EFFECT OF SELECTED SEEDING RATES ON THE FRUITING RESPONSE, YIELD, AND FIBER PROPERTIES OF NARROW-ROW COTTON IN SOUTHWESTERN OKLAHOMA

By

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CHAPTER I

INTRODUCTION

Cotton (Gossypium hirsutum L.) has traditionally been grown in rows spaced 36 to 40 inches apart, with variable spacing of plants within rows. These conventional row widths have been standardized for uniformity in the mechanization of production operations. Research has shown that variable spacing of plants within the row in 40-inch rows with populations from 15,000 to 75,000 plants per acre results in little or no detectable differences in yield and fiber quality provided that the distribution of plants was fairly uniform.

During the past few years, cotton planters and harvesters have been developed that are capable of operating effectively over a wide range of row spacings. Herbicides have provided a method of weed control that is not limited to standard row-width equipment. These developments have made possible the production of cotton in other than the conventionally spaced 40-inch rows.

The practice of increasing the number of rows per acre by decreasing the width between rows will increase the population of plants per acre if the plant spacing within the row remains constant. This fact has resulted in narrow-row, high plant-population cotton production.

Specialists and producers have reasoned that narrow-row, high-population cotton production holds great potential for reducing production costs. Cost reduction should be obtained through a shortened fruiting period. Normally, a fairly high yielding cotton produces five to eight bolls per plant. The development of these bolls on the stalk may span a period of five to eight weeks. The basic idea behind the narrow-row system is to reduce the time span to approximately two to three weeks by increasing the number of plants per unit area and allowing each plant to produce only a few bolls. A shorter fruiting period would mean less time for insect damage, thus lowering costs of production for insect control. The earlier maturity would reduce exposure to unfavorable weather conditions at harvest-time which would in turn result in less pre-harvest loss and the production of higher quality lint.

Cotton producers are searching for ways to produce high quality, high yield cotton by efficient economical means. The proven and potential advantages of narrow-row cotton production are creating considerable interest among growers of both dryland and irrigated cotton.

The objectives of this study were to determine the influence of selected seeding rates on the fruiting response, yield, and fiber properties of narrow-row cotton in southwestern Oklahoma.

CHAPTER II

LITERATURE REVIEW

Studies relating to cotton spacing have been conducted over a long period of time in the United States. Most have been made on the conventional 36 to 40-inch row widths, with little interest being expressed in closer rows.

A summary of tests conducted at several locations throughout the Cotton Belt between the years of 1886 and 1919 were made by Brown (1). These early investigations showed that increased population resulted in smaller plants with shorter lateral branches. There were also reductions in boll size.

Wilkes and Corley (8) report that these early tests were evaluated primarily from the standpoint of yield. Generally speaking, they showed that the spacing of plants drilled in rows could vary considerably without materially affecting yield provided the plants were fairly uniformly distributed.

In the early 1950's, work was initiated on the High Plains of Texas using conventional varieties planted in narrow-row widths with increased seeding rates. This work was initiated at the Texas A & M University Agricultural Research and Extension Center at Lubbock (3, 5). These investigations determined that yield could be increased by 10 to 20 percent and cost of production could be reduced by 10 to 15 percent through the use of narrow-rows. These results were highly encouraging;

but due to weed problems and inadequate harvesting equipment for narrow-row production, research involving the cultural system was abandoned until the early 1960's.

In the early 1960's, practical and commercial use of herbicides was becoming accepted for weed control in cotton. Also, during this time, the finger-type, narrow-row harvester was designed and perfected at the Texas A & M University Research and Extension Center at Lubbock. Narrow-row, high-population production adapts itself to a once-over stripper-type harvester. By 1965, weed control and harvesting problems had been adequately solved for narrow-row cotton production which gave added incentive for research in this area.

