THE EFFECT OF SKIP-ROW PLANTINGS ON AGRONOMIC AND FIBER PROPERTIES OF COTTON

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CHAPTER I

INTRODUCTION

Skip-row planting is the practice of alternating planted rows of a crop with blank or skipped rows. This practice in cotton was first conceived by growers many years ago as a possible method of increasing yields per planted acre. It was based on observations made by the growers themselves that the outside rows of a cotton field produced higher lint yields than did the adjacent inside rows, presumably because of less inter-row competition for soil moisture. The basic assumption of skip-row patterns is that the growing crop will have available for its use the soil moisture stored beneath the planted area as well as that stored beneath the skipped area adjacent to it (26).

Various forms of skip-row planting of cotton have been used for many years in the arid areas of the west, and in recent years they have become commonplace in most areas of the Cotton Belt. Federal acreage allotments and price supports in cotton have almost made compulsory the evaluation of skip-row planting patterns as a possible method for maximizing yield of fiber and net returns per allotted acre.

Skip-row plantings of cotton have always been permitted by the Agricultural Stabilization and Conservation Service (ASCS), the branch of the federal government which enforces acreage allotments; but most producers did not use this method of planting prior to 1956 because the ASCS considered both planted and skipped rows in patterns as planted to cotton. From 1956 to the present certain skip-row patterns have been encouraged depending upon the regulations in force at a particular time for determining the cotton acreage. From 1956 through 1961, regulations permitted no skipped area less than 13 feet, 4 inches wide to be counted as area not planted to cotton in the calculation of the allotment. In practical terms, this meant that those patterns with the equivalent of less than four 40-inch rows skipped would be counted as solidly planted cotton in this period. In 1962 the regulations were changed to require a skipped area only 36 inches wide, and this allowed almost any combination of skip-row planting patterns to be used. In an effort to curtail total cotton production due to large surpluses on hand at the time, restrictions were again imposed on skip-row plantings in 1966 and 1967. Under those regulations, an area of two rows planted and one skipped (2X1) and two rows planted and two skipped (2 X 2) counted as 86 2/3 and 65 percent planted, respectively, compared with 66 2/3 and 50 percent, respectively, under the 1962-65 regulations. In 1968 regulations reverted to the 1962-65 plan in which only the area actually planted to cotton would be counted as cotton acreage.

The practice of skip-row planting of cotton in the U.S. increased from a few hundred acres in 1956 to near 3 million acres in 1965. According to 1965 ASCS records, Arizona planted the largest percentage of its acreage in some form or another of skip-row patterns; and Texas had the greatest number of acres planted in skip-row patterns (13). Skip-row plantings were increasing in all areas of the Cotton Belt until restrictions were imposed on the 2 X 1 and 2 X 2 skip-row patterns in 1966 and 1967. In 1967 the acreage planted to skip-row planting patterns had dropped to approximately 1 1/2 million acres. From 1962 through 1965 skip-row planting patterns involving less than four planted rows were most widely used. However, the restrictions imposed in 1966 and 1967 encouraged most growers to switch to patterns involving four or more planted rows and to divert more acreage. ASCS data show that in Oklahoma the use of skip-row planting increased from approximately 1200 acres in 1961 to 32,000 acres in 1965.[1] The skip-row acreage fell to near 20,000 acres in 1966 and to 13,698 acres in 1967. Statistics on the acreage planted in 1968 are unavailable at the present time.

The objectives of this research were to determine the effect of three skip-row planting patterns in comparison with a solidly planted check on the agronomic and fiber properties of cotton grown under Oklahoma conditions and to compare the results obtained with those of similar studies elsewhere. In addition, measurements were also taken to determine the influence of row position in the 4 X 4 pattern on the agronomic and fiber properties of cotton.

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[1]Agricultural Stabilization and Conservation Service, Oklahoma State Office, Stillwater, Oklahoma. Personal Communication. April 4, 1969.

CHAPTER II

REVIEW OF LITERATURE

Effects of Skip-Row Planting on the Agronomic Properties of Cotton

Numerous studies in cotton involving skip-row planting patterns have been conducted across the Cotton Belt but published reports of those studies are comparatively few. The reports on the effects of skip-row planting on the agronomic properties of cotton are summarized in this section. These properties are yield on a planted area basis, yield on a total area basis, maturity, boll size, and lint percent. Subsequent sections will discuss the effects of skip-row planting on the fiber properties of cotton, the advantages and disadvantages of the patterns, and the economics of various skip-row patterns versus solid planting.

In the past when skip-row patterns have been compared to the solid pattern, lint yields have been reported on an actual planted area basis and/or on a total area basis. The planted area basis reflects yield from only those rows occupied by cotton while the total area basis reflects yield from both the planted and adjacent fallow rows. Most researchers have reported yields on a planted area basis because it is more useful in showing the added yield increase per allotted acre of skip-row systems over solid systems. However, some have preferred to report yields on a total area basis since it reflects the productivity of both planted and fallow areas used in the planting pattern. In either case the method used has a profound influence on the interpretation of the results. For this reason yield as determined under the two systems has been reviewed separately in this paper.

Yield on a Planted Area Basis

Fisher et al. (8) reported yield increases in Arizona of the plant four-skip four (4 X 4) pattern above solid-planted cotton. Yield tended to be greater where growth was more rank. Boll rot was reduced in the 4 X 4 pattern apparently because of better air movement and more light. Dick and Owings (5) in a three-year study in Mississippi showed 45 and 77 percent increases in seed cotton yield, respectively, for the 4 X 4 and plant two-skip two (2 X 2) patterns over solidly planted cotton. Greatest increases came in 1956, a dry year, from the 2 X 2 pattern, and those increases were attributed to the greater amount of soil moisture and sunlight per row of that pattern. The 1957 and 1958 seasons were relatively wet and increases from skip-row patterns were not as great as in 1956, but the increases obtained were probably due in part to increased aeration and sunlight along the outside rows resulting in less boll rot. Sturkie and Boseck (32) compared the 4 X 4 and 2 X 2 patterns with conventional solid plantings in Alabama from 1956 through 1960. Average increases for the 2 X 2 and 4 X 4 patterns over solid planting for the three-year period, 1958-1960, were 57 and 31 percent, respectively, where 600 pounds of 8-8-8 fertilizer were used and 46 and 28 percent where 900 pounds were applied. Data over the five years at the lower fertilizer level showed yield increases of 56 percent for the 2 X 2 pattern and 33 percent for the 4 X 4 pattern.

McCollum (19, 20) in North Carolina compared various patterns against solid planting from 1960 through 1962. The plant two-skip one (2 X 1) pattern produced 41, 34, and 36 percent more yield than solid planting over the three years. In 1961 plant one-skip one (1 X 1), 2 X 1, plant three-skip one (3 X 1), plant four-skip one (4 X 1), and plant five-skip one (5 X 1) patterns were compared with solid planting. In these tests cotton plants in outside rows had approximately 25 percent more bolls that were 10 percent heavier than plants in inside rows. Longnecker and Lyerly (18) made yield comparisons of inside versus outside rows of Acala 1517C in combination fertility-irrigation tests in the El Paso Valley of Texas. Outside rows produced 500 to 700 pounds more lint than inside rows which they considered to be solidly planted. This yield increase represents a bale or more per planted acre if all rows are outside rows as in the 2 X 2 or plant two-skip four (2 X 4) patterns or one-half bale if only half of the rows are outside rows as in the 4 X 4 pattern. Increased yields from the outside rows were attributed to increases in boll size, bolls per lateral branch, and lateral branches per plant. Bruce (3) in Mississippi reported yield increases of 27 to 34 percent for the 2 X 1 pattern over solid planting in tests conducted in 1959 and 1960 on a fine sandy loam soil. Soil moisture measurements taken during the growing season showed that soil water use occurs to a somewhat greater depth than 48 inches and that soil water is removed rather uniformly by solid planted cotton. In the 2 X 1 pattern there was 1.5 to 2.2 inches more water in the skipped row position than at the cotton row. This water was available to the plant and may have accounted for much of the increased yield.

