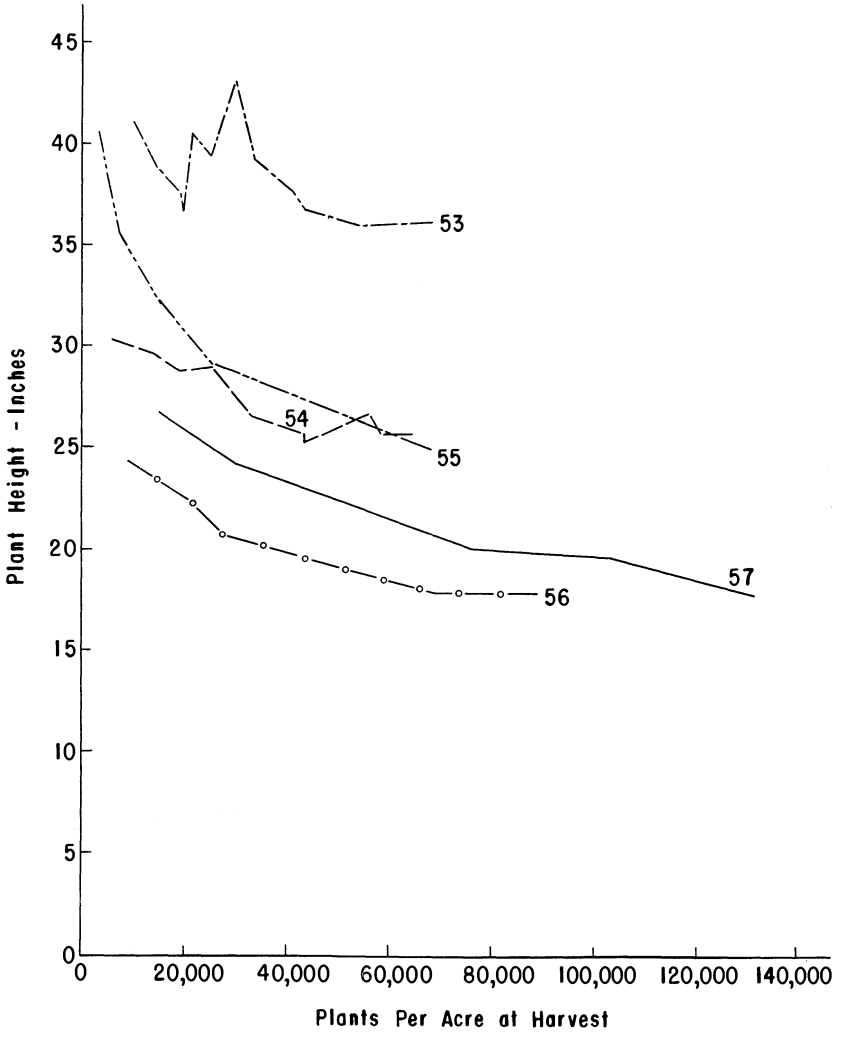

Figure 4. Plant height—inches.

Plant Width

The plant width was measured for each population during the five years of testing. This was done by measuring from the extreme

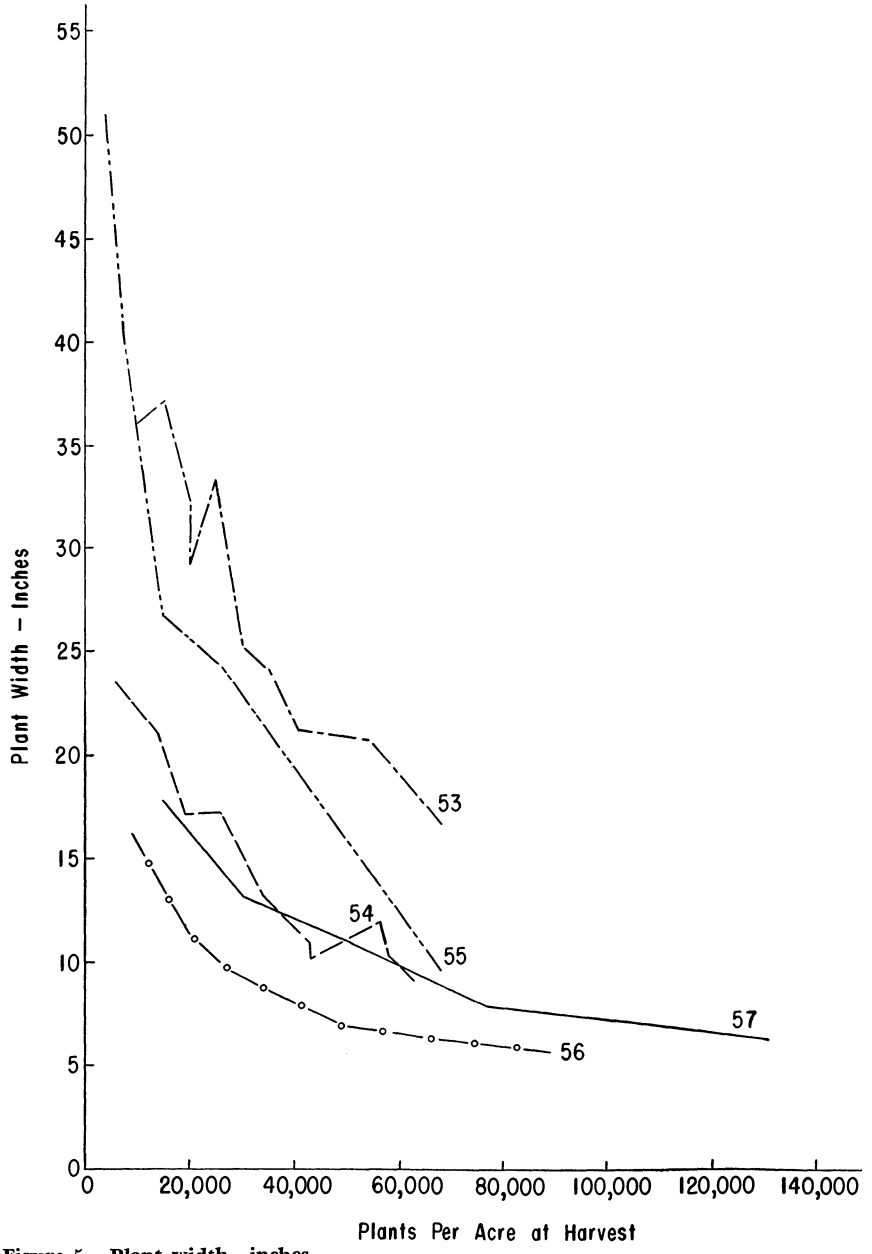

Figure 5. Plant width—inches.

width of the plant on one side of the row to the extreme width on the other side of the row. During this five year period, results obtained were consistent although in different years the width of the plant differed markedly. Plant width consistently decreased as plant population increased. There were no exceptions to this trend and in view of the consistency of the data, it was concluded that plant widths decreased as plant population increased. Plant population changes had a greater influence on plant width than plant height.

Height of the Low Boll

The height of the lowest fruiting of cotton plants is of considerable importance where stripper harvesting is used. It is most desirable

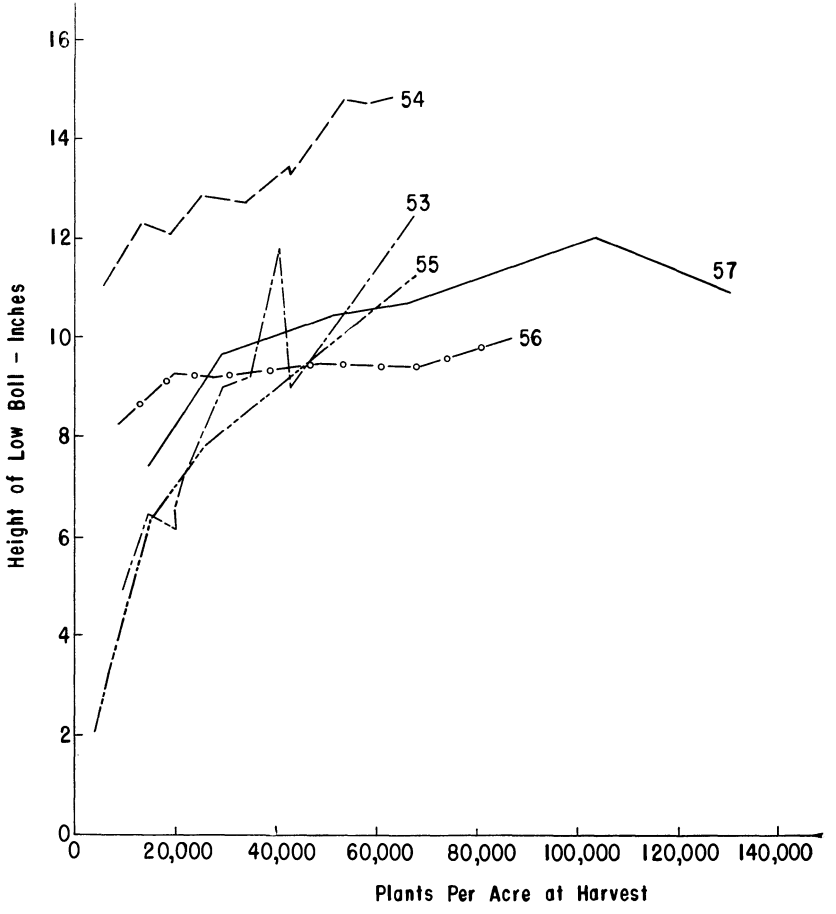

Figure 6. Height of low boll—inches.

that the fruiting height of the plant be such that the cotton stripper does not have to run on the ground surface in order to harvest all the cotton. The height of the low boll was found by measuring the distance from the ground surface to the lowest part of the lowest boll on plants in each population.

Plant population had a consistent influence on height of the lowest boll during a 5 year test period. The trend established in each of the years was that as plant population increases, height of the low boll increases. At extremely low populations of 10,000 plants per acre, or less, numerous bolls were lying on the ground. Such a boll position made machine harvesting most difficult and was not conducive to high quality cotton. Because of the consistency of the results, it was concluded that the height of the lowest boll increased as plant population increased.

Height of the High Boll

The height of the high boll was obtained by measuring the distance from the ground surface to the highest part of the top-most mature boll on the cotton plants in each population. Because dryland cotton does not generally grow too high for satisfactory performance of commercially available harvesters, this measurement was taken only 4 years. The results during these 4 years were quite consistent and, as would be expected, were related to the total height of the plant. As the plant population increased, the height of the high boll decreased. This trend was consistent in all 4 years when this measurement was made.