Several experiments have been conducted to relate machine harvest efficiency to plant population. Porterfield et al. (4) found that plants were more suitable for machine harvest when planted under closer spacing. Jones et al. (2) showed that the close spacing decreased the overall plant height and plant spread, increasing the height to the first limb, and decreasing the diameter of the stalk at the base. Ray et al. (6) found that plant height and branches were shorter, stem diameters were narrower, fewer plants were pulled up, and stripper loss was less as plant populations increased from 18,000 to 77,400 per acre. Although the feasibility of narrow-row, high-population cotton production has been emphasized many times, some potential problems still exist. Wiese and Smith (7) state that the full utilization of the agronomic, economic, and mechanical advantages of closely spaced cotton is dependent upon adequate chemical weed control. Ray (5) points out that merely going to narrow rows alone will be of little or no benefit; the concept involves a system of culture, with variety being an important key to its success. He further states that narrowing the row width and increasing plant population will not hasten crop maturity; more likely it will delay maturity. Ray indicates that variety is a key factor and that new varieties, developed specifically for the system of production, should greatly enhance the potential of narrow-row, high-population cotton.

CHAPTER III

MATERIALS AND METHODS

This study was conducted during the 1971 growing season to determine the fruiting response, yield, and fiber quality of cotton produced under the narrow-row, high-population concept.

Two widely grown cotton varieties, Lankart LX571 and Lockett 4789A, were selected because of their wide area of adaptation and popularity for dryland production in Oklahoma. Of the presently grown varieties in Oklahoma, these two possess growth and fruiting characteristics that should make them adapted to narrow-row production.

The two varieties were planted at four seeding rates, namely, 15, 30, 45, and 60 pounds per acre in 10-inch rows. The test plot was planted with a John Deere 71 Flexi Planter with eight units mounted on a double tool bar. Each unit is equipped with double-disk openers and a press wheel which provides for control of seeding depth and covering.

Pre-plant treatment consisted of seed-bed preparation, application of a pre-plant herbicide, and the addition of fertilizer based on the results of soil tests. The test site was located at Granite, Oklahoma, on a Miles fine sandy loam soil which received an application of 30 pounds N, 60 pounds of P_2O_5, and 30 pounds of K_2O per acre. This 2 x 4 factorial study was planted in a randomized complete-block design with four replications. Individual plots of each variety measured 16 by 100 feet.

Because of prolonged dry weather during July and early August, all treatments received two applications of supplemental water applied by sprinklers at the rate of approximately 1½ inches per application. Because of an early boll weevil infestation, the plots received one insecticide application.

Population counts were made seven days after emergence of seedlings and of mature plants immediately prior to harvest. Periodic readings of fruit initiation and development were made on all treatments during the entire fruiting period.

All plots were harvested with an Allis Chalmers XTB-707 finger-type header unit. Portions of the plots were harvested for yield determinations, and these were 13 x 50 feet in size. The test was harvested December 28, 1971. Cotton lint samples were submitted to the Smith-Doxey Cotton Classing Office for grade determination and to the Fiber Laboratory of the Oklahoma Agricultural Experiment Station at Stillwater, Oklahoma, for fiber analyses.

The number of seed per pound was determined for each of the variety lots used in the test. The number of seed per pound for Lankart LX571 was 3700 and for Lockett 4789A, 4018 seed per pound.

CHAPTER IV

RESULTS AND DISCUSSION

The plots were planted on June 8 but were lost because of a high intensity rain that fell within twenty-four hours following planting. The test was replanted on June 18 and a good stand emerged within four days. Some of the boll maturity results that were observed during this investigation can probably be attributed to the relatively late planting date. Individual treatments are shown in Table I.

Population counts were made at two intervals. One count was made seven days following emergence and the other count was made just prior to harvest. The seedling emergence count (Fig. 1) showed the highest and lowest percent emergence populations ranged from a low of 59.5 percent for Treatment number 2 to a high of 78.0 percent for Treatment number 5. Stand emergence for the variety Lockett 4789A was higher at all rates than Lankart LX571.

Plant distribution pattern was more irregular at the lower seeding rates (Treatments 1 and 5). Many plants in this population range were undesirable for machine stripper harvesting because of large central stems and lateral branches which lowered harvesting efficiency.

