PATTERNS OF WEATHER, PLANT GROWTH, AND INSECT ATTACK DURING 1974-75

J.R. Mauney

The crop year 1974 at the University of Arizona Cotton Research Center, Phoenix, was characterized by an early, rapid buildup of flower production and fruit set. The crop in 1975 was late in germination and characterized by high rates of square shed prior to first flower. Flowering rate and fruit set did not reach normal levels until mid-August. Though final yield was very similar in the two years, the 1975 crop was much later in maturing.

The increase in early square shed in 1975 could not be explained by extreme temperatures. Plants in 1974 were subjected to much higher day and night temperatures during early flowering without loss of squares. A more likely explanation for the square shed was the presence of plant bugs in greater numbers on young plants in 1975 than in 1974. Though populations did not reach "economic" proportions until early July, the damage was much more severe than expected because the plants were relatively younger in July of 1975 than in July of 1974.

Differences between planting dates were evident in the fruiting pattern of 1975 plants. One week earlier germination escaped some early square shed. These plants set a few early fruit, grew more slowly in mid-season when few fruit were being set, and recovered more rapidly from the shedding condition.

EFFECTS OF ENVIRONMENT ON COTTON PLANT PRODUCTIVITY

G. Guinn

Photosynthesis limits yields when photosynthesis is severely restricted by low light intensity, short days, nutrient deficiencies, or certain herbicides. There is some question, however, as to whether photosynthesis limits yield when conditions are near optimum. A test was conducted during the spring of 1975 in controlled-climate greenhouses to investigate this question. Conditions were very nearly ideal for maximum rates of photosynthesis. The days were long, bright, and clear, and the plants were spaced not less than 31 cm (12.2 in.) apart to minimize shading. Nutrients were supplied at normal and at 2X normal concentrations, and were renewed as often as every five days. Photosynthesis was further increased by enriching the atmosphere with CO_2 so that a daytime level of 630 ppm was maintained after April 28. Measurements by John Hesketh indicated that photosynthesis rates initially increased about 65% but then declined until they were about 31% above the rate for control plants in normal (330 ppm) CO_2.

Nutrient level had relatively little effect on number of blooms and bolls produced in a normal atmosphere of 330 ppm CO_2 (Table 1), but doubling the nutrient level considerably increased the number of blooms and bolls produced in the CO_2-enriched atmosphere. This suggests that more nutrients were needed when photosynthesis was stimulated by CO_2 enrichment. Numbers of blooms and bolls produced and dry weight of bolls per plant were all greatly increased by 630 ppm CO_2 and were highest with 630 ppm CO_2 and 2X nutrient level. Conversely, shedding rates were lowest in 630 ppm CO_2 and with 2X nutrients (Table 1). Rate of ethylene evolution by young bolls was higher for bolls grown on plants in the normal atmosphere than on plants in the CO_2-enriched atmosphere (data not shown), and was probably a causal factor in the higher shedding rates. The results suggest that genetic selections and cultural practices to increase photosynthesis could be expected to increase yields. (This was a cooperative experiment conducted by J.D. Hesketh, J.R. Mauney, K. Fry, and J.W. Radin, in addition to G. Guinn. Other data were also collected, and some of these data indicate that excessive accumulation of starch in leaves may have an inhibitory effect on photosynthesis.)

Ethylene is a powerful plant-produced hormone that stimulates shedding (abscission) of plant parts. Additional tests conducted during 1975 confirmed an earlier report that moisture stress stimulates ethylene production by young bolls in greenhouse and laboratory tests. However, a test with field-grown plants showed little difference in rates of ethylene production by bolls from plants that were irrigated weekly compared with those that were irrigated once every three weeks.

Table 1. Effects of Nutrient Level and CO_2 Enrichment of the Atmosphere on Number of Blooms Produced, Abscission Rate, Boll Number, and Boll Weight Per Plant on Greenhouse-grown DPL 16 Cotton Plants.

	630 ppm CO_2	330 ppm CO_2	Ratio
	Number of blooms per plant		
2X nutrients	105	69	1.52
Normal nutrients	86	67	1.28
	Percent of tagged bolls shed		
2X nutrients	28.7	35.9	0.80
Normal nutrients	31.0	41.0	0.76
	Number of bolls per plant		
2X nutrients	74.8	41.6	1.80
Normal nutrients	59.3	39.4	1.51
	Dry weight of bolls per plant, g.		
2X nutrients	280	157	1.66
Normal nutrients	236	143	1.65

Therefore, it appears that bolls on field-grown plants can adjust to and survive moisture stress that is sufficient to limit vegetative growth of plants. (In this particular test, however, heavy shading may have stimulated ethylene production on plants that were irrigated weekly so that the rate of ethylene production by their bolls equalled that by bolls on moisture-stressed plants.)

Experiments were conducted to test the hypothesis that membrane integrity affects ethylene production. Membranes are composed of lipids and proteins. It has been reported that moisture stress causes a decrease in lipid content and deterioration of membranes. When I injected lipase (a lipid-digesting enzyme) into five-day-old bolls, they produced much more ethylene than control bolls that had an equal amount of water injected into them. Other lipase enzymes also stimulated ethylene production. Bromelain, a proteinase from pineapple, stimulated ethylene production somewhat, but other proteinases did not. Although proteinases might attack membrane proteins, they may also attack the enzymes that produce ethylene. Other enzymes tested had no effect. Injection of lipid solvents also stimulated ethylene production; the stimulation appeared to correlate with ability to dissolve lipids. Of the organic solvents tested, methanol gave the least stimulation and a mixture of ethanol and chloroform gave the greatest. Propanol and butanol gave intermediate rates. If it is true that membrane integrity affects ethylene production one might predict that any condition that interferes with synthesis of membrane components, such as a deficiency of photosynthate, nitrogen, or sulfur, would cause increased rates of ethylene production that would, in turn, cause increased rates of abscission.

GROWTH PATTERNS OF COTTON PLANTS UNDER LIMITING NITROGEN

J.W. Radin and L.L. Parker

In 1975, experiments were begun to characterize the growth of cotton plants and their patterns of N use under N-limiting conditions. Plants were grown in the greenhouse in aerated solution cultures. In initial experiments, cultivars were selected which have divergent backgrounds and which are normally grown under widely different environmental conditions. Plants were grown until the N supply was exhausted and growth stopped.

The table shows the dry weight distribution among the various parts of plants grown on 224 mg NO_3-N per plant. Of the four upland varieties, Coker 310, a rain-fed cultivar from the