Grissom and Spurgeon (10) in Mississippi found that cotton planted on two silt loam soils in a 4 X 4 pattern produced 45.1 percent more than solid plantings and that the 2 X 2 pattern produced 67.3 percent more than the solid plantings. However, no yield increases from skip-row plantings were obtained on a clay soil. Outside rows of the 4 X 4 pattern in these tests yielded 59 percent more than the inside rows and even produced more than the outside rows of the 2 X 2 pattern. The factors which Grissom and Spurgeon concluded that affected the response of cotton to skip-row plantings were soil type, the particular pattern used, weather conditions, grasses and weeds, and whether other crops were interplanted or not. Douglas and Brooks (7) in Southeast Georgia obtained average yield increases of 30.6 percent from the 4 X 4 pattern over solid plantings using three varieties in tests conducted from 1960 through 1962. No differences in varietal response to planting pattern were found. The greatest response to the pattern was obtained in a season of low rainfall and least response when rainfall was high. On the average the outside rows of the pattern produced 73 percent more than those on the inside and 65.7 percent more than solid plantings. This data tended to support the results of others indicating that highest yields would be expected from a 2 X 2 skip-row system in which every row is an outside row.

Hawkins and Peacock (11, 12, 13) in the Georgia Coastal Plains compared the 2 X 2 system with solid plantings using eight varieties in tests conducted from 1959 through 1964. A five-year average increase of 40 percent of the pattern over the solid planting was obtained. Variations from year to year in the influence of the pattern were observed, and these variations were thought to be due primarily to such factors as distributions of rainfall, availability of soil moisture, temperature changes, and effectiveness of insect control. Later studies (13) conducted in the Piedmont area of Georgia showed a 27 percent average increase for the 2 X 2 pattern and 20 percent for the 2 X 1 pattern over solid plantings.

Langford and Gohlke (14) in tests conducted from 1958 through 1962 on the Texas High Plains reported that skip-row and interplanting systems with soybeans produced higher cotton yields than solid plantings. In 1964 nine different cotton planting patterns and two irrigation methods were tested (15). Seven of the patterns involved interplanting with castor beans and grain sorghum. Six of the skip-row interplanting systems increased cotton yields from 11 to 33 percent indicating that the cotton benefited from the skipped rows whether those rows were planted to other cash crops or left fallow. Langford (16) reported three-year average increases in yield for a 2 X 1 skip-row pattern and for two skip-row interplant systems over solid plantings.

Dick and Loe (6) reported from variety skip-row interaction studies conducted in Mississippi in 1963 and 1964 that the average increase for the 2 X 1 pattern over solid planting was 28 percent and for the 2 X 2 pattern 43 percent. No variety consistently reacted more favorably in its yield to skip-row planting than the other varieties tested. All varieties were found to react differently to skip-row patterns in different years. Melville and Oakes (21) compared several skip-row patterns in the Red River Valley area of Louisiana from 1962 through 1965. Highest yield increases were obtained from the 2 X 2 pattern on both clayey and sandy soil. No yield advantage of the 4 X 4 pattern over the plant four-skip two (4 X 2) and 2 X 1 patterns were shown. Yield increases were slightly higher for all skip-row patterns on sandy as compared to clayey soils.

Briggs and Massey (2) in studies conducted from 1962 through 1964 at three locations in Arizona reported that the greatest increase over solidly planted cotton was attained with a plant one-skip two (1 X 2) pattern. They felt, however, that if a grower wanted to plant skip-row cotton the 2 X 2 pattern would probably be the most practical pattern to use. Spurgeon (31) in studies made from 1962 through 1965 in the Mississippi Delta reported on five skip-row patterns as compared to solid planting. The design and the percent of yield increase of skip-row over solid planting was as follows: 2 X 2, 46.8 percent; 2 X 1, 29.5 percent; 4 X 4, 29.9 percent; 4 X 2, 25.2 percent; and 4 X 1, 15.1 percent. Parks et al. (27) studied microclimate and its influence on cotton yields. They concluded that the yield increases from the skip-row patterns cannot all be attributed to moisture but that much of the yield increase was due to increased light intensity within the cotton canopy; higher temperature of the individual plant's environment; and more air circulation in and around all of the plants.

Newman (24) summarized the results of skip-row dryland studies in Texas at Lubbock from 1963 through 1965, at Big Spring from 1958 through 1962, and at Spur from 1937 through 1943. The average yield increases for the 2 X 1 pattern over the solid planting were 27, 48, and 44 percent for each of the respective locations and 82, 81, and 89 percent for the 2 X 2 pattern over the solid planting at the same locations. In the studies at Lubbock, Newman (26) also compared planting systems under four minimal moisture levels. Over all moisture levels, average yield increases of 58 percent for the 2 X 2 pattern over the solid planting were obtained. The data also showed that total water-use efficiency and irrigation water-use efficiency were higher for skip-row systems than for solidly planted cotton. Newman (25) also studied soil-moisture use for cotton in the 2 X 1, 2 X 2, and 4 X 4 patterns and in solidly planted cotton under different moisture regimes. He found that cotton plants in the 2 X 1 and 2 X 2 patterns produce enough lateral roots to utilize significant amounts of moisture stored beneath the adjacent fallow areas but that they do not produce sufficient lateral root growth to utilize moisture stored in fallow areas more than 80 inches (two normal rows) wide.

Bridge et al. (1) in Mississippi conducted a variety skip-row interaction study in 1965 and 1966 and revealed that the average yield over all varieties was 33 percent higher from the 2 X 1 pattern and 52 percent higher from the 2 X 2 pattern than from solid planting. The more determinate variety, Stoneville 213, had a greater response to skip-row planting than did the more indeterminate varieites, probably because it had longer to set an extra crop of bolls. Also, the influence of skip-row patterns varied from year to year and was probably due to inconsistencies of moisture, temperature, and other weather conditions that likewise varied from year to year. Graves and McCutchen (9) in Tennessee studies conducted over two years found that four varieties responded similarly to a 2 X 2 pattern which on the average produced 46.2 percent more lint in 1965 and 22.8 percent more in 1966 than did the solid treatments. Mullins (23) conducted five tests in Tennessee in 1965 and 1966 on three soil types to compare yields of various patterns with high two-row beds. Yield increases over the solid planting were 36 percent for the 2 X 1 pattern; 60 percent for the conventional 2 X 2 pattern; and 46 percent for the 2 X 2 pattern with high beds. The upland soils also produced higher yield increases than did the bottomland soils.