The second stand count was made at harvest time to determine final plant population from which yield would be obtained (Table II). The greatest decrease in stand from the time of emergence to harvest occurred at the highest seeding rates for both varieties (Treatments 4

TABLE I

SEEDING RATES FOR THE TWO VARIETIES

Treatment Code Numbers	Variety	Seeding Rate (lbs./A)
1	Lankart LX571	15
2	Lankart LX571	30
3	Lankart LX571	45
4	Lankart LX571	60
5	Lockett 4789A	15
6	Lockett 4789A	30
7	Lockett 4789A	45
8	Lockett 4789A	60

TABLE II

STAND AND PLANT POPULATION AT HARVEST TIME

Treatment	Emergence Stand (Percent)	Harvest Stand (Percent)	Plant Population Per Acre at Harvest (Thousands)
1	70.0	63.7	35.4
2	59.5	52.0	57.7
3	61.7	54.3	90.3
4	63.5	50.0	111.0
5	78.0	60.3	43.2
6	67.0	61.9	74.6
7	74.0	67.4	121.7
8	74.0	65.1	157.0

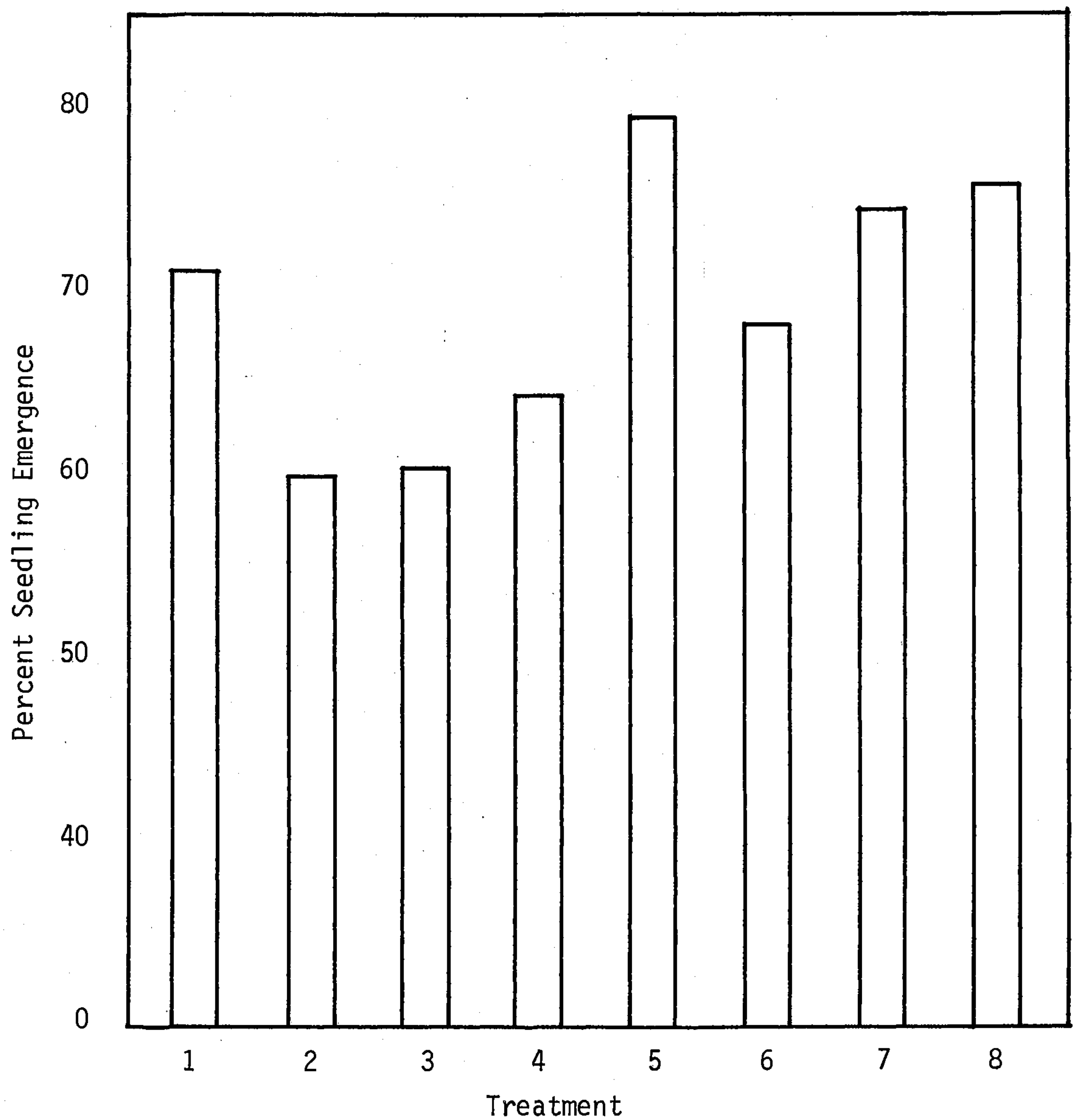

Fig. 1. Percent Seedling Emergence as Influenced by Seeding Rate

and 8). The final stand percent ranged from a low of 50.0 for Treatment 4 to a high of 67.3 for Treatment 7.

