DROUGHT RESISTANCE OF COTTON PLANTS GROWN UNDER NITROGEN DEFICIENCY

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In greenhouse-grown cotton (Gossypium hirsutum L.), N deficiency affected several characters which are believed to be associated with drought resistance. Leaves of N-deficient plants were smaller than normal and had smaller cells. N deficiency also changed the relationship between leaf water potential and relative water content (RWC). For any given potential, the RWC of N-deficient leaves was greater than for normal leaves. Also, the change in RWC per unit change in potential was about 50% less in N-deficient leaves. Osmotic potentials at 100% RWC (determined from pressure-induced exudation curves) were 2 to 3 bars lower in N-deficient leaves, but little of this difference could be ascribed to organic acid or sugar concentrations.

Stomatal behavior was also affected by N deficiency. The threshold water potential for stomatal closure was raised 4 to 10 bars by N deficiency, depending upon the temperature. In some cases stomates of N-deficient leaves closed considerably before turgor was lost. Thus, although N deficiency apparently induced some structural aspects of drought tolerance in the leaf mesophyll, stomates were converted to a "water-saving", or drought avoidance, mode of behavior.

In practical terms, these results mean that N-deficient plants have some protection against drought injury. This protection takes the form of both drought avoidance (earlier closure of stomates to avoid excessive water loss) and true drought tolerance (for a stress of a given severity, the altered leaf structure retains a larger fraction of the tissue water). These results have not yet been tested in the field.

THE EFFECT OF PLANTING DATE AND RATE ON DEVELOPMENT AND YIELD OF PIMA COTTON

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The yield of Long Staple cotton was tending to decline in the early 1970's. In spite of introductions of higher yielding varieties the trend seemed irreversible. A logical explanation for this occurence was not known.

In late 1972 it was decided that some effort should be expended to seek solution for this phenomena. After thorough consideration it appeared that planting date and rate were possible keys to a solution. It was noted that Long Staple was most always planted earlier than other cotton under less than optimum conditions. Seed was usually placed in a relatively low temperature soil and as a result germination and subsequent growth was slow.

We theorized that by delaying planting date 2-3 weeks warmer soil temperatures would result in faster germination and plant development might compensate for the time loss.

The initial test, established in 1973, compared two planting dates, April 6 and April 21 and two seeding rates, 13 and 17 pounds per acre. The test design was ramdomized with four replications. Actual yield weights from this test (Table I) showed no significant differences although there was a considerable yield range.

Table 1
RATE AND DATE OF PLANTING
LONG STAPLE COTTON, 1973

Planting Date	Seeding Rate lbs./A	Lint/Acre[1/] (pounds)
April 6	13	872a
April 21	17	792a
April 21	13	765a
April 6	17	763a

1/Yields followed by same letter not significantly different at 5% level by Duncan's New Multiple Range Test.

Table 2
RATE AND DATE OF PLANTING
LONG STAPLE COTTON, 1974

Planting Date	Seeding Rate lbs./A	Lint/Acre[1/] (pounds)
April 3		
April 3	13	873a
April 24	17	779a
April 3	17	763a
April 24	13	721a

1/Yields followed by same letter not significantly different at 5% level by Duncan's New Multiple Range Test.

Table 3
RATE AND DATE OF PLANTING
LONG STAPLE COTTON, 1975

Planting Date	Seeding Rate lbs./A	Lint/Acre[1/] (pounds)
April 14	13	623a
April 29	17	577a
April 29	13	568a
April 14	17	552a

1/Yields followed by same letter not significantly different at 5% level by Duncan's New Multiple Range Test.

The test was modified in 1974 by extending the time interval between planting dates to three weeks. All other aspects of the test remained the same including using the same test field and design.

The results of this test (Table 2) show there was no significant differences between any treatments although the April 24 planting at 13 pounds produced considerably less cotton.

Comparing the 1973 and 1974 growing seasons we found them quite different in that the 1973 season was acceptable for planting throughout the planting season from temperature stanpoint. The 1974 season fluctuated from the desirable planting temperatures to well below. The fluctuations occurred within 3 or 4 day time spans throughout the planting period. Despite these seasonal differences, the results of the two tests were relatively consistent.

In view of these seasonal differences, the test was extended through the 1975 season in order to achieve a concensus. However, the 1975 test was modified slightly to compensate for later planting dates resulting from an untimely rain during early April.

To a large extent the results of this test (Table 3), support the two previous years experience. However, all yields in 1975 were much lower, apparently reflecting the later planting dates and unfavorable planting conditions.