Rich (30) in studies conducted from 1962 through 1966 in the Grand Prairie area of Texas found that the 2 X 1 and 2 X 2 patterns were better than a 2 X 4 pattern because a diminishing return effect with each added increment of space was observed. The data showed that as space per drill was increased, yield did not increase uniformly and that the 2 X 2 pattern appears to be the practical limit of space for skip-row cotton. Valliant (35) in tests conducted from 1965 through 1967 on the High Plains of Texas obtained significant increases in yield over solid plantings with a cotton-grain sorghum interplant system and a 2 X 2 pattern.

Yield on a Total Area Basis

Mulkey (22) reported that solidly planted cotton produced higher yields in tests conducted in 1966 on the Rolling Plains of Texas than did cotton planted in each of four skip-row and three interplant systems. Increases of 3.6 percent over the 2 X 1, 15.2 percent above the 2 X 2, and 32.6 percent more than the 4 X 4 patterns were obtained for the solid pattern. Newman (24) summarized longterm studies of skip-row cropping systems on the High and Rolling Plains of Texas. He found no significant differences between yields of solid and skip-row cotton when calculated on a total area basis. Skip-row patterns produced higher yields than the solid pattern during certain years at Spur and Big Spring, but the differential in those years was not sufficient to favor any pattern over the long run. At Lubbock, Newman (26) found that solid plantings produced higher average yields than skip-row plantings within all moisture levels except one. The 2 X 1 pattern in these tests produced a higher yield than did the 2 X 2 pattern. Rich (30) concluded that if the objective is yield per total rather than allotted area then solid planting and the 2 X 1 pattern would give similar responses and should be used. Briggs and Massey (2) reported that solid planting in Arizona produced higher yields than cotton planted in any skip-row pattern on an actual physical area basis and that the 2 X 1 system is the highest yielding pattern.

Maturity

Several years of research in Mississippi (1, 6) suggested a slight tendency toward earlier maturity in solid plantings compared to skip-row systems. Bridge *et al.* (1) found that the more indeterminate varieties showed a greater tendency toward lateness than did the most determinate variety, Stoneville 213, which was used in the skip-row studies. Hawkins and Peacock (12) in the Coastal Plains of Georgia revealed that a significantly greater percentage of the total yield was harvested at first picking from the solidly planted rows than from the various patterns used. They felt that this could possibly be due to the ability of the plants in the patterns to make more efficient use of nutrients and moisture and, therefore, to produce a larger middle and top crop. McCollum (20) found no significant differences between solid and skip-row plantings in the proportion of open bolls at first harvest. His data did show that when comparing different patterns there was a small but nonsignificant trend toward earlier maturation of bolls in outside row positions.

Boll Size

Longnecker and Lyerly (18) observed that plants on the outside rows of a pattern produced larger bolls than plants on inside rows. McCollum (20) obtained a 10 percent increase in boll size from outside rows. Other research (1, 7, 11, 12, 13, 22) has also shown that an increase in boll size can be expected when going from solid to skip-row planting systems and, as a result, fewer bolls are required to produce a pound of lint.

Lint Percent

Picked lint percentage is not measurably altered by skip-row systems (1, 6, 7, 11, 12, 13, 20). Workers in Mississippi (1, 6) and Georgia (13) have obtained slight, but non-significant, decreases in picked lint percent when going from solid to skip-row plantings. Mulkey (22) obtained a slightly higher pulled lint percent from solid planting than from skip-row and interplant systems. Valliant *et al.* (34) reported that pulled lint percents were higher in interplant systems and the 2 X 1 pattern than solid plantings. Langford (15) obtained no substantial differences in pulled lint percent between the solid and 2 X 1 systems in 1964.

Effects of Skip-Row Planting on the Fiber Properties of Cotton

Skip-row planting systems may and probably do provide an environment more conducive to the development of the cotton fiber than do solid plantings. Considering the emphasis placed on fiber quality in recent years, this possible increase in fiber quality is of special importance and should be investigated.

Fiber Length

Hawkins and Peacock (11, 12, 13) in Georgia Coastal Plains tests obtained significantly longer fiber from the 2 X 2 design over solidly planted cotton. However, they did find that varieties responded differently to the methods of planting. In contrast, their Piedmont tests (13) failed to show a significant increase in fiber length for either the 2 X 1 and 2 X 2 patterns. In general, the fiber produced in the patterns was slightly longer; but differences were not significant, and differential varietal response to the skip-row patterns was not exhibited. Bridge et al. (1) found planting pattern to have a significant influence on fiber length and to result in an increase in staple length as one progresses from solid to 2 X 1 and 2 X 2 patterns. Dick and Loe (6) in earlier studies in Mississippi reported similar findings.

Newman (26) reported that cotton planted in the 2 X 2 pattern produced longer fiber than did the others when lengths were determined in thirty-seconds of an inch, but not when measured as Upper Half Mean. Significant fiber length increases were obtained from irrigation. Langford and Gohlke (15) did not obtain fiber length increases from any of the interplant and skip-row systems compared in 1964 tests on the Texas High Plains. Langford's (16) 1965 data showed that the interplant and 2 X 1 systems produced slightly shorter fibers than solid planting. Valliant's (35) studies have shown practically no differences in fiber length among planting systems when grown under irrigation. Graves and McCutchen (9) in Tennessee, McCollum (20) in North Carolina, and Mulkey (22) in Texas obtained no significant differences in planting patterns for fiber length when reported as thirty-seconds of an inch.

Fiber Strength

Dick and Loe (6) reported fiber strength differences to be inconsistent for planting patterns but that strength was greater in the 2 X 1 and 2 X 2 patterns than in the solid plantings. Langford (16) obtained slight increases in fiber strength from cotton grown in interplant and skip-row systems. Hawkins and Peacock (13) found no significant differences in fiber strength in solid or skip-row patterns in Georgia tests. In general, a slight decrease in fiber strength was observed in the patterns. Bridge et al. (1) revealed similar findings in Mississippi. Other researchers (20, 26, 34, 35) have found no significant differences in fiber strength due to planting systems.

Fiber Coarseness

Dick and Loe (6) obtained higher micronaire (fiber coarseness) readings in the solidly planted cotton than in the 2 X 1 and 2 X 2 patterns. In contrast, Hawkins and Peacock (13) reported significantly lower micronaires were produced in solid plantings in the Georgia Piedmont. Other research studies (1, 11, 12, 13, 20) in Mississippi, North Carolina, Georgia, and Texas revealed no consistent influence of planting pattern on micronaire. Langford's test in 1965 (16) showed micronaire increases in the skip-row and interplant designs when compared to solidly planted cotton. He theorized that the crop interplanted with cotton reduced air movement and thus increased the temperature surrounding the cotton plant. Since higher temperatures induce a faster rate of plant growth and fiber development, this in turn could account for the increased micronaire values obtained.

Advantages and Disadvantages of Skip-Row Systems

Hawkins and Peacock (13) recognized several of the advantages and disadvantages of skip-row plantings. The primary advantage being increased yield per allotted or planted area with other advantages being improved air circulation, better penetration of sunlight, reduction in disease losses, reduction of wheel damage during cultivation and insecticide applications, greater increase in boll set of late season flowers, and more available moisture and plant nutrients if weeds and grasses are controlled. The disadvantage connected with skip-row plantings are a greater land area is required to plant a given allotment; extra cost of land preparation and labor; cost of weed and grass control in the skipped areas; increased cost of irrigation, if used; and defoliation and mechanical harvesting may be more difficult on larger plants. Sturkie and Boseck (32) found an additional advantage of the skip-row system to be that the application of insecticides by spray or dusting machines operated in the skips without damaging the cotton. An additional disadvantage they noted was that the skip-row systems are not adapted to steep slopes because of erosion of the bare or fallow areas. Others (5, 14, 21) have found that more planning is usually necessary before planting to skip-row systems and machinery often has to be altered for planting, cultivating, fertilizing, and insect control. The advantages and disadvantages along with ASCS regulations should be closely considered before deciding whether or not to use a skip-row system. The grower must decide if the lint yield increase per allotted area from the system is enough to offset additional income that might be obtained if the fallow areas were planted to another crop (13, 14, 21, 32).