Boll Weight

Boll weights were taken for 2 years by weighing 25 bolls from each replication of each plant population. These bolls were weighed after they had come to a uniform moisture content. Both years the weight per boll decreased as plant population increased. This decrease in boll weight was perhaps not of great importance, but the trend seems to be consistent and does not differ from what one would expect. Unless the number of bolls per plant decreased or boll weight decreased, one would then expect an increase in yield as plant population increased.

PRE-HARVEST LOSS

Pre-harvest loss was measured by collecting all cotton on the ground from a measured plot immediately prior to harvesting. Plots were laid out to contain 1/200th of an acre. Cotton on the ground within the test area was put into a sack and taken to the laboratory for analysis. Only cotton locks or cotton bolls which showed evidence of maturity were gleaned in the pre-harvest loss sample. The percent loss was obtained by dividing the pre-harvest loss of clean seed cotton by the total clean seed cotton in the test area.

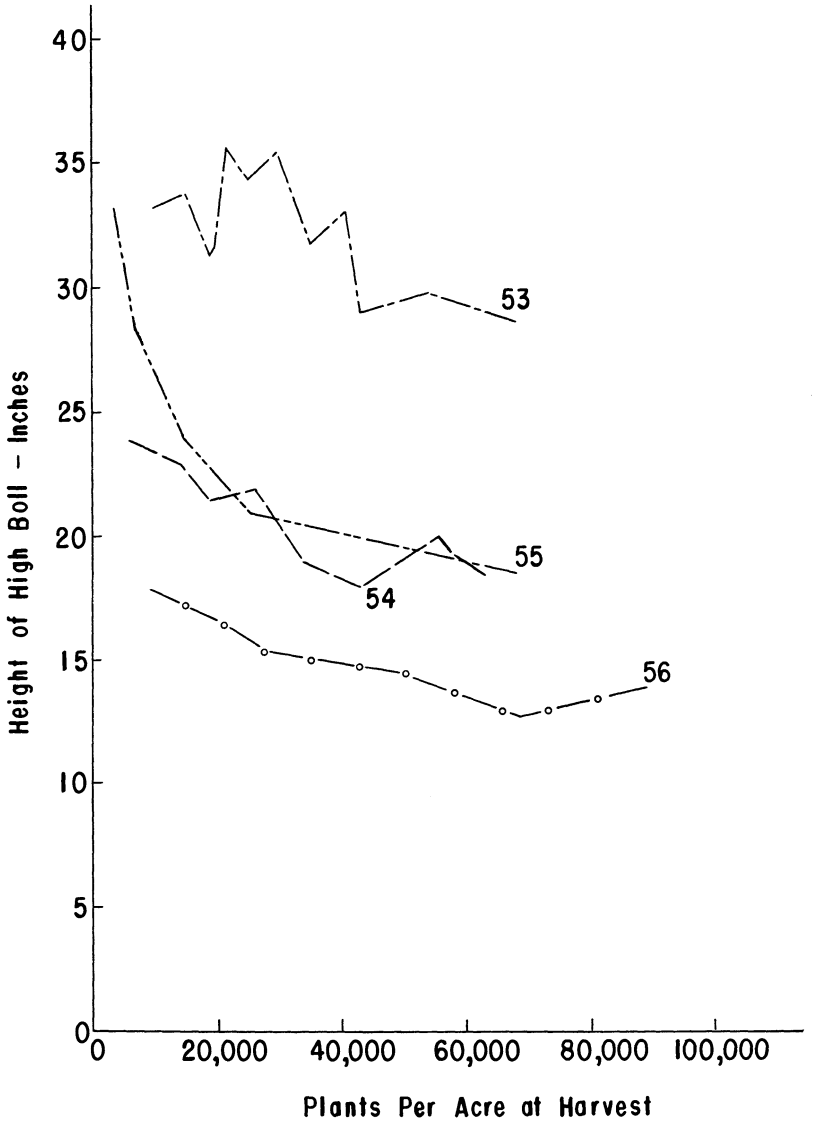

Figure 7. Height of high boll—inches.

In five of the six years, the pre-harvest loss increased as plant population increased. Only in 1956 did this trend alter appreciably. In 1956, a statistical analysis of the data showed no significant difference among the various populations. Pre-harvest loss ranged from approxi-

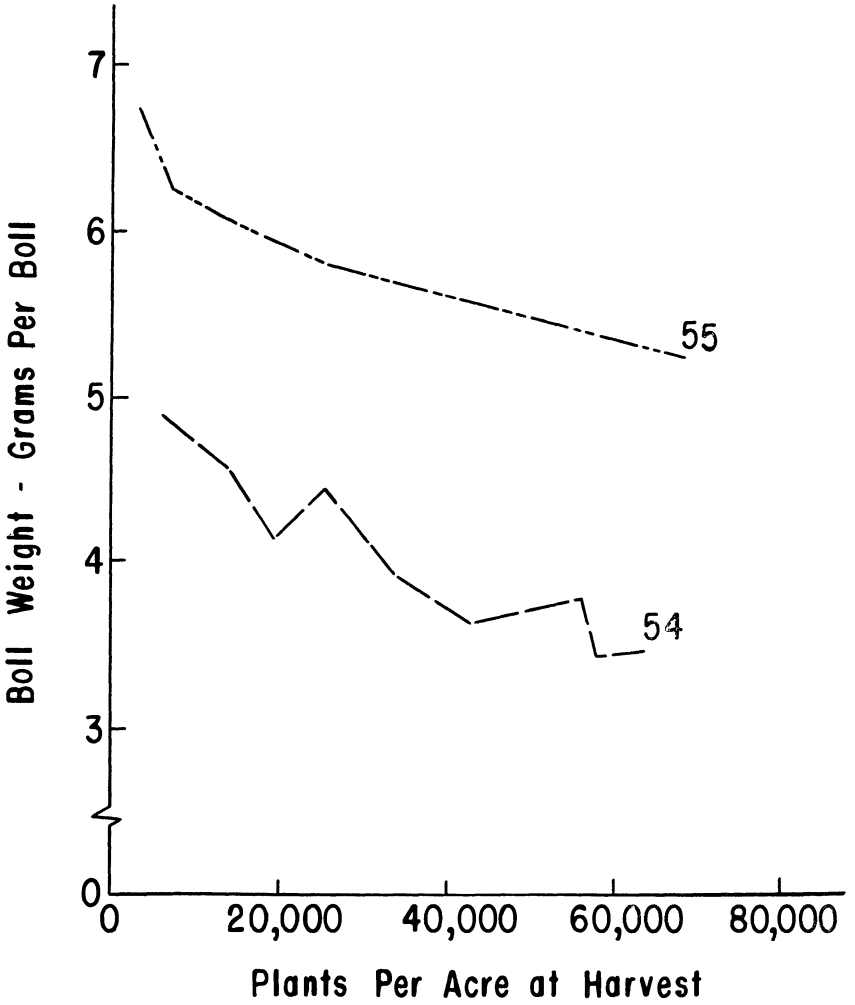

Figure 8. Boll Weight—grams per boll.

mately one percent to thirteen percent. This would indicate that pre-harvest loss may be influenced not only by the plant population, but also by the climatic conditions for any given year. Pre-harvest loss does not seem to be directly associated with yield. However, in a year when high yield was obtained, the number of pounds of cotton lost before harvest was greater.

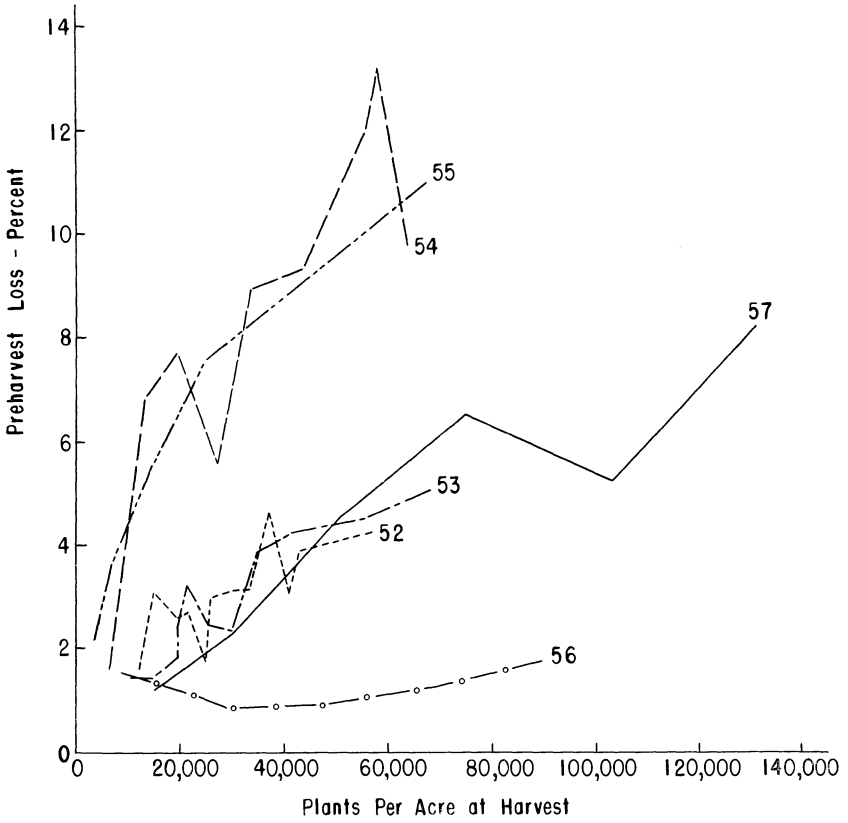

Figure 9. Preharvest loss—percent.

The Seed Cotton Per Burr Ratio

The seed cotton per burr ratio was measured by taking the pre-harvest loss into the laboratory and separating, by hand, the seed cotton from the burrs. The seed cotton and burrs were then weighed separately and the weight of the seed cotton was divided by the weight of the burrs. As this ratio increases, it indicates that more of the pre-harvest loss was in the form of loose locks. As the ratio decreases, it indicates that more of the pre-harvest loss was in the form of whole bolls on the ground.

This seed cotton/burr ratio in the pre-harvest loss was measured 2 years. There was a trend toward higher ratios as plant population increases. This would indicate that higher populations drop more individual locks than whole bolls to the ground before harvest.