During the 1974 and 1975 growing seasons, this study was carefully monitored. Each year 16 separate one-two thousandth acre areas were selected within the 19 acre test field to determine weekly: flowering rate, percent flowers that developed into bolls and yield of lint. Actual yield was verified by harvesting and weighing 4 rows from each 12 row treatment.

Relative to flowering rate, the early planting dates produced flowers earlier in the season than late planting dates. In 1975, the first flower appeared about two weeks later than during 1974. Both years the peak flowering period was reached at mid-August. Irregardless of the planting date, flowering period developed later in the growing season than is commonly believed.

During peak bloom, August 15-28, in 1974 more than 37% of the flowers opened and bolls from these flowers produced 46% of the total yield. In 1975, the peak bloom period extended from August 18 to September 7. During this period 51% of the blooms occurred and 51% of the yield was produced.

Thus, it appears that 50% of total yield is produced during the last two weeks of August. This is an extremely critical portion of the growing season and is strongly affected by water, fertility, insects and other management practices utilized 3 to 4 weeks prior to this peak period. Bolls set during this time span required 65 to 75 days to reach maturity.

Temperatures in the three production seasons were highly varible in the early season period, April 1 to May 15. Differences between the 1973 and 1974 planting seasons were noted earlier in this report. The 1975 season was very dissimilar from the other two years. There never was a date that was desirable for planting during April and much of May. Thus planting date and seeding rate did not affect yields nearly as much as in the previous two years. (Table 4).

Table 4
RATE AND DATE OF PLANTING
LONG STAPLE COTTON, 1973-75

Treatment	1973	1974	1975	3 yr. Ave[1/]
Early date-low rate	872	873	623	789a
Late date-high rate	792	779	577	716a
Early date-high rate	763	763	552	693a
Late date-low rate	765	721	568	685a

1/Yields followed by same letter not significantly different at 5% level by Duncan's New Multiple Range Test.

In 1973 the yield difference, from high to low, was 109 pounds of lint, in 1974 the difference was 152 pounds and in 1975 there was only a 55 pound differential.

SUMMARY

Although the 1973, 1974 and 1975 growing seasons were dissimilar some generalizations appear valid:

1. Highest yield was obtained from the earliest planting date using a 13 pound per acre (low) seeding rate.

2. The yield advantage from an early planting date can be partially overcome by increasing seeding rate (17 pounds).

3. A large amount of total yield is made from blooms occurring during the final two weeks of August.

4. The production cycle of Pima S-5 does not lend itself to shorter or delayed production systems to any appreciable degree.

INFLUENCE OF MUNICIPAL WASTEWATER ON COTTON FIBER YIELD AND QUALITY[1]

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Experiments were conducted in the field to study the influence of municipal wastewater on cotton fiber yield and quality near Buckeye, Arizona, in 1974 and 1975. The soil type was a Gila loam. Conventional culture for growing cotton on 38-inch beds was used. The crop was planted in April and harvested in November each year. Approximately 4 acre-feet of irrigation water were required to produce a cotton crop. Two sources of irrigation water were used: (1) pump water from local wells (control treatment) and (2) municipal wastewater plus pump water in a 50:50 mixture. The pump water contained approximately 4600, 21, and 0 ppm of total soluble salts, nitrate nitrogen, and elemental phosphorus, respectively. The wastewater plus pump water mixture contained about 2200, 6, and 37 ppm of total soluble salts, nitrate nitrogen, and elemental phosphorus, respectively. Fifty pounds per acre of nitrogen were applied before planting to the cotton that was irrigated with pump water. No nitrogen was applied to the cotton that was irrigated with the wastewater plus pump water mixture. The experimental design was a Modified Randomized Complete Block with four replications.

Yield and fiber quality data for cotton grown with the two sources of irrigation water are presented in Tables 1 and 2. Cotton irrigated with the wastewater plus pump water mixture produced taller plants that contained more vegetative growth than did cotton that was irrigated with pump water alone. When cotton was irrigated with the wastewater plus pump water mixture the yields of seed cotton and lint cotton were equal to or higher than the yields of seed cotton and lint cotton from plants irrigated with pump water. Wastewater had no significant detrimental effect on any cotton fiber quality characteristics.

Municipal wastewater can be used effectively as a source of irrigation water and plant nutrients in the commercial production of cotton in Arizona and, possibly, in similar environments throughout the world. When wastewater is mixed with pump water that is high in total soluble salts, the salt content of the mixture is lowered and the quality of the irrigation water is improved. The use of municipal wastewater in the commercial production of cotton makes more conventional pump water available for domestic uses.