Economics

Since more land is required for skip-row patterns, Partenheimer and Yeager (28) made an economic analysis of Sturkie and Boseck's results. They wanted to know if the increase in yield obtained from the 2 X 2 and 4 X 4 skip-row patterns was sufficient to command its use or could the fallow land be put to more profitable use. Based on estimated costs for the skip-row patterns, the 2 X 2 planting gave the highest return to land, management, and fixed cost. They pointed out that if a farmer planted 4 X 4 instead of 2 X 2, he would be sacrificing $32.07 per acre in return to land, management, and fixed cost. They concluded that if enough good cotton land is available it appeared profitable to plant cotton in the 2 X 2 skip-row pattern. If good land is more limited, then the 2 X 1 pattern becomes the best alternative. Fisher et al. (8) in cooperative research on economics with Arizona cotton growers in 1956 found that skip-row planting is profitable where a yield increase of half a bale or more per acre is possible and where no profitable alternative crops exist.

Cooke and Heagler (4) made an economic appraisal of skip-row planting in 1962 and 1963 in Yazoo-Mississippi Delta counties. Several farmers were interviewed each year to obtain information on yields, production practices, and equipment modifications for several skip-row patterns. Sandy, loam, well-drained clay, and poorly drained clayey soils were considered. Their analysis showed that the 2 X 2 pattern gave the highest returns of any skip-row pattern. They stated that the soil resources available materially affects the particular pattern used. If sufficient acreages of suitable soils are available, all cotton should be planted in the 2 x 2 pattern, but as suitable soils become more scarce a combination of 2 X 2 and 2 X 1 or 2 X 1 alone should be used depending on the situation. They found production costs associated with skip-row cotton were considerably higher than those of solid cotton and all skip-row planting systems, other than 4 X 4, materially reduce equipment efficiency in peak demand periods. Lard and Goddard (17) made an economic comparison of skip-row and solid plantings from 1962 to 1964 on the Ames Plantation in Tennessee. Per acre cotton yields and net returns on the 2 X 2 skip-row pattern exceeded the solid planting in each year of the test. The average increased net return from the 2 X 2 pattern over solid planting was $133.48 acre per year. From these studies they concluded that if a farmer has adequate land adapted to growing cotton, he can consider growing skip-row cotton. However, he must give careful consideration to his cotton allotment program and alternative uses for the land that could be taken up by the skipped area. Rich (29) in studies conducted from 1961 to 1963 in the Grand Prairie area of Texas found that skipping either two or four 40-inch rows gave the highest yields of lint cotton when used with two planted rows. He reported that skip-row planted cotton produced a net value of about $50 per acre over the three years the tests were conducted. This was a relatively large return per cultivated acre in the Grand Prairie area and was more income than could normally be made by producing a crop on the skipped rows. McCollum (20) determined that the decision as to which skip-row pattern to use and to what extent, should be based on the available soil resources, adaptability of available equipment, the USDA policy, acreage allotment, anticipated yield levels, and the production costs of the various skip-row patterns relative to planting solid and to each other.

CHAPTER III

MATERIALS AND METHODS

Treatments

Lankart 57, a medium-early stormproof variety, was planted in the following planting patterns: plant two rows-skip one (2 X 1), plant two-skip two (2 X 2), plant four-skip four (4 X 4), and plant all-skip none as a check. Lankart 57 was chosen because it was the most popular variety grown in Oklahoma under dryland conditions at the time. The 2 X 1, 2 X 2, and 4 X 4 patterns were studied since they were the most commonly employed skip-row systems across the Cotton Belt at the time this study was initiated.

Cultural Methods

In 1965 and 1966 dryland tests were conducted on a Reinach silt loam and a Meno loamy sand at Chickasha and Mangum, Oklahoma, respectively. A randomized complete block experimental design with four replications was used at each location in each year. Plots included four planted rows of cotton 100 feet long. Initially the entire area of the test was planted in 40-inch rows with acid-delinted and chemically treated seed at a rate of approximately 20 pounds per acre. The skip-row patterns were established between two and three weeks after germination in each test by eliminating all plants in the appropriate rows. Two border rows were left between adjacent plots in an attempt to equalize border effects between plots. The planting dates in 1965 at Chickasha and Mangum were June 3 and June 9, respectively, and June 6 at Chickasha and June 16 at Mangum in 1966. Fertilizer was not applied to the experiment in either year at Chickasha. The plots at Mangum were fertilized, before planting, with 150 and 200 pounds of 14-28-14 fertilizer per acre in 1965 and 1966, respectively. Cultural practices were performed as required to control weeds and insects.

Data Collection

Most data were collected on a plot basis for both agronomic and fiber characters. Subsamples within plots were taken for plant height and between the two inside and outside rows of the 4 X 4 pattern for all traits. Plant height was measured in inches just prior to the first killing frost in each year at Chickasha. Before harvesting, 25-boll samples were taken from all plots within a test, and these samples were used to determine boll size and seed index. Boll size was measured as the weight in grams of seed cotton per boll, and seed index was calculated as the weight in grams of 100 seed. Two harvests could be made only on the 1965 Chickasha test. Earliness in that test was expressed as percent first harvest and based on lint rather than seed cotton yield. It was calculated by dividing the weight of lint in pounds obtained from the first harvest of a plot by the total lint yield of that plot. Each plot was harvested by hand, snapped cotton weighed separately, and weights recorded to the nearest hundredth of a pound.

Four to four and one-half pound samples of snapped cotton were obtained from each plot and ginned on a 10-saw gin to determine pulled lint percent, i.e., the percentage of lint in a snapped sample of cotton. These percents were then multiplied by the weights of snapped cotton per plot to obtain lint yields per plot. These plot yields were next multiplied by correction factors to get them on an acre basis. Yields are reported here in pounds of lint per acre on an allotted basis under the four sets of ASCS regulations that have been in force at various times.

The lint portions from the ginned samples discussed above were taken to the fiber laboratory for measurements of fiber length, strength, and coarseness. Fiber length was measured in inches on the digital fibrograph as 2.5 percent span length. Fiber strength was measured on the stelometer at the 1/8" and 0" gauge settings in grams per grex. Fiber coarseness was measured on the micronaire in micronaire units. Fiber samples from each harvest from each plot of the 1965 Chickasha test were analyzed separately, and then a weighted average of each fiber measurement over the two harvests was calculated for each plot based on percentage of total lint yield per harvest of that plot. All subsequent calculations using the 1965 data from Chickasha were made from those weighted averages.