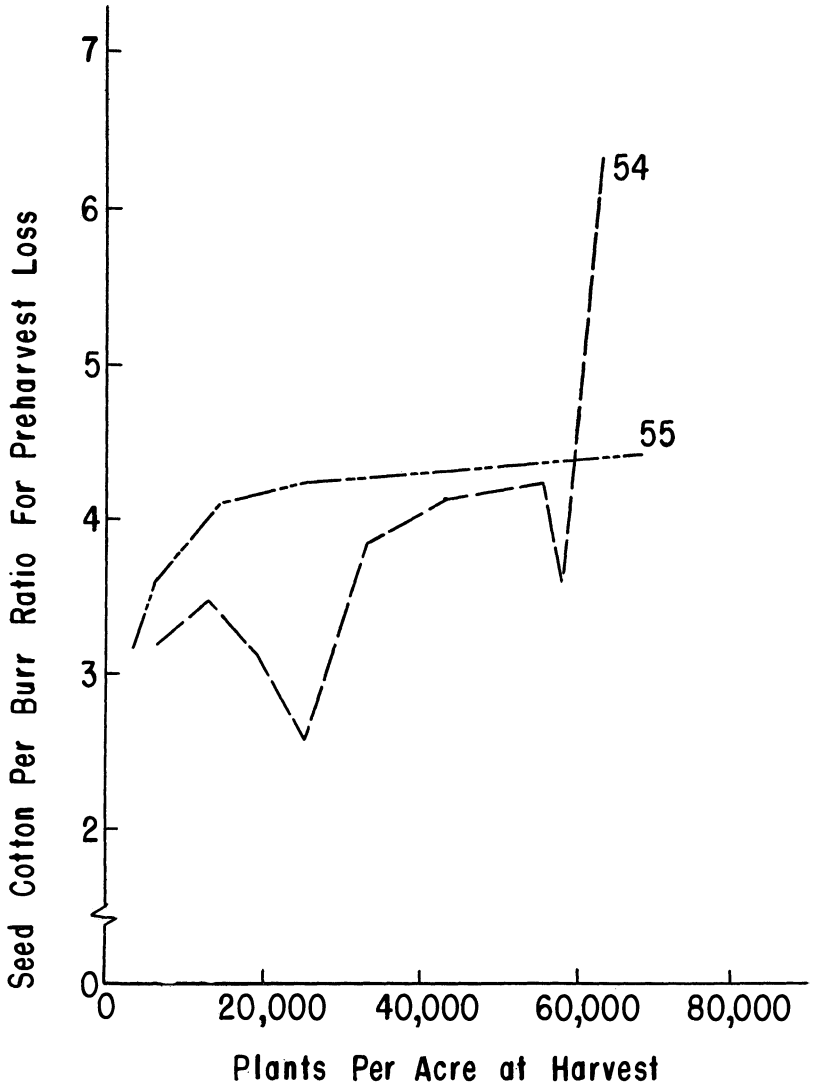

Figure 10. Seed cotton per burr ratio for preharvest loss.

MACHINE LOSS

Machine Loss on Ground

Immediately following the passage of the stripper through the test area, the machine loss in the test area was gathered for analysis. Any material on the ground which was cotton and showed a fair degree of maturity was gleaned. This measurement was taken for 4 years. Three

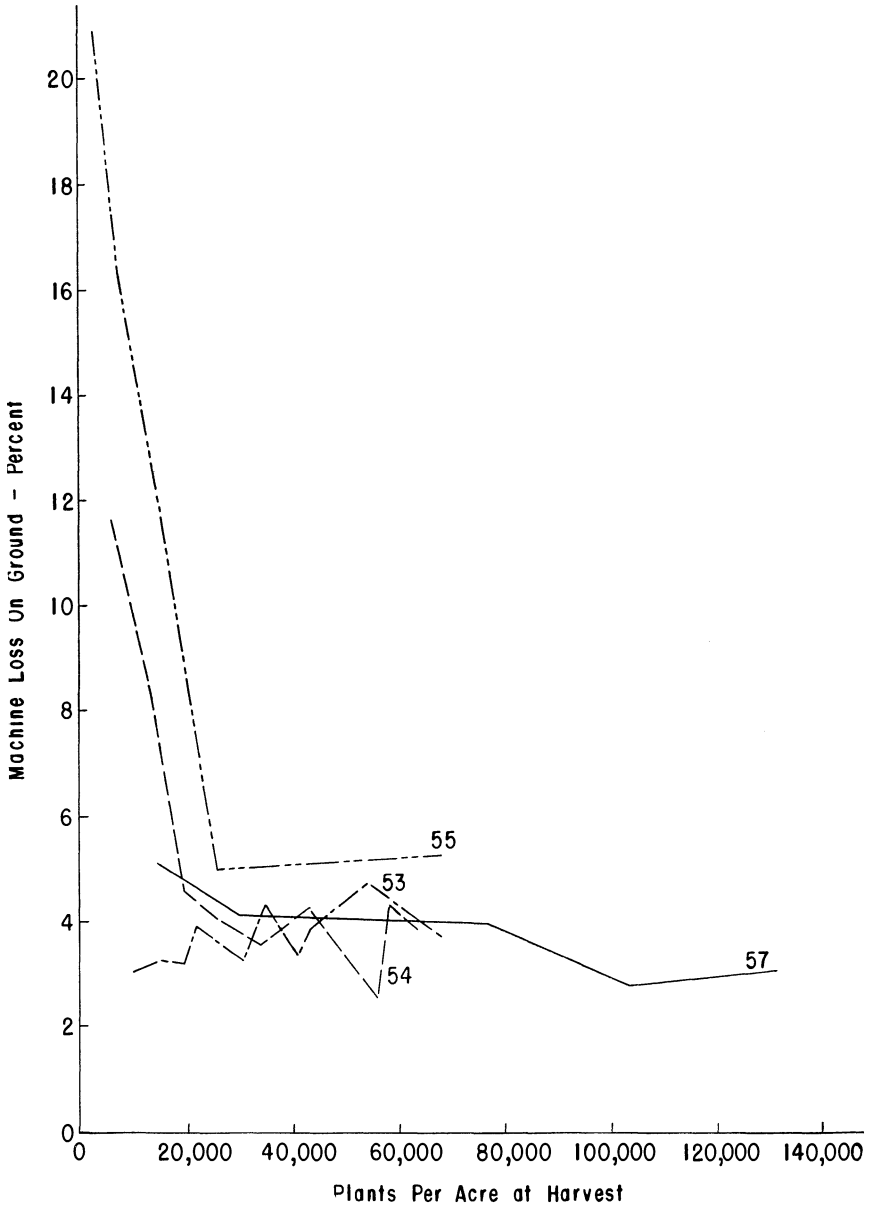

Figure 11. Machine loss on ground—percent.

of the four year's data showed that machine loss on the ground decreased as plant population increased. The fourth year there was a slight trend toward increasing machine loss on the ground as plant population increased. The tremendous difference in magnitude for those years when population increase had tended to reduce machine loss on the ground far out weighs in importance the one year when machine loss tended to increase.

In general, as plant population increased, the machine loss on the ground decreased. For extremely low populations of 10,000 plants per acre, or less, machine losses in 2 years were excessively high. In general, however, above 20,000 plants per acre machine loss ranged from 3 to 5 percent. Five percent of the seed cotton available for harvest as the stripper pulled into the plot area was lost and counted as machine loss on the ground.

The Seed Cotton Per Burr Ratio on the Ground

The machine loss on the ground was taken to the laboratory and separated into two parts, seed cotton and burrs. The seed cotton was weighed and this weight divided by the burr weight. This measurement was taken for 2 years. In 1954, extreme variability in the ratio obscured any trend which might be present. In 1955, there was a definite and rather consistent increase in ratio values as plant population increased. This was not an unexpected result, since the seed cotton per burr ratio in the pre-harvest loss tended to increase as plant population increased. As plant population increased, a greater quantity of the machine loss on the ground was seed cotton in the form of locks rather than whole bolls.

Machine Loss on the Plant

The machine loss on the plant was obtained by gathering all cotton remaining on the plants in the test area immediately after the harvester had passed. The machine loss on the plant was the seed cotton remaining on the plant, expressed as a percent, of the total seed cotton available for harvesting just before the harvester pulled into the test area.

The amount of seed cotton remaining on the plant after the stripper had passed through the test section was small. In no case was this larger than 1.5 percent and in most instances was less than 1 percent. In general, the majority of the cotton left in the field by a cotton stripper was on the ground and very little of it did remain on the plant. Of the three years when this measurement was made, a definite trend toward decreasing machine loss on the plant as plant population increased was evident in only one year. Because the magnitude of this loss was small and the variability great, it was doubtful that this attribute would be important in selecting a plant population.

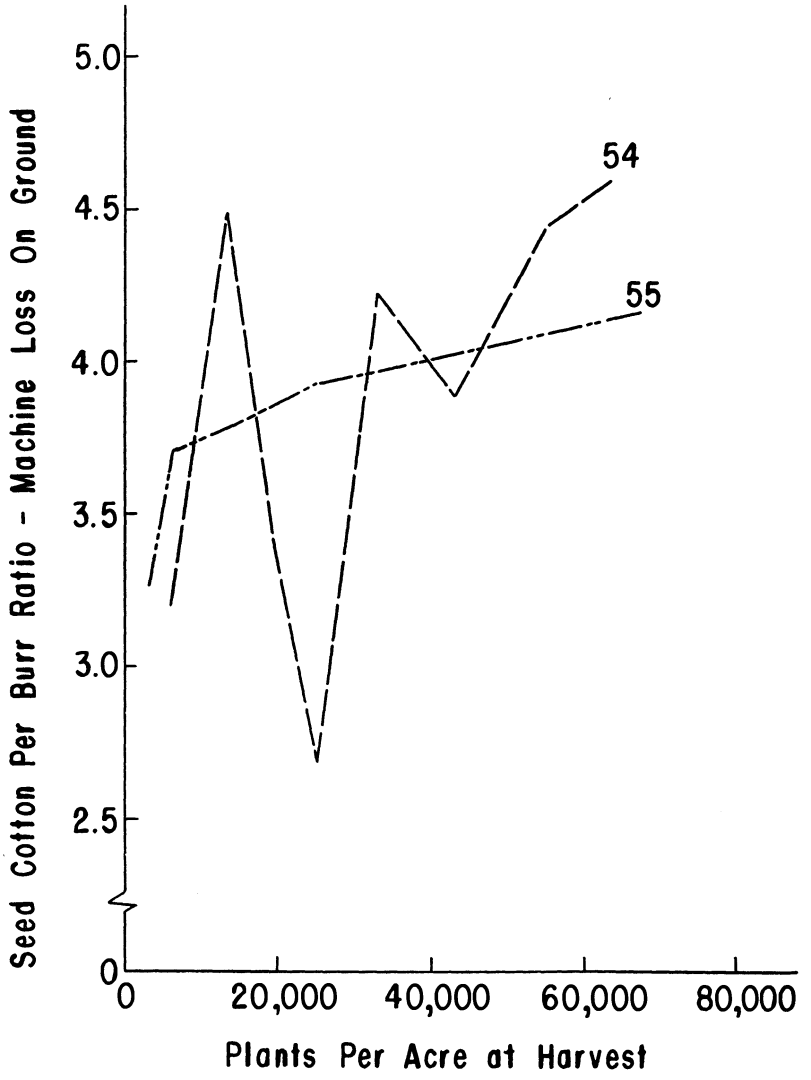

Figure 12. Seed cotton per burr ratio—machine loss on ground.