Node counts and height of first fruiting node were made to determine the relation between first fruiting branch initiation as influenced by seeding rates (Table III). The first fruit initiation node was not influenced by seeding rate. All treatments initiated the first fruiting branch at either the seventh or eighth node. The height of the first fruiting branch above ground level was influenced by seeding rates. As seeding rates increased, height of first fruiting branch increased. Height differences increased with increased seeding rates. The higher the seeding rate the greater the internode elongation.

TABLE III

NODE NUMBER AND HEIGHT OF FIRST FRUITING BRANCH

Treatment	Node Range (in number)	Height to Fruiting Node (Mean in Inches)
1	7-8	4.5
2	7-8	5.5
3	7-8	7.0
4	7-8	8.5
5	7-8	5.0
6	7-8	6.0
7	7-8	7.5
8	7-8	9.5

The first fruit initiation from the time of emergence in days to the first fruiting square or bud is shown in Table IV. As the seeding rate increased for each variety, the number of days from emergence to first square initiation increased. Lankart LX571 reached the fruit initiation stage quicker than Lockett 4789A at all seeding rates.

TABLE IV

EMERGENCE TO FIRST FRUIT INITIATION

Treatment	Period from Emergence to Fruit Initiation (Days)
1	29
2	31
3	36
4	38
5	32
6	34
7	39
8	41

Square counts were made at weekly intervals from the time of square initiation until harvest to determine the rate of squaring, time of peak squaring, and total square production. Squaring rates increased weekly through the fourth week, and the squaring peak for all treatments was reached during the fourth week. Total square production per acre increased as seeding rates increased.

During the flowering and fruiting period (Fig. 2), the weeks of active flowering decreased at the higher seeding rates of 45 and 60 pounds per acre for each variety. The decrease in weekly flowering for the four rates of seeding was more apparent with Lankart LX571.