Analysis of Data

The three tests which were harvested were treated as separate environments in the analysis of the data. The procedure was to conduct a three-environment, combined analysis of variance on a plot basis for each character measured. The F-test was made for environment, treatment, and environment by treatment interaction effects. If a non-significant interaction effect was obtained, no further analyses were necessary; and inferences were based on the three-environment average for that particular character. If a significant interaction was found in the initial analysis of a character, a combined analysis of two sets of two environments was conducted. These sets were one location over two years (Chickasha-1965 and 1966) and one year over two locations (1965-Chickasha and Mangum). The same F-tests were used as before. If interactions were not significant, no further analyses were required and inferences could have been based on the two environmental averages for that character. If significant interactions were also obtained in the two environment tests, separate analyses of variance would be required for that character in each test. However, since all characters except fiber coarseness brought to this stage of testing had significant interactions in one or both two-environment sets, analyses of variance were conducted in each environment for those characters. The Duncan's New Multiple Range Test (33) was used to show the significant differences or lack of them among treatment means for each character.

CHAPTER IV

RESULTS AND DISCUSSION

Investigation of Planting Patterns

The skip-row planting patterns in use at a particular time have depended to a large extent on the ASCS regulations for determining acreage allotments in force at that time. Presented in Table I is a summary of those regulations up to the present. As shown in the table, cotton in the 4 X 4 and 2 X 2 patterns would occupy 50 percent, the 2 X 1 patterns 66 2/3 percent, and the solid pattern 100 percent of the total land area involved. Prior to 1956 all planting patterns were counted as 100 percent solidly planted cotton. From 1956 to the present the 4 X 4 pattern acreage has been determined by the occupied land area. In 1962 the regulations were amended to also calculate the allotment of the 2 X 1 and 2 X 2 patterns on the basis of rows actually planted to cotton. The regulations were in force until 1966 when they were again changed. At that time a penalty of sorts was imposed on the 2 X 1 and 2 X 2 patterns whereby each would count as more acreage than the land actually occupied. In 1968 and 1969 the regulations were changed to correspond to those of 1962-1965 in which only the rows actually planted to cotton were included in the allotment.

Lint yields per allotted acre were calculated under each of the four sets of regulations. Under those regulations prior to 1956 the

TABLE I

ASCS SKIP-ROW REGULATIONS

Pattern	Percent of Total Acreage in Cotton	Percent of Total Acreage as Allotted Acreage			
		Prior to 1956	1956-61	1962-65, 1968-69	1966-67
4 X 4	50	100	50	50	50
2 X 2	50	100	100	50	65
2 X 1	66 2/3	100	100	66 2/3	86 2/3
Solid	100	100	100	100	100

allotted area is equal to yield on a total area basis. This means that both the planted and fallow rows are included in the calculation of yield per unit area. Under the regulations where the skip-row pattern acreages counted only the planted rows in the allotment, the allotted acre yield is equal to yield calculated on a planted area basis. The allotted acre yields for the 2 X 1 and 2 X 2 patterns under the 1966-67 regulations were calculated by including the respective penalties imposed.

Analyses over Environments

Due to late planting caused by unfavorable weather conditions, an extremely early frost, and a severe fusarium wilt infestation during the growing season, the Mangum test was not harvested in 1966. This reduced the study to three tests (Chickasha in 1965 and 1966 and Mangum in 1965). These three tests were treated as separate environments in the initial analyses of the data.

The three-environment analyses of variance for the agronomic properties are presented in Tables II and III and those for the fiber properties are given in Table IV. A significant environment by planting pattern interaction was shown for yield (under each set of regulations), pulled lint percent, boll size, fiber length, and fiber coarseness. The significance of these interactions suggests that the relative performance of those characters in the planting patterns was different from environment to environment and that an examination of the means over environments for such characters would be misleading. Therefore, if the interaction was significant, mean differences in patterns were not studied in these analyses. Non-significant interactions between environment and planting patterns were obtained for 100 seed index and the two

TABLE II

MEAN SQUARES FOR YIELD UNDER THE DIFFERENT ASCS REGULATIONS: ANALYSES OF THREE ENVIRONMENTS

Source	df	Mean Squares			
		Prior to 1956	1956-61	1962-65, 1968-69	1966-67
Environment	2	374150**	563364**	1024464**	761676**
Pattern	3	20799	83359	122975	52342
Environment X Pattern	6	5275**	19448**	39557**	23931**
Error	27	898	1249	1835	1436

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE III

MEAN SQUARES FOR PULLED LINT PERCENT, BOLL SIZE, AND 100 SEED INDEX: ANALYSES OF THREE ENVIRONMENTS

Source	df	Mean Squares		
		Pulled Lint Percent	Boll Size	100 Seed Index
Environment	2	122.56**	7.1547**	17.96**
Pattern	3	1.79	.4843	.64
Environment X Pattern	6	1.27**	.6285*	.64
Error	27	.25	.2246	.49

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE IV

MEAN SQUARES FOR FIBER LENGTH, STRENGTH, AND COARSENESS: ANALYSES OF THREE ENVIRONMENTS

Source	df	Mean Squares 2.5% Span Length	Micronaire	1/8" Gauge Stelometer	0" Gauge Stelometer
Environment	2	.006705**	13.9250**	.0819**	.0409*
Pattern	3	.002159	.0100	.0024	.0052
Environment X Pattern	6	.000978*	.1183**	.0063	.0017
Error	27	.000341	.0041	.0063	.0078

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

stelometer measurements indicating that the response of those characters to planting patterns and relative to one another was statistically the same in each environment. Since the interactions for those three characters were not significant, the mean differences between patterns could be studied. However, no significant differences in those characters due to planting pattern were found. The means for these three traits over environments may be found in Table V. The three-environment analysis did reveal significant differences in environments for all characters studied.

Analyses Over Locations in One Year and Over Years at One Location

Those characters which had significant interactions in the previous analyses were then analyzed in sets of two environments, i.e., over locations in one year and over years at one location. It is recognized that a year effect is confounded within the first set and that a location effect is confounded in the second rendering the tests somewhat less sensitive than if the Mangum test in 1966 could have been used.

The yield analyses are summarized in Tables VI and VII. The Chickasha and Mangum data in 1965 (Table VI) showed that yield (under the regulations prior to 1956) was significantly affected by planting patterns and that the responses were the same relative to one another in both tests. Analysis of that data for yield under the remaining regulations gave significant interaction effects. The Chickasha data over 1965 and 1966 (Table VII) showed significant interactions for yield under all regulations.

The analyses for pulled lint percent, boll size, fiber length, and fiber coarseness are presented in Tables VIII and IX for the same

TABLE V

COMPARATIVE FIBER STRENGTH AND 100 SEED INDEX AMONG PLANTING PATTERNS: THREE ENVIRONMENT AVERAGES

Pattern	Fiber Strength 1/8" Gauge Stelometer	Fiber Strength 0" Gauge Stelometer	100 Seed Index
Solid	3.31 a*	1.92 a*	14.5 a*
2 X 1	3.27 a	1.95 a	14.6 a
2 X 2	3.27 a	1.92 a	15.0 a
4 X 4	3.30 a	1.93 a	14.7 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

TABLE VI

MEAN SQUARES FOR YIELD UNDER THE DIFFERENT ASCS REGULATIONS: ANALYSES OF CHICKASHA AND MANGUM IN 1965

		Mean Squares			
Source	df	Prior to 1956	1956-61	1962-65, 1968-69	1966-67
Environment	1	509041**	755221**	1326821**	1000759**
Pattern	3	13152**	90010	176022	82806
Environment X Pattern	3	990	15730**	25457**	14228**
Error	18	1008	1260	1920	1465