Total Machine Loss

The total machine loss was obtained by adding together the loss on the ground and the loss on the plant. This total machine loss, in percent, was measured 6 years. In 2 of these 6 years, variability was so great among the populations that no definite trend was apparent. In 4 years,

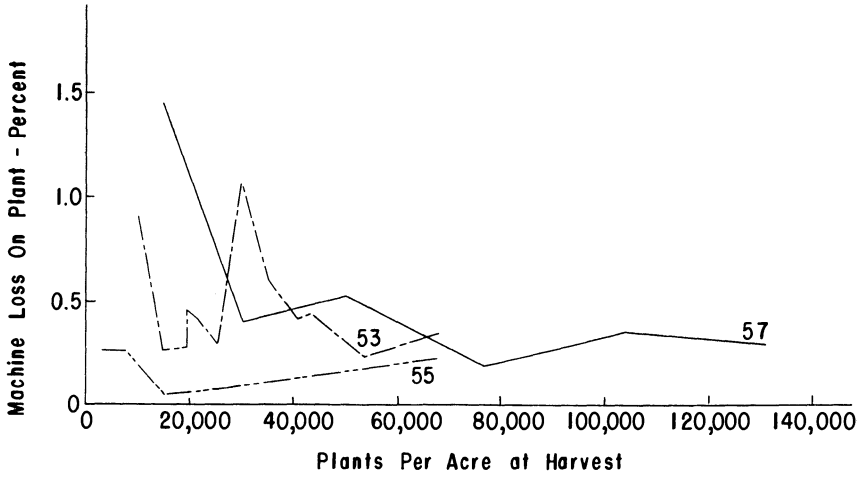

Figure 13. Machine loss on plant—percent.

percent machine loss decreased as population increased. Except for the results of one year and for populations below 20,000 plants/acre, a total machine loss of less than 6 percent of the seed cotton available to the harvester at harvest time was measured.

YIELD OF SEED COTTON

Net Yield

Net yield of cotton was obtained by taking the total amount of material harvested in the test area and separating the clean seed cotton and weighing it. In 3 of the 6 years there was a significant decrease in net yield as plant population increased. One year there was a significant increase in net yield as population increased and 2 years there was no significant difference in net yield among the populations tested. It would appear that net yield was not a reliable criteria for selecting a given plant population for best results.

Total Yield

The total yield of seed cotton was obtained by adding together the weight of seed cotton in the pre-harvest loss, the weight of the seed cotton in the total machine loss, and the net yield of seed cotton. The influence of population on total yield of seed cotton was precisely the same as the influence of population on net yield. In 3 of the 6 years tested, there was a significant decrease in total yield as plant popula-

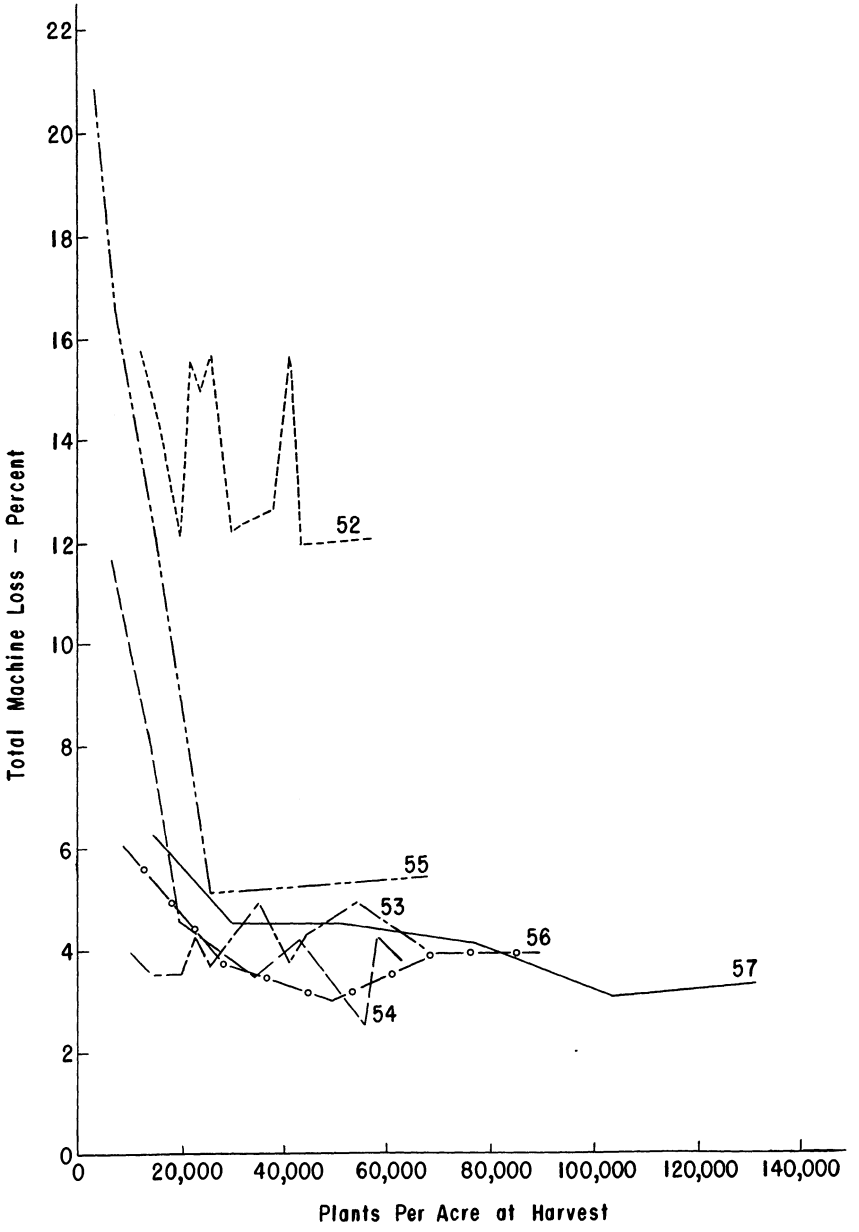

Figure 14. Total machine loss—percent.

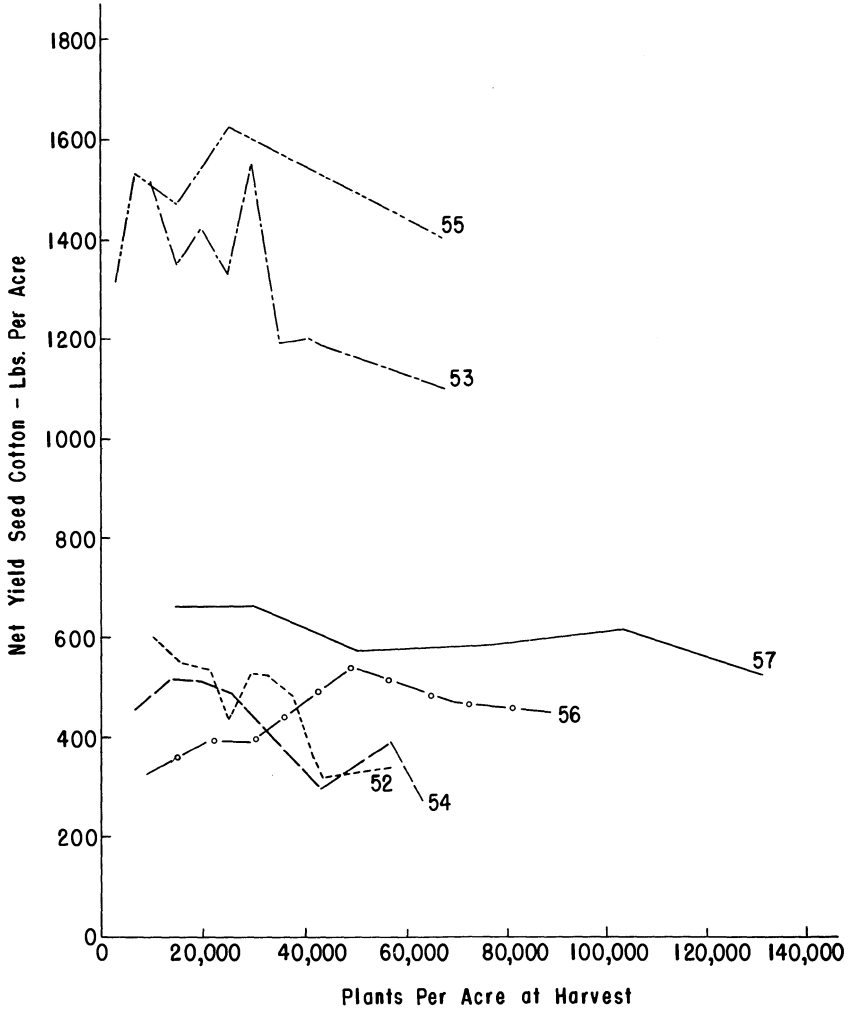

Figure 15. Net yield seed cotton—lbs. per acre.

tion increased. One year total yield increased as plant population increased and in 2 years there was no significant effect on total yield by plant population.