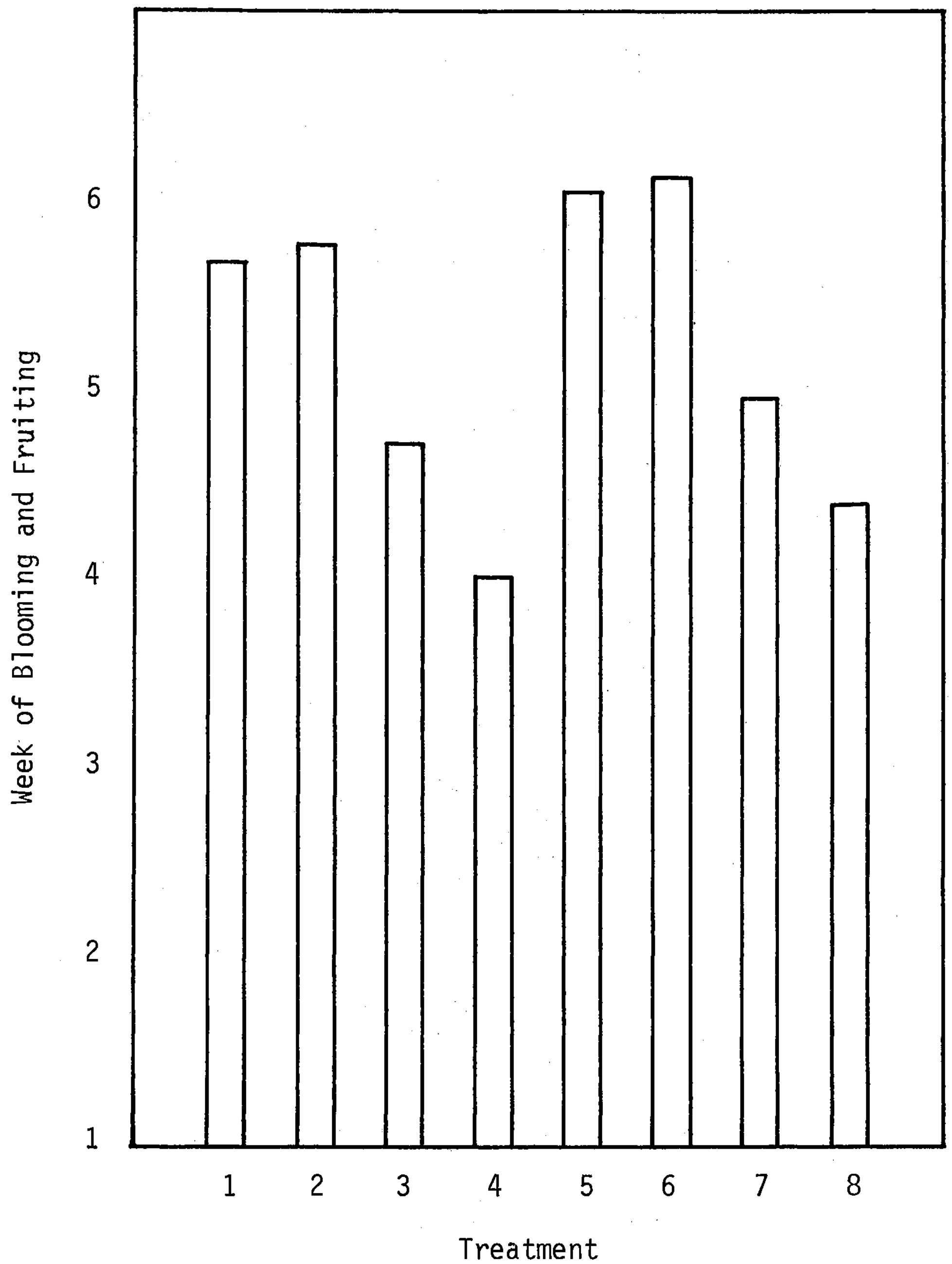

Fig. 2. Blooming and Fruiting as Affected by Seeding Rates

The number of days from flowering to boll maturity (Fig. 3) increased at the higher seeding rates of 45 and 60 pounds for each variety. The lateness of planting shifted the boll development and maturation period into a very unfavorable temperature period for optimum boll development. Lockett 4789A was slower in boll maturity than Lankart LX571 at all seeding rates.

Ten-boll samples were harvested from each replicated treatment and weighed. With the exception of the difference between the 15 pound and 30 pound seeding rates of Lankart LX571, the weight decreased as the seeding rate increased (Table V). There was a 14 percent decrease in sample weight between the Lankart LX571, at the 15 and 60 pound rates. The weight decrease between the two rates for Lockett 4789A was 20 percent.

TABLE V

BOLL WEIGHT IN GRAMS

Treatment	Weight of 10 Boll Sample (in grams)
1	81
2	81
3	74
4	69
5	65
6	63
7	58
8	52