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE VII

MEAN SQUARES FOR YIELD UNDER THE DIFFERENT ASCS REGULATIONS: ANALYSES OF CHICKASHA IN 1965 AND 1966

Source	df	Mean Squares			
		Prior to 1956	1956-61	1962-65, 1968-69	1966-67
Environment	1	609132**	926161**	1720976**	1268426**
Pattern	3	19792	72359	89208	39235
Environment X Pattern	3	8021**	34529**	78568**	46572**
Error	18	1142	1668	2410	1917

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE VIII

MEAN SQUARES FOR PULLED LINT PERCENT, BOLL SIZE, FIBER LENGTH, AND FIBER COARSENESS: ANALYSES OF CHICKASHA AND MANGUM IN 1965

Source	df	Mean Squares			
		Pulled Lint Percent	Boll Size	2.5% Span Length	Micronaire
Environment	1	53.30**	11.1628**	.012052**	.0100
Pattern	3	1.98	1.0934*	.003479**	.0267
Environment X Pattern	3	2.22**	.3624	.000616	.0200
Error	18	.25	.2677	.000368	.0483

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE IX

MEAN SQUARES FOR PULLED LINT PERCENT, BOLL SIZE, FIBER LENGTH, AND FIBER COARSENESS: ANALYSES OF CHICKASHA IN 1965 AND 1966

Source	df	Mean Squares			
		Pulled Lint Percent	Boll Size	2.5% Span Length	Micronaire
Environment	1	244.76**	10.2831**	.000528	21.2900**
Pattern	3	.04	.1897	.000744	.0067
Environment X Pattern	3	.08	.7338**	.001059*	.0467
Error	18	.24	.0837	.000324	.0489

*,**Significant at the 0.05 and 0.01 levels of probability, respectively.

combinations of environments used above. The pulled lint percent data from 1965 revealed a significant interaction (Table VIII), but the Chickasha tests (Table IX) did not.

Planting patterns had a significant effect on boll size (Table VIII) in 1965. Response of boll size in that year to the patterns was similar at Chickasha and Mangum. In contrast, a significant interaction was observed between 1965 and 1966 at Chickasha (Table IX).

Significant planting pattern effects and non-significant interaction effects for fiber length were observed in the 1965 data (Table VIII). However, analysis of the 1965 and 1966 Chickasha data produced a significant interaction (Table IX).

Neither interaction nor pattern effects were significant for fiber coarseness in either analysis (Tables VIII and IX). These results were rather surprising in view of the significant interaction obtained for this trait in the three-environment analyses (see Table IV).

Plant height data from both years at Chickasha was available. This information was collected in the same way as that cited above except that separate measurements were taken on the inside and outside rows of the 4 X 4 pattern. Therefore, this data was treated as though there were five treatments for the purpose of analysis. The data from this analysis (Table X) revealed a significant effect of planting pattern on plant height. A non-significant interaction was also shown which indicated that the relative response of plant height to pattern was the same in both environments.

Significant environmental effects were obtained in each analysis for all traits except for fiber coarseness in 1965 and for fiber length at Chickasha.

TABLE X

MEAN SQUARES FOR PLANT HEIGHT: ANALYSES OF CHICKASHA IN 1965 AND 1966

Source	df	Mean Squares Plant Height
Environment	1	1073.30**
Pattern	4	66.91**
Environment X Pattern	4	13.20
Error	24	5.26

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

Since fiber coarseness did not have a significant interaction in either analysis of two environments and plant height in the Chickasha data did not exhibit a significant interaction in the only analysis in which it was involved, the means over environments for those traits were determined and are given in Table XI. No significant differences between patterns were shown by fiber coarseness. An examination of plant height means over the two environments studied (Table XI) shows that cotton plants grown in the 2 X 1, 2 X 2, and the two outside rows of the 4 X 4 pattern were significantly taller than plants grown in the solid planting and in the two inside rows of the 4 X 4 pattern. There was no significant difference between the two inside rows of the 4 X 4 pattern and the solidly planted cotton. This data suggests that the two outside rows of the 4 X 4 pattern obtain a greater amount of the moisture stored beneath the adjacent skipped area than do the inside rows.

Analyses of Separate Environments

Those characters which displayed significant interactions in at least one of the analyses of that character in the previous section were then analyzed within each environment. Tables including the analyses of variance were thought unnecessary at this stage since the Duncan's New Multiple Range Test summarizes most effectively which means are or are not significantly different from one another.

Lint yield per allotted acre under the four sets of regulations is summarized for each environment in Tables XII and XIII. Yield response to planting pattern was similar under each set of regulations in the 1965 Chickasha and Mangum environments.

TABLE XI

COMPARATIVE FIBER COARSENESS AND PLANT HEIGHT AMONG PLANTING PATTERNS: TWO-ENVIRONMENT AVERAGES

Pattern	Fiber Coarseness 1965-66	Fiber Coarseness Chickasha and Mangum	Plant Height 1965-66
Solid	3.8 a*	4.5 a*	26.6 b*
2 X 1	3.8 a	4.6 a	30.9 a
2 X 2	3.8 a	4.6 a	33.1 a
4 X 4	3.8 a	4.6 a	--
4 X 4 (outside rows)	--	--	32.8 a
4 X 4 (inside rows)	--	--	27.9 b

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

TABLE XII

COMPARATIVE YIELD AMONG PLANTING PATTERNS (ASCS REGULATIONS UP TO 1962): ANALYSES OF SEPARATE ENVIRONMENTS

	Pounds Lint Per Allotted Acre					
	ASCS Regulations: Prior to 1956			ASCS Regulations: 1956-61		
	Mangum	Chickasha		Mangum	Chickasha	
Pattern	1965	1965	1966	1965	1965	1966
Solid	223 a*	478 a*	283 a*	223 b*	478 b*	283 a*
2 X 1	247 a	517 a	202 b	247 b	517 b	202 b
2 X 2	223 a	486 a	150 c	223 b	486 b	150 b
4 X 4	176 b	396 b	140 c	353 a	793 a	279 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

TABLE XIII

COMPARATIVE YIELD AMONG PLANTING PATTERNS (ASCS REGULATIONS 1962 TO 1969): ANALYSES OF SEPARATE ENVIRONMENTS

	Pounds Lint Per Allotted Acre					
	ASCS Regulations: 1962-65, 68-69			ASCS Regulations: 1966-67		
	Mangum	Chickasha		Mangum	Chickasha	
Pattern	1965	1965	1966	1965	1965	1966
Solid	223 c*	478 c*	283 a*	223 c*	478 c*	283 a*
2 X 1	371 b	778 b	304 a	286 b	599 b	233 a
2 X 2	445 a	972 a	300 a	343 a	748 a	230 a
4 X 4	353 b	793 b	279 a	353 a	793 a	279 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

In 1965 under the regulations effective prior to 1956, the solid, 2 X 1, and 2 X 2 patterns produced significantly higher yields than the 4 X 4 pattern. In the 1966 Chickasha test the solid planting produced significantly higher yields than any of the skip-row patterns. Based on this method of calculating an allotment, the four planted rows of cotton in the 4 X 4 pattern apparently cannot compensate for the yield lost by skipping the four adjacent rows. Under these regulations, one apparently cannot go wrong by planting in the solid pattern.