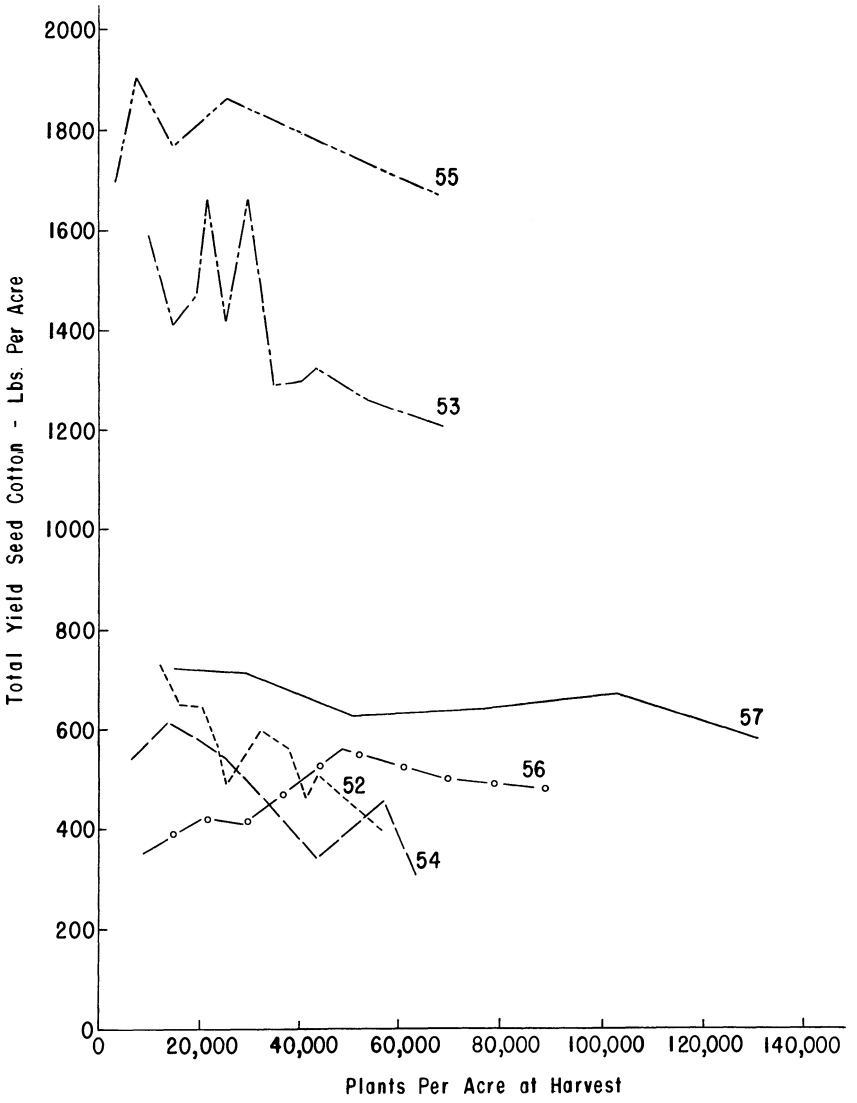

Figure 16. Total yield seed cotton—lbs. per acre.

TRASH IN THE HARVESTED COTTON

Sticks

The percent sticks in the harvested cotton was obtained by removing the sticks from the harvest sample, weighing the sticks and dividing this weight by the weight of the clean seed cotton in the harvest sample.

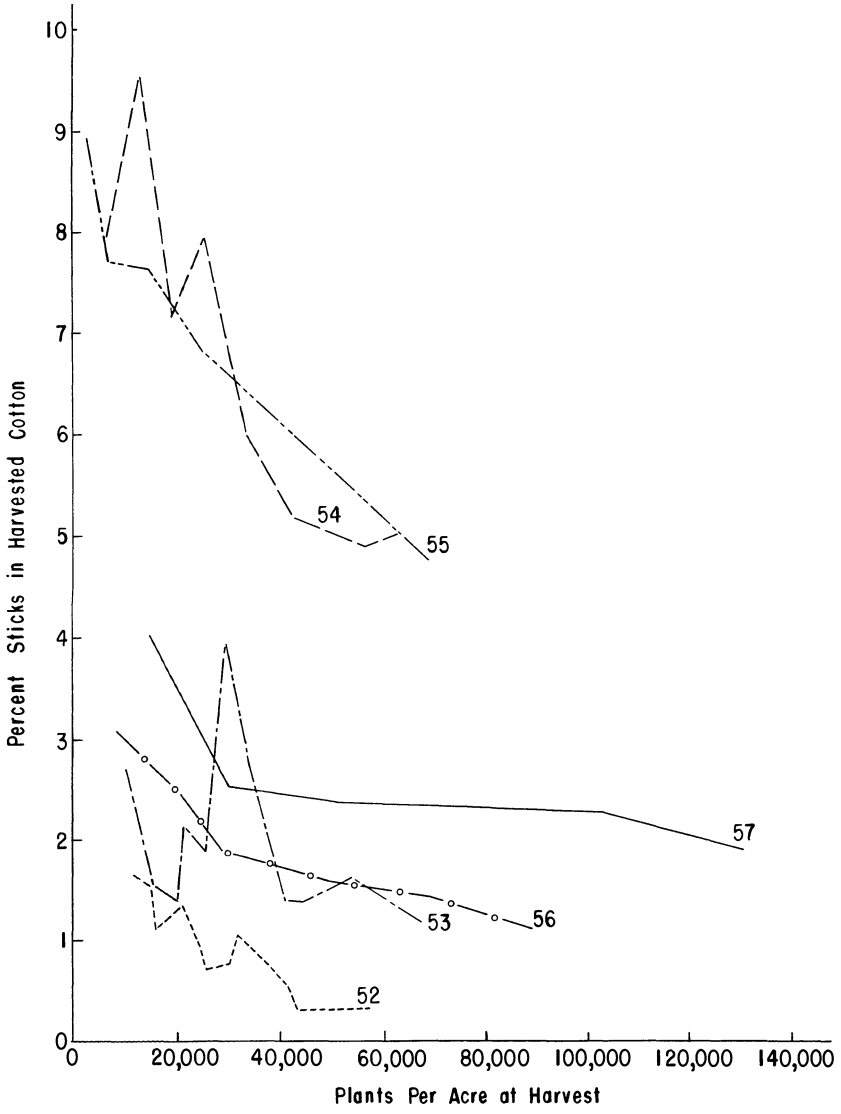

Figure 17. Sticks in harvested cotton—percent.

Measurement of the percent sticks in the harvested cotton was made 6 years. In 5 of the 6 years there was a significant consistent trend for sticks to decrease as plant population increased. The sixth year, variability among the populations was so great that no significant difference in stick content existed among the populations.

Since sticks are one of the most undesirable types of extraneous material in harvested cotton, it appears that a significant reduction in stick content can be obtained by selecting higher plant populations. The percent of sticks ranged from approximately 10 percent to less than 1 percent.

Burrs

The percent burrs in the harvested cotton was obtained by removing the burrs from the harvest sample and dividing the burr weight by the weight of the clean seed cotton. Although there was a wide variation in burr weight among the different years, in no test for any year was the percent burr significantly influenced by plant population. When harvesting with a stripper harvester, most of the burrs would be harvested along with the seed cotton. The percent burrs in the harvest sample did not appear to be an important criteria in selecting a plant population for best cotton production.

Large Leaf Trash

The large leaf trash was measured by removing all of the large leaves and material, other than sticks and burrs, which can be removed readily by hand from the harvest sample. The large leaf content in the harvest sample seemed to vary a great deal from year to year. In 3 of the 4 years measurements of this attribute were made, there was a definite increase in large leaf content as plant population increased. In one year, there was no significant difference in large leaf content among the plant populations, although the trend appeared to be a decreasing content as population increased. In general, large leaf content of the harvested cotton increased as plant population increased.

Small Leaf Trash

The small leaf trash was obtained by running the harvested sample through a fractionating device. The small leaf trash is that extraneous material too small to be picked out by hand. During the 4 years in which this attribute was measured, there was a significant increase as population increased in the small leaf trash in the harvest sample for 3 of the 4 years. One year there was no significant influence by plant population on the small leaf trash in the harvested cotton.

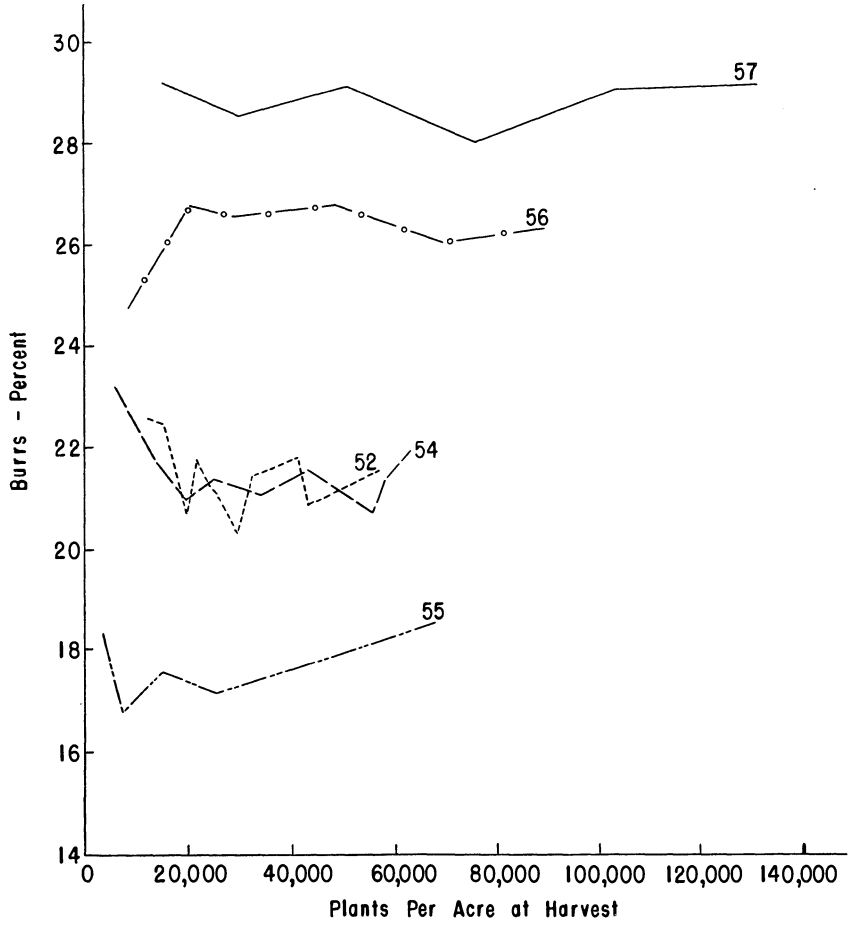

Figure 18. Burrs in harvested cotton—percent.

Motes

The percent of motes in the harvested sample was obtained from fractionation data. The mote content of the harvest sample was measured 4 years. Two years the mote content significantly increased as plant population increased. One year there was a trend toward decreasing mote content as population increased and one year there was no significant effect on mote content by plant population. If percent motes in the harvested sample was influenced by plant population, it generally increased as the plants per acre increased.