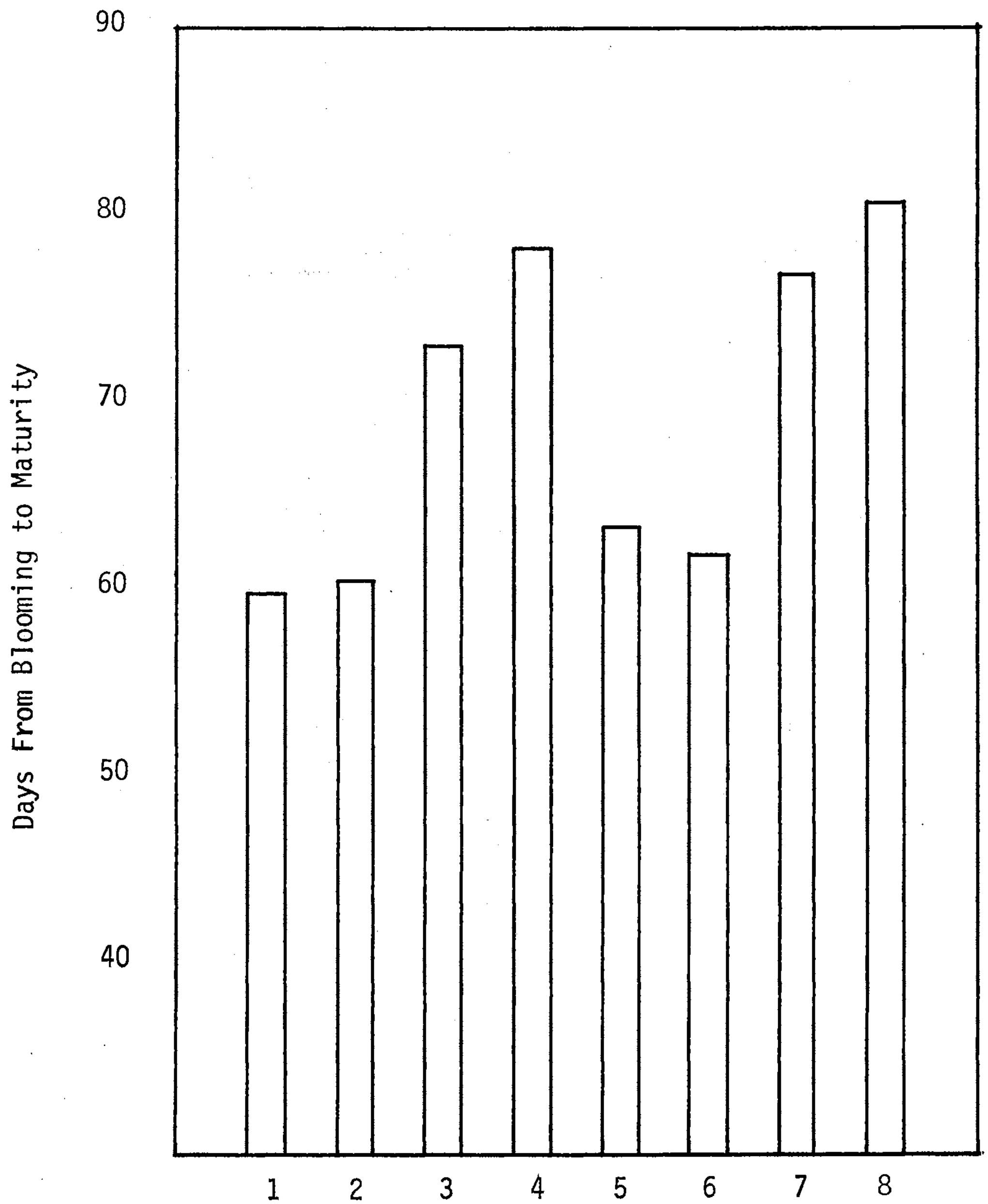

Fig. 3. Flowering to Boll-Maturity

Yield results showed the highest seed cotton production to be at the 30 pound seeding rate for both varieties (Table VI). The lint yield was also highest at the 30 pound seeding rate.

TABLE VI

SEED COTTON, GINNING PERCENT, AND LINT YIELD

Treatment	Seed Cotton (lbs./A)	Ginning Percent	Lint Yield (lbs./A)
1	2083	22.3	464.5
2	2231	23.2	517.6
3	2077	22.4	465.2
4	1889	24.9	470.4
5	2010	23.2	466.3
6	2278	23.3	530.8
7	2144	23.2	497.4
8	1943	24.2	470.2

The lint turnout ranged from 22.3 percent for Lankart LX571 at the 15 pound rate to 24.9 percent for the 60 pound rate (Table VI). Lint turnout for the Lockett 4789A at the 15 pound rate was 23.2 percent and 24.2 percent at the 60 pound rate.

Staple length was not significantly affected by seeding rates. Length of lint of both varieties at all seeding rates stapled from 15/16 to one inch in length (Table VII).

Micronaire is a measurement of fiber fineness and maturity. The desirable range as set by official standards is a reading between 3.5 and 4.9. Seeding rates and varieties had very little influence on micronaire readings. Lankart LX571 at seeding rates of 15, 30, and 45 pounds per acre produced micronaires which barely fall within the desirable range. All other treatments fell just below that range (Table IV). Micronaire readings below 3.5 would suggest immature fibers as the two varieties are inherently higher micronaire cotton than 3.5.