Under the 1956-61 regulations, only the planted rows of the 4 X 4 pattern were counted in the grower's allotment. Using this method of calculated allotted acres, the 4 X 4 pattern produced significantly higher yields than the other patterns in 1965. At Chickasha in 1966 no significant differences were found between the solid and 4 X 4 pattern while both produced significantly higher yields than the 2 X 1 and 2 X 2 patterns. Under these regulations, one should probably plant his cotton in the 4 X 4 pattern provided he has the acreage. If not, he should plant what he can in the 4 X 4 pattern with the remainder planted in the solid pattern.

Under the 1962-65, 68-69 regulations, only the planted rows in each skip-row pattern were included in the allotment; and yields correspond to those calculated on a planted area basis. All skip-row patterns had significantly higher yields than the solid planting in the 1965 tests and 2 X 2 pattern produced significantly higher yields than the 2 X 1 and 4 X 4 patterns. However, there were no differences for yield among planting patterns in 1966. Under these regulations, one would be advised to plant any skip-row pattern rather than solid cotton. However, primary advantage would appear to lie with the 2 X 2 pattern.

The 1966-67 regulations were intermediate between those prior to 1961 and those of 1962-65, 1968-69 in that a portion of the skipped rows in the 2 X 1 and 2 X 2 patterns were counted as planted to cotton. The restrictions, as expected, did have a deflating effect on the calculated yields per acre obtained from the two skip-row patterns. However, even under these regulations, all skip-row patterns produced significantly higher yields than the solid plantings in the 1965 tests and the 2 X 2 and 4 X 4 patterns had significantly higher yields than the 2 X 1 pattern. The 1966 data show no significant differences among planting patterns. Under these regulations, one should still plant in a skip-row pattern rather than in the solid pattern. Preference should be given to the 2 X 2 and 4 X 4 patterns over the 2 X 1.

Table XIV contains the pulled lint percent and boll size data for each pattern in each environment. A significant decrease in lint percent was obtained in going from solid to skip-row planting in 1965 at Mangum. However, no significant differences were found for lint percent at Chickasha in either year. The importance of this trait lies in the fact that the higher the pulled lint percent the fewer pounds of snapped cotton are required to make a bale. Harvesting and ginning costs are therefore lower.

All skip-row patterns produced significantly larger bolls than the solid planting in the 1965 Chickasha environment while the 4 X 4 and 2 X 2 patterns had significantly larger bolls than the 2 x 1 pattern. No significant differences were found in the other two tests. Larger bolls mean that fewer bolls are required to produce a pound of seed cotton.

Two harvests could be made at Chickasha in 1965; and, as a result,

TABLE XIV

COMPARATIVE PULLED LINT PERCENT AND BOLL SIZE AMONG PLANTING PATTERNS: ANALYSES OF SEPARATE ENVIRONMENTS

	Pulled Lint Percent			Boll Size		
	Mangum	Chickasha		Mangum	Chickasha	
Pattern	1965	1965	1966	1965	1965	1966
Solid	26.5 a*	27.8 a*	22.5 a*	7.28 a*	8.20 c*	7.73 a*
2 X 1	25.4 b	27.9 a	22.3 a	7.45 a	8.71 b	7.94 a
2 X 2	25.2 b	27.9 a	22.3 a	8.24 a	9.03 a	7.38 a
4 X 4	24.0 c	27.9 a	22.1 a	7.31 a	9.06 a	7.41 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

earliness measured as percent first harvest was calculated and analyzed in that experiment. As shown in Table XV, no significant differences were found for earliness among planting patterns.

The fiber lengths presented in Table XV revealed significant differences in the effects of the patterns in the 1965 tests, but not in the 1966 test. Apparently, an increase in fiber length, if obtained, is more likely to be found if the 2 X 2 pattern is grown. This trait is important in that it has a direct bearing on the price per pound that the grower receives for his lint.

Investigation of the 4 X 4 Pattern

An outside row in the 4 X 4 skip-row pattern is competing for moisture and nutrients with adjacent rows on only one side while an inside row must compete with a row on both sides of it. Measurements were taken to compare the effects of inside versus outside rows on the agronomic and fiber properties of cotton. Yield comparisons were made on a planted area basis.

Analyses Over Environments

The analyses of agronomic properties are presented in Table XVI. Significant interactions between environment and row position were obtained for all characters suggesting that relative response of each character to row position was different among the three environments. Significant environmental effects were found for all characters.

The analyses of fiber properties are summarized in Table XVII. A significant interaction was present only for fiber length. Significant differences in 1/8" gauge stelometer due to row position were obtained

TABLE XV

COMPARATIVE EARLINESS AND FIBER LENGTH AMONG PLANTING PATTERNS: ANALYSES OF SEPARATE ENVIRONMENTS

Pattern	Percent First Harvest Chickasha 1965	2.5% Span Length Mangum 1965	2.5% Span Length Chickasha 1965	2.5% Span Length Chickasha 1966
Solid	83.0 a*	.980 b*	1.016 b*	1.038 a*
2 X 1	78.7 a	1.007 ab	1.040 a	1.033 a
2 X 2	71.5 a	1.037 a	1.060 a	1.035 a
4 X 4	72.1 a	.995 b	1.059 a	1.036 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

TABLE XVI

MEAN SQUARES FOR YIELD, PULLED LINT PERCENT, BOLL SIZE, AND 100 SEED INDEX: ANALYSES OF THREE ENVIRONMENTS (4 X 4 PATTERN)

Source	df	Mean Squares			
		Yield	Pulled Lint Percent	Boll Size	100 Seed Index
Environment	2	629110**	69.97**	7.6938**	10.04**
Row Position	1	30083	2.80	2.6268	4.59
Environment X Row Position	2	218323**	3.83**	.9373*	3.38*
Error	9	3048	.37	.1497	.47

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE XVII

MEAN SQUARES FOR FIBER LENGTH, STRENGTH, AND COARSENESS: ANALYSES OF THREE ENVIRONMENTS (4 X 4 PATTERN)

		Mean Squares			
Source	df	2.5% Span Length	Micronaire	1/8" Gauge Stelometer	0" Gauge Stelometer
Environment	2	.007770**	7.8650**	.0390	.0162*
Row Position	1	.002542	.0100	.0661*	.0063
Environment X Row Position	2	.002280*	.0100	.0010	.0043
Error	9	.000383	.0411	.0112	.0034

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

but not for 0" gauge stelometer or micronaire. Significant environment effects were present for all traits except 1/8" gauge stelometer.

The means for fiber strength and coarseness are shown in Table XVIII. Outside rows produced fiber with significantly higher 1/8" gauge stelometer values than inside rows. Higher 0" gauge stelometer values in the outside rows were also obtained although the difference was not significant.

Analyses Over Locations in One Year and Over Years at One Location

The combined analyses for yield, boll size, and 100 seed index over locations in 1965 and over years at Chickasha are presented in Tables XIX and XX, respectively. Significant interactions were found for yield in both analyses, for boll size over years at Chickasha, and for 100 seed index over locations in 1965.

The same analyses for pulled lint percent and fiber length are presented in Tables XXI and XXII. Significant interaction effects were present for pulled lint percent in the over locations analysis and for fiber length in the over years analysis.

Since at least one of the analyses in this section revealed significant interactions for each trait, means over years and over locations were not examined. Plant height differences between inside and outside rows may be studied by consulting Table XI.

Analyses of Separate Environments

Comparative yield, boll size, and 100 seed index for each test are presented in Table XXIII. Outside rows produced significantly higher yields than inside rows in the 1965 tests, but not in the 1966 test.