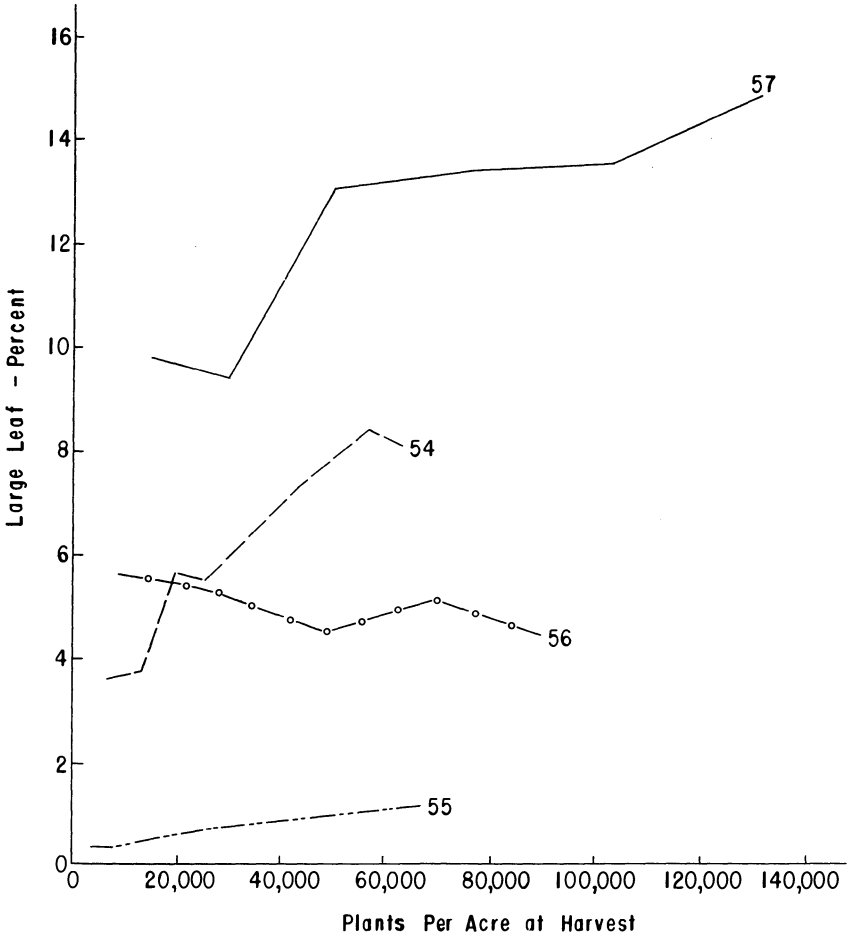

Figure 19. Large leaf in harvested cotton—percent.

Total Trash

The total trash in the harvest sample was obtained by removing all trash from the harvested sample. The large trash was removed by hand and the smaller trash components were removed by running the sample through a fractionator. Total trash in the harvest sample was measured for 5 years. In 2 of the 5 years, as population increased, there was a significant increase in the total trash. One year there was a significant decrease in total trash as population increased and 2 years there was no significant effect on total trash as influenced by the plant population.

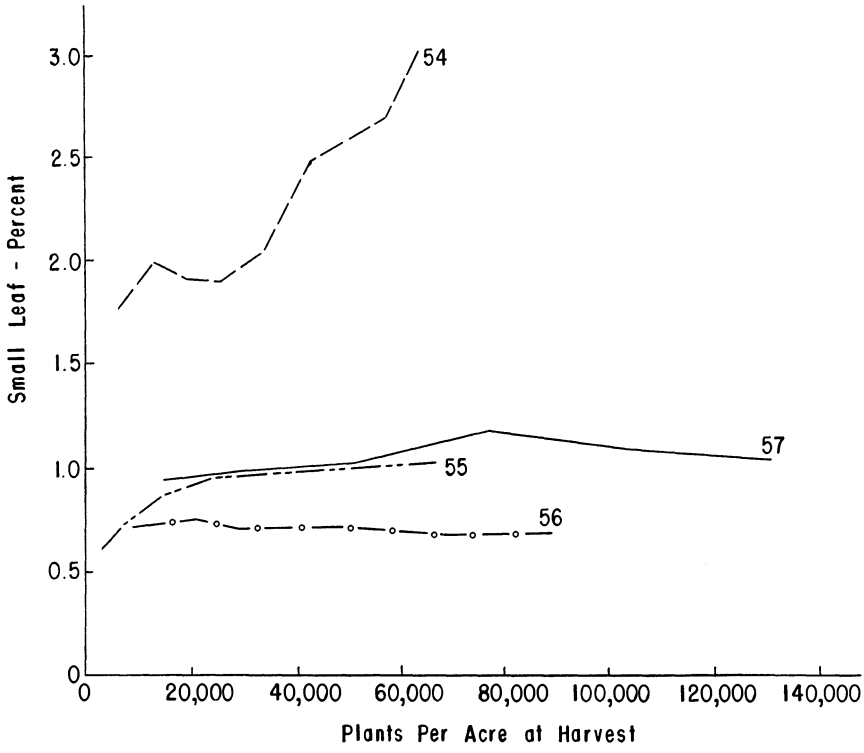

Figure 20. Small leaf in harvested cotton—percent.

GINNING RESULTS

Gin Turnout

Gin turnout is defined as the pounds of lint cotton, plus any trash remaining in the lint, from 2400 pounds of stripped material fed into the gin. During the last 3 years of this test, the field samples were sufficiently large to permit ginning samples to be taken from each population. In all 3 years there was a significant increase in gin turnout as plant population increases. It would appear that a relatively high population might be selected for maximum gin turnout. Part of the increase in gin turnout was undoubtedly due to the increase in small, foreign material from high populations that was not removed in the gin. Until such time as there is an adequate premium for removing more of the trash from the lint, high turnout will be generally advantageous to the cotton producer.

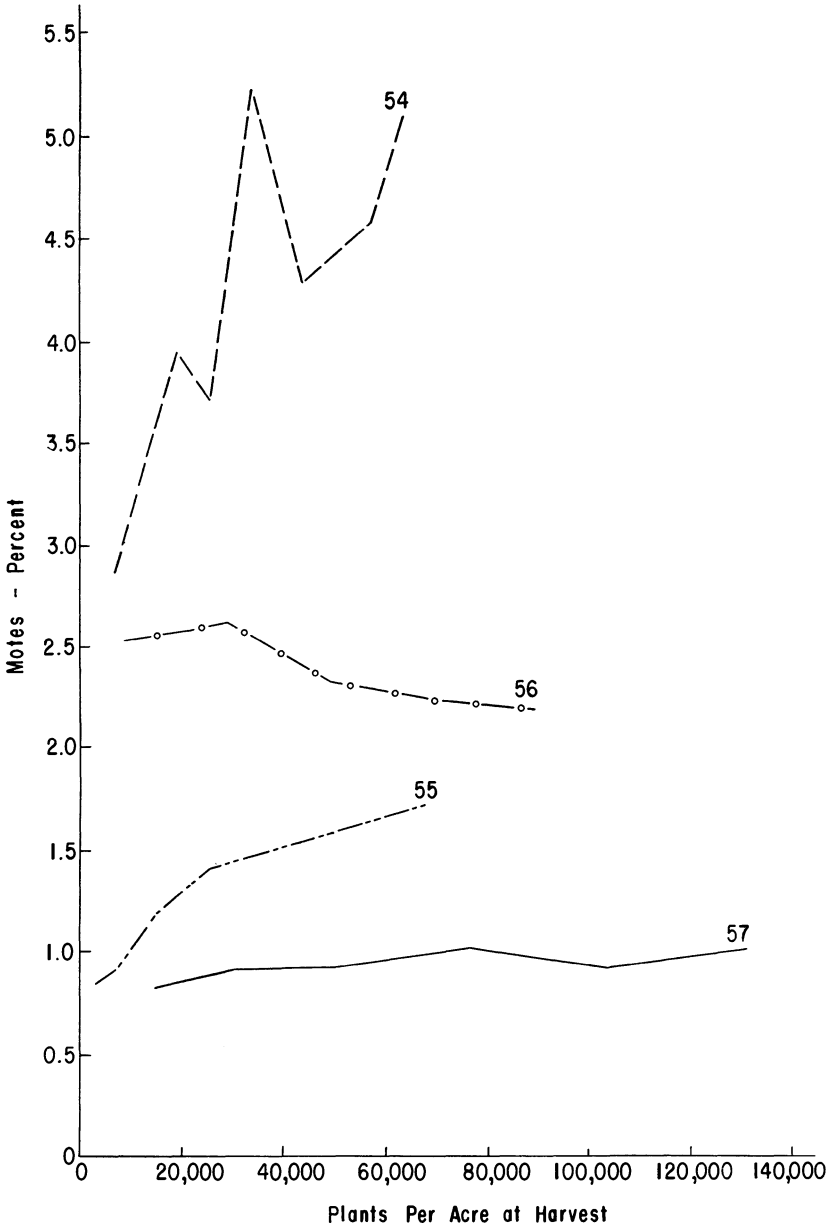

Figure 21. Motes in harvested cotton—percent.