TABLE VII

FIBER LENGTH AND QUALITY FACTORS

Treatment	Staple Length (in Inches)	Micronaire	Grade
1	31/32	3.5	LM
2	31/32	3.7	LM
3	31/32	3.5	LM Lt Sp
4	1 inch	3.4	LM Lt Sp
5	31/32	3.3	LM St Sp
6	31/32	3.4	LM St Sp
7	15/16	3.2	LM Sp
8	15/16	3.4	LM Lt Sp

Grade results were on the less desirable side of the scale. All treatments graded Low-Middling or Low-Middling Light Spot with the exception of Lockett 4789A at the 60 pound seeding rate in which the variety graded Low-Middling Spot. Unfavorable harvest weather resulted in open bolls being exposed to wet weather through December. This resulted in rather low grade cotton being harvested.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objective of this study was to determine the effect of selected seeding rates on the fruiting response, yield, and fiber properties of narrow-row cotton in southwestern Oklahoma.

Lockett 4789A exceeded Lankart LX571 in stand emergence and survival at all seeding rates except the 15 pound per acre rate in which Lankart LX571 gave the best results. Emergence and stand survival of plants appeared adequate for optimum production of cotton at each of the various seeding rates.

Square initiation was delayed as plant populations increased. Height of first fruiting branch increased as seeding rate increased. Squaring pattern for varieties at all plant populations followed the same trend and reached peak squaring during the fourth week. Total square production increased with seeding rate.

Higher plant populations tended to shorten the flowering and fruiting period but occurred later in the season in this experiment, thus defeating the objective of earlier maturing determinate plants. Time required for boll maturity increased as plant populations increased. The Lockett variety was later in maturity at all seeding rates. Boll size decreased as plant population increased.

Ginning percent increased 1.0 and 2.6 percent from the 15 pound to the 60 pound seeding rate for Lockett 4789A and Lankart LX571, respectively. Fiber length was influenced very little by plant population. There was a trend toward higher micronaires for the Lankart variety over Lockett 4789A at all seeding rates but micronaire was not affected by plant population.

There was no appreciable difference for yield of seed cotton, yield of lint, and ginning percent between the two varieties at the various seeding rates. Results of this experiment indicated that populations of 57,000 to 74,000 plants per acre were adequate for optimum production of narrow-row cotton under dryland conditions.

Higher plant populations resulted in more efficient machine harvesting. The 15 pound seeding rate resulted in plants which were less desirable for machine harvesting because of their large central stems and lateral branches.

LITERATURE CITED

1. Brown, H. B. 1923. Cotton spacing. Miss. Agr. Exp. Sta. Bull. 212.

2. Jones, D. L., E. B. Hudspeth, Jr., L. L. Ray, E. L. Thaxton, Jr., H. J. Walker, W. L. Owen, Jr., and H. C. Lane. 1956. Cotton production on the Texas High Plains. Texas Agr. Exp. Sta. Bull. 830.

3. Kirk, I. W., A. D. Brashears, and E. B. Hudspeth, Jr. 1969. Influence of row width and plant spacing on cotton production characteristics on the High Plains. Texas Agr. Exp. Sta. Publ. MP-937.

4. Porterfield, J. G., O. G. Batchelder, and W. E. Taylor. 1958. Plant population for stripper harvested cotton. Okla. Agr. Exp. Sta. Bull. B-514.

5. Ray, L. L. 1972. Another look at narrow-row, high-population cotton: Varieties. Summary Proc. of the 1972 Beltwide Cotton Prod.-Mech. Conf. p. 39-40.

6. Ray, L. L., E. B. Hudspeth, and E. R. Holekamp. 1959. Cotton planting rate studies on the High Plains. Texas Agr. Exp. Sta. Publ. MP-358.

7. Wiese, A. F., and D. T. Smith. 1971. Herbicides in narrow-row cotton culture. Crop Sci. 11:518-520.

8. Wilkes, L. H., and T. E. Corley. 1968. Planting and cultivation. p. 117-149. <u>In</u> Elliot, C., Hoover, and K. Porter, Jr. (ed.) Advances in production and utilization of quality cotton: Principles and practices. Iowa State Univ. Press, Ames.

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