TABLE XVIII

COMPARATIVE FIBER STRENGTH AND COARSENESS:
THREE-ENVIRONMENT AVERAGE
(4 X 4 PATTERN)

	Fiber Strength		Fiber Coarseness
Row Position	1/8" Gauge Stelometer	0" Gauge Stelometer	Micronaire
Outside	1.98 a*	3.31 a*	3.9 a*
Inside	1.88 b	3.28 a	4.0 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

TABLE XIX

MEAN SQUARES FOR YIELD, BOLL SIZE, AND 100 SEED INDEX: ANALYSES OF CHICKASHA AND MANGUM IN 1965 (4 X 4 PATTERN)

Source	df	Mean Squares		
		Yield	Boll Size	100 Seed Index
Environment	1	801920**	12.2151**	14.06**
Row Position	1	412806	3.9007**	6.25
Environment X Row Position	1	52212**	.6005	5.05*
Error	6	3246	.2125	.49

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE XX

MEAN SQUARES FOR YIELD, BOLL SIZE, AND 100 SEED INDEX: ANALYSES OF CHICKASHA IN 1965 AND 1966 (4 X 4 PATTERN)

Source	df	Mean Squares		
		Yield	Boll Size	100 Seed Index
Environment	1	1066573**	10.8241**	16.00
Row Position	1	215993	.3721	.07
Environment X Row Position	1	165039**	.3481**	.00
Error	6	3699	.0140	.24

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE XXI

MEAN SQUARES FOR PULLED LINT PERCENT AND FIBER LENGTH: ANALYSES OF CHICKASHA AND MANGUM IN 1965 (4 X 4 PATTERN)

Source	df	Mean Squares Pulled Lint Percent	 2.5% Span Length
Environment	1	62.41**	.015007**
Row Position	1	6.25	.006007*
Environment X Row Position	1	3.81*	.000599
Error	6	.34	.000469

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE XXII

MEAN SQUARES FOR PULLED LINT PERCENT AND FIBER LENGTH: ANALYSES OF CHICKASHA IN 1965 AND 1966 (4 X 4 PATTERN)

Source	df	Mean Squares Pulled Lint Percent	 2.5% Span Length
Environment	1	133.93**	.001702*
Row Position	1	.03	.000116
Environment X Row Position	1	.57	.001784*
Error	6	.49	.000172

*, **Significant at the 0.05 and 0.01 levels of probability, respectively.

TABLE XXIII

COMPARATIVE YIELD, BOLL SIZE, AND 100 SEED INDEX:
ANALYSES OF SEPARATE ENVIRONMENTS
(4 X 4 PATTERN)

Row Position	Yield			Boll Size			100 Seed Index		
	Mangum	Chickasha		Mangum	Chickasha		Mangum	Chickasha	
	1965	1965	1966	1965	1965	1966	1965	1965	1966
Outside	450 a*	1012 a*	293 a*	8.00 a*	9.36 a*	7.42 a*	15.3 a*	16.0 a*	14.0 a*
Inside	243 b	576 b	264 a	6.63 a	8.76 b	7.41 a	12.9 b	15.9 a	13.9 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

Bolls were significantly larger on the outside rows in the 1965 test at Chickasha, but not in the other two. Significant differences in seed size between the outside and inside rows were found only in the 1965 Mangum environment. Here, the outside rows produced larger seed than the inside rows.

Comparative pulled lint percent, earliness, and fiber length for each test are summarized in Table XXIV. Outside rows produced significantly lower pulled lint percent at Mangum in 1965 while the differences at Chickasha were not significant. No significant differences in earliness were detected between inside and outside rows. Outside rows produced significantly longer fiber at Chickasha in 1965 but not in the other two tests.

TABLE XXIV

COMPARATIVE PULLED LINT PERCENT, EARLINESS, AND FIBER LENGTH:
ANALYSES OF SEPARATE ENVIRONMENTS (4 X 4 PATTERN)

Row Position	Pulled Lint Percent			Percent First Harvest	2.5% Span Length		
	Mangum	Chickasha		Chickasha	Mangum	Chickasha	
	1965	1965	1966	1965	1965	1965	1966
Outside	22.9 b*	27.8 a*	22.4 a*	68.4 a*	1.021 a*	1.070 a*	1.028 a*
Inside	25.1 a	28.1 a	22.0 a	78.9 a	.970 a	1.043 b	1.044 a

*Values within a column followed by a common letter are not significantly different at the 0.05 level of probability.

CHAPTER V

SUMMARY AND CONCLUSIONS

Lankart 57, a medium-early stormproof cotton variety, was planted in solid and skip-row patterns (2 X 1, 2 X 2, and 4 X 4) in replicated, randomized tests in 1965 and 1966 at Chickasha and Mangum, Oklahoma. Due to extenuating circumstances, the 1966 test at Mangum could not be harvested. Data on yield (under four sets of ASCS regulations), pulled lint percent, boll size, earliness, seed size, plant height, fiber length, fiber strength, and fiber coarseness were studied.

From the data presented skip-row planting practices appear to affect yield, lint percent, boll size, and fiber length under some environmental conditions but not others.

The set of ASCS regulations used to calculate the acreage planted had a significant effect on the interpretation of the yield results. Under the regulations in effect prior to 1956, the solid pattern would give the most dependable high yields; under the 1956-61 regulations, the 4 X 4 pattern should be used as much as feasible with the remainder planted in the solid pattern; under the 1962-65, 68-69 regulations, any skip-row pattern would be better than solid planted cotton, but primary advantage would appear to lie with the 2 X 2 pattern; and under the 1966-67 regulations, one should still plant in the skip-row patterns rather than in the solid pattern, but preference should be given to the 2 X 2 and 4 X 4 patterns over the 2 X 1. Planting patterns produced similar yield responses under a given set of regulations in the 1965 tests. However, the responses from year to year at Chickasha were rather inconsistent.

Planting pattern did not have a consistent influence on pulled lint percent. In 1965 at Mangum solid planting produced cotton with significantly higher pulled lint percent than did the skip-row systems. However, no differences were found in the two Chickasha tests.

Planting patterns also had no consistent influence on boll size. Significantly larger bolls were produced by the skip-row patterns in 1965 at Chickasha but not in the other tests.

Although not significant, a tendency toward earliness was evident in solid over skip-row planting. Other workers (1, 6, 12) have also noticed this trend.

The pattern of planting had no significant effect on 100 seed index, on 1/8" and 0" gauge stelometer, or on fiber coarseness.

Based on the Chickasha tests, cotton plants grown in the 2 X 1 and 2 X 2 patterns and in the outside rows of the 4 X 4 pattern will be substantially taller than those grown in the solid pattern and in the inside rows of the 4 X 4 pattern.

Planting pattern did not have a consistent influence on fiber length. In the 1965 Chickasha test fibers from the skip-row patterns were significantly longer than those from the solid planting. In the 1965 Mangum environment fiber from only the 2 X 2 pattern was significantly longer than that from the solid planting. However, no significant differences in this trait were obtained in the 1966 Chickasha test. Fiber length increases, if they occur, are most likely to result from the 2 X 2 skip-row pattern.

Analysis of inside versus outside rows of the 4 X 4 skip-row pattern suggests that increases in 1/8" gauge stelometer, yield, boll size, seed size, plant height, and fiber length and that decreases in pulled lint percent can often, but not invariably, be found in outside rows as compared to inside rows. No differences due to row position in the pattern were found for 0" gauge stelometer, fiber coarseness, and earliness.

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