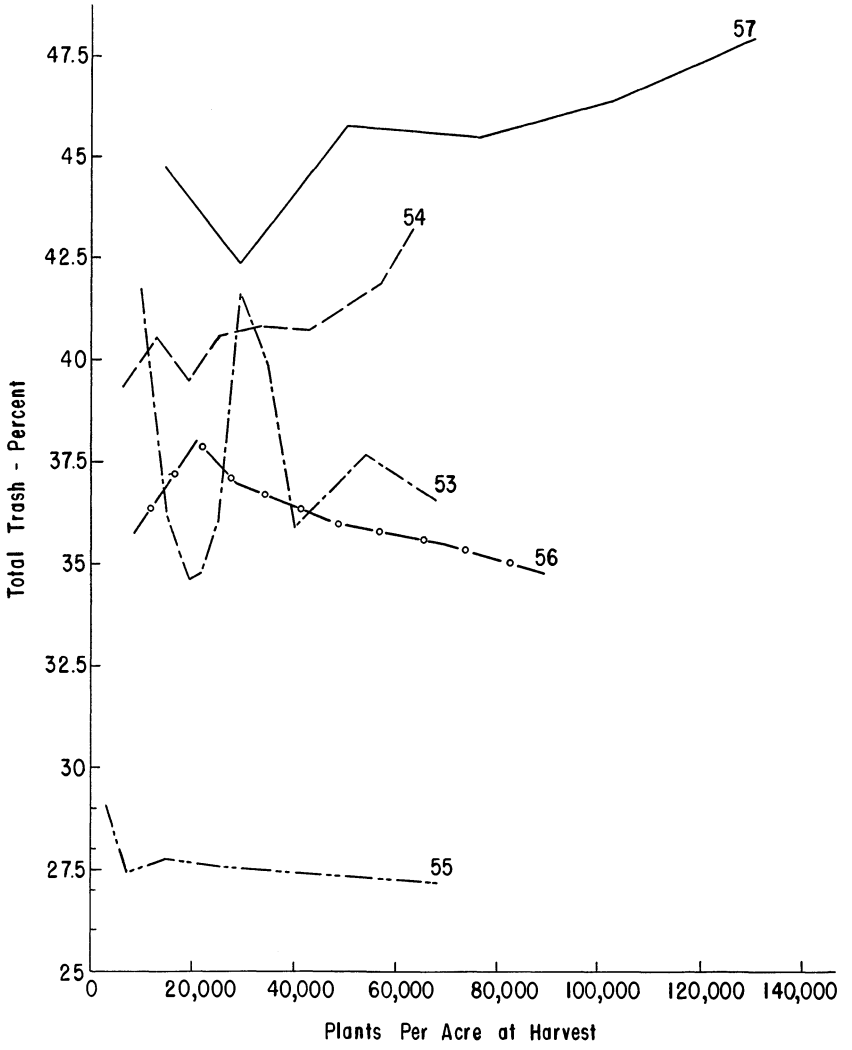

Figure 22. Total trash in harvested cotton—percent.

Staple Length

The staple length of cotton was obtained by taking samples of the ginned cotton from each plant population to a government classing office for grade and staple determinations. This was done for 3 years. All 3 years the trend was toward shorter staple length as plant popula-

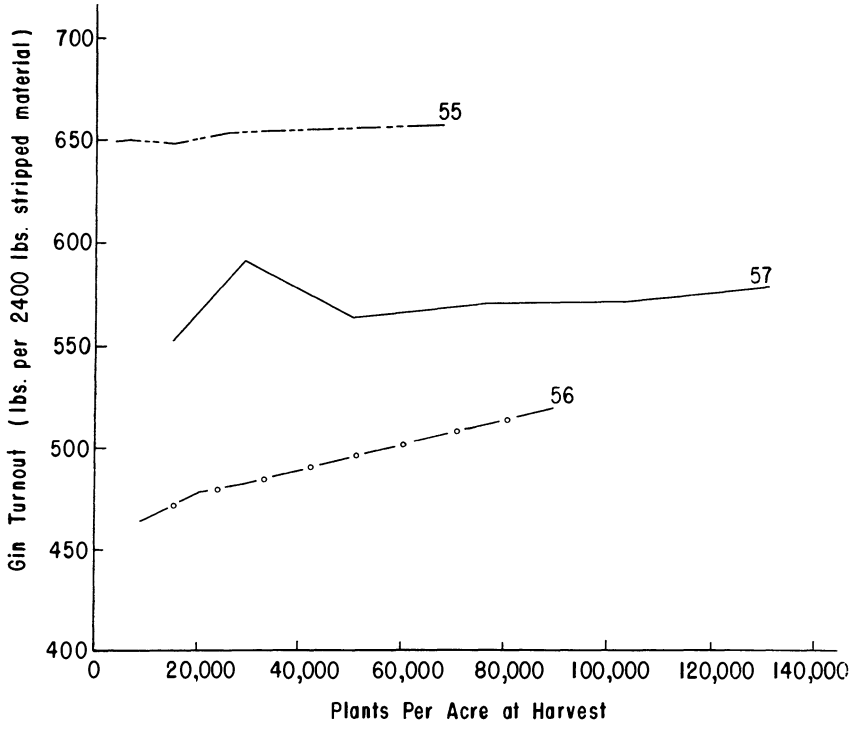

Figure 23. Gin turnout (lbs. per 2400 lbs. stripped material).

tion increased. During 2 of these years this decrease was significant and the third year a trend only was evident and no significant difference existed among the plant populations in staple length.

Grade Index

The grade index of the cotton ginned from each population was determined from grades assigned to the samples at the government classing office. For 2 years the grade index was so variable that no trend could be established with respect to plant population. In one year there was a tendency for grade index to increase as population increased. It is doubtful that grade index is a satisfactory criteria to use in selecting a particular plant population; however, in 2 years it was noted that grade reductions due to bark in the ginned lint were much more frequent among the three lower populations than among higher populations. This was probably because of the rank plant growth associated with low populations.

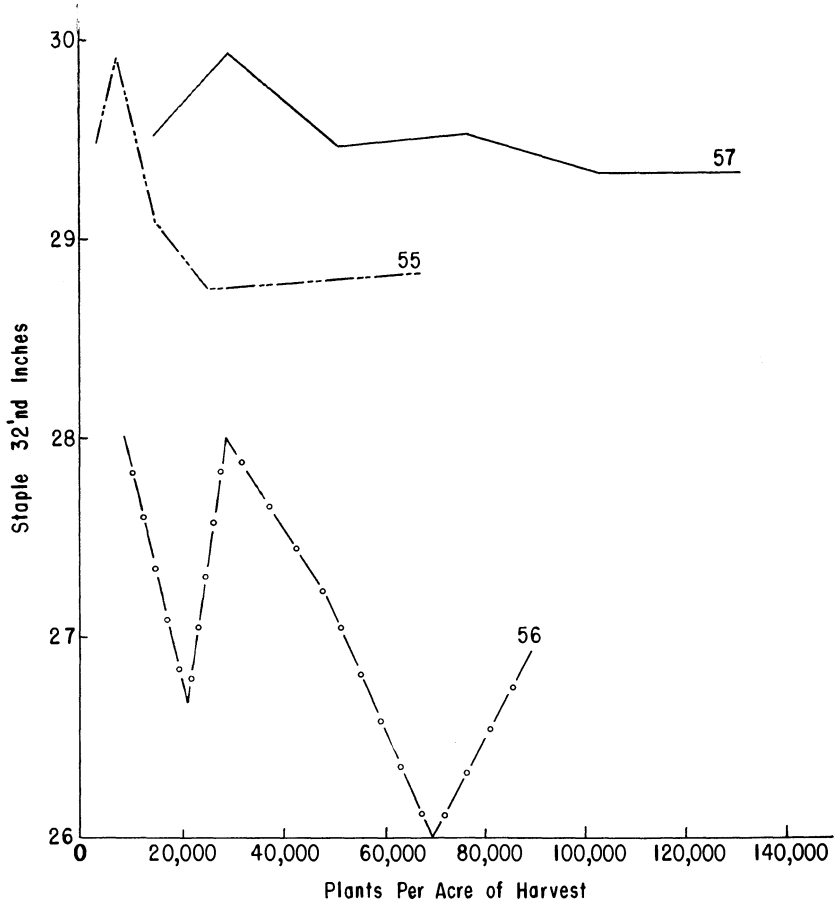

Figure 24. Staple 32'nd inches.

Lint Waste

After the cotton produced by each plant population had been ginned, analysis was made of the waste in the ginned lint. The difference in lint waste among the populations was significant in all 3 years this measurement was taken. However, in only one year was there a definite trend of increasing lint waste as plant population increased. This increase in lint waste might contribute to the increased gin turnout which was found as plant population increased.

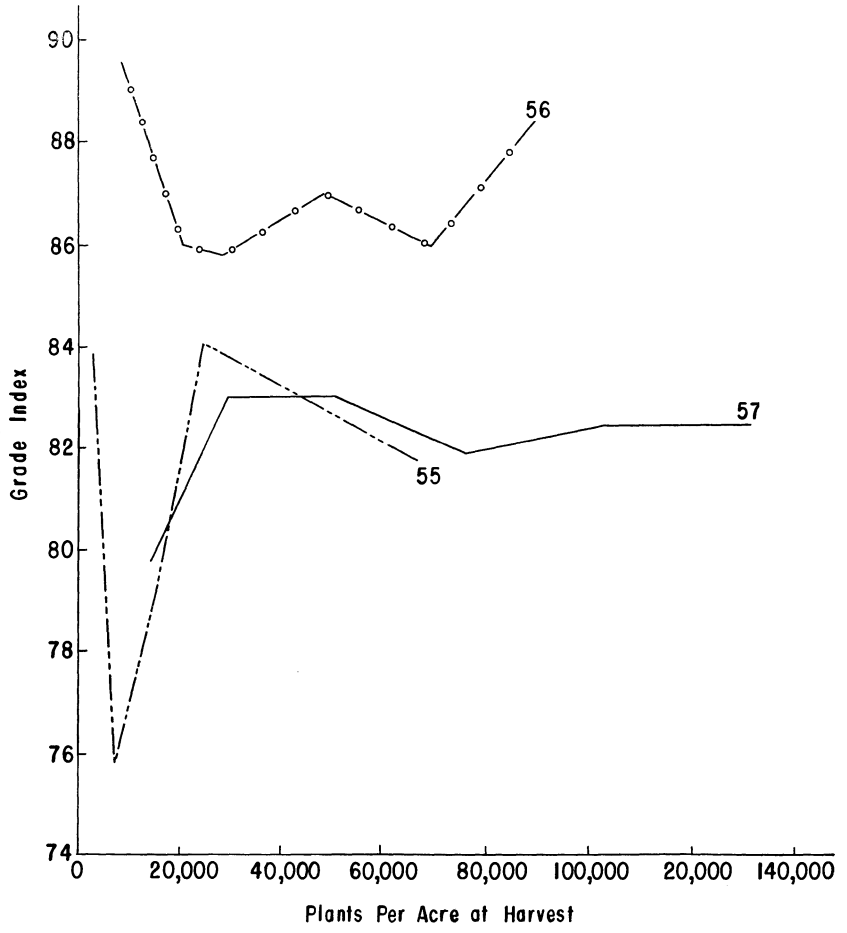

Figure 25. Grade Index.

Returns Per 2400 Pounds of Harvested Material

The return in dollars per 2400 pounds of stripped material ginned was measured for 3 years. The government loan schedule and grades and staples assigned in the government classing office were used as the basis for computation of returns. For 2 years the trend was for an increasing return from 2400 pounds of stripped material as population increased. There was a significant difference among populations all 3 years; however, in one year there seemed to be no particular trend due to plant population.

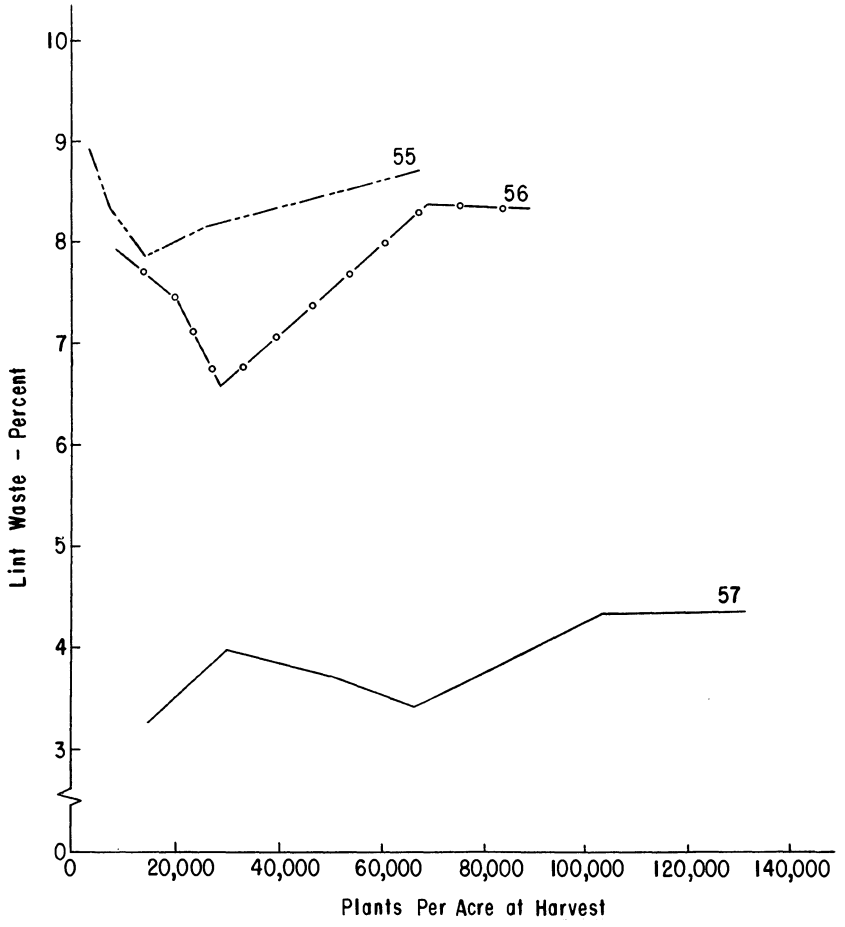

Figure 26. Lint waste—percent.

Gross Returns

The gross returns in dollars per acre for several plant populations were measured for 3 yearss. Gross returns were significantly affected by plant population in all 3 years, however, the trend was not consistent. In one year, there was a definite trend toward increasing gross returns as plant population increased, a second year gross returns tended to decrease as population increased and the third year there was no trend established relative to plant population. It would appear that gross returns in dollars per acre is not consistently influenced by the plant

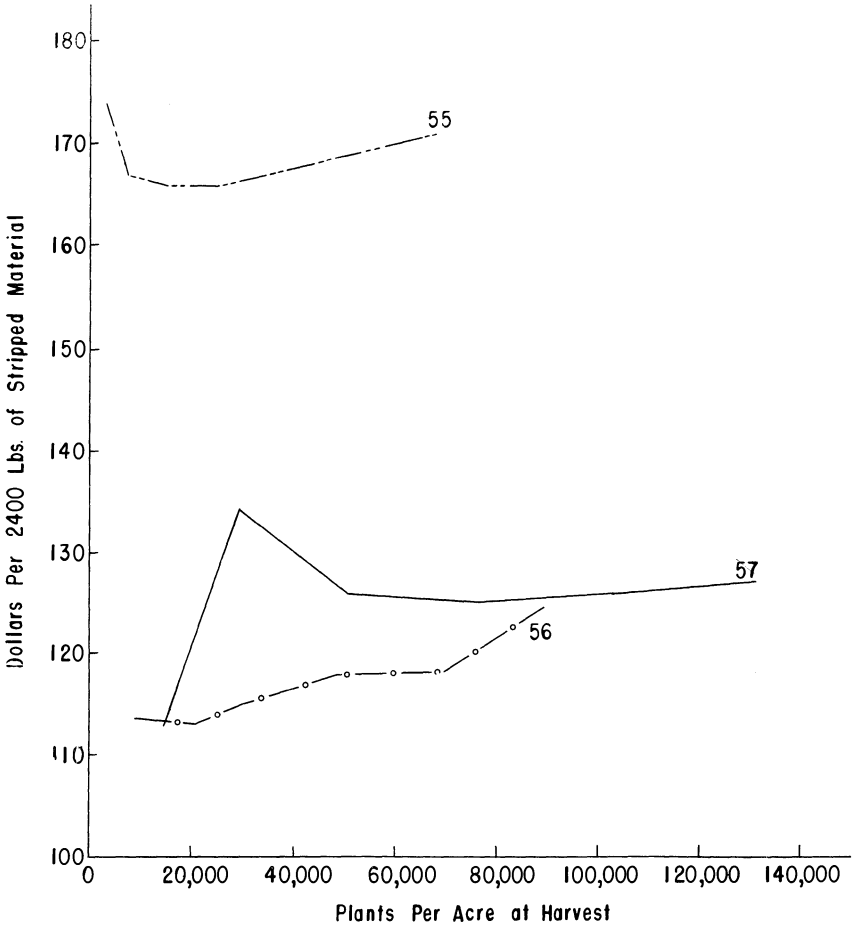

Figure 27. Dollars per 2400 lbs. of stripped material.

population; although in each of the 3 years it has been noted that highest gross returns have been associated with an intermediate population (20 to 50 thousand plants per acre).

SUMMARY

Twenty-eight attributes which were thought to have some importance on successful mechanized cotton production were measured on different plant populations. Some measurements were taken for 6 years, others for a fewer number of years. Where several year's data exists and trends were consistent, the following conclusions were drawn:

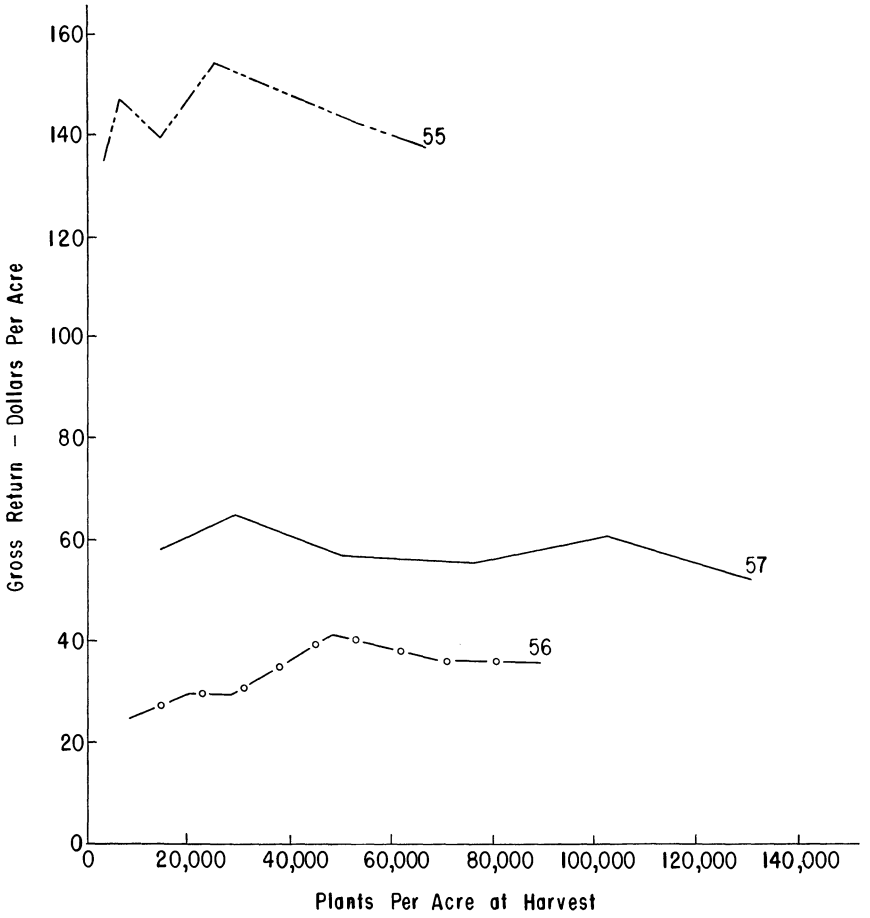

Figure 28. Gross return—dollars per acre.

Those attributes which increased in value as plant population increases were: (1) pre-harvest loss, (2) height of the low boll, (3) small leaf trash and (4) gin turnout. Those attributes measured which consistently decreased in value as plant population increased were: (1) weight of the bolls, (2) root depth, (3) plant height, (4) plant width, (5) height of the high boll, (6) sticks in the harvested cotton, (7) total machine loss and (8) staple length.

Other attributes measured which showed definite, but less consistent trends were evaluated. Those which tended to increase as population

increased were: (1) percent emergence, (2) motes in the harvested cotton, (3) large leaf in the harvested cotton, (4) total trash in the harvested cotton, (5) the cotton per burr ratio in the pre-harvest loss and the (6) dollars returned per 2400 pounds of material ginned. Those attributes which tended to decrease in value as plant population increased were: (1) net yield, (2) total yield and (3) machine loss on the ground. This group of nine attributes gave considerable evidence of a definite trend as influenced by plant population, however, there is less consistency in this group than in the first group of twelve attributes.

A third group of attributes measured, about which no definite conclusions were made on the basis of the data taken from these tests, includes: (1) manhours per acre of hoeing time, (2) burrs in the harvested cotton, (3) machine loss on the plant, (4) cotton per burr ratio of the machine loss on the ground, (5) gross returns in dollars per acre, (6) grade index and (7) lint waste. For this group of attributes there appeared to be insufficient information available to make definite and conclusive statements of the effect of plant population on these attributes.

There have been widely publicized recommendations on the most desirable plant population for stripper harvesting. In the upland cotton growing areas of the United States, these recommendations have ranged from 20 to 50 thousand plants per acre. The data from 6 years of testing different plant populations do not indicate a need for change in this recommendation. A plant population in the range from 20 to 50 thousand plants per acre makes a satisfactory compromise between those undesirable attributes that increase in value as population increases and those desirable qualities that decrease in value as plant population decreases.

On the basis of 6 years testing, it was definitely established that certain attributes of cotton plant type, harvesting and ginning characteristics can be altered appreciably by selecting a plant population consistent with the objectives of mechanized cotton production.

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10/58—3½M