**Cotton Yield Can Be Affected by 2,4-D**

## GROWTH REGULATORS

# Effect of 2,4-D on Growth and Yield of Cotton

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**Experiments conducted in Louisiana, following reports of damage to crops, showed that when 2,4-D is applied in excess of 0.01 pound per acre at any stage of growth except when cotton bolls are essentially mature, significant decreases in yield result. Oil content and seed weight are reduced in proportion to the amount of 2,4-D applied during the fruiting stage.**

THE UNIQUE PROPERTIES OF 2,4-DICHLOROPHENOXYACETIC ACID and related compounds have led to their wide use for control of broad-leafed weeds. The literature on use of these chemicals for weed control is voluminous; the fact that many broad-leaved crops such as cotton may be injured has received little attention. During the period July 1948 to September 1952 the Louisiana Department of Agriculture investigated more than 500 complaints of 2,4-D injury to crops, principally cotton. Reports from other states where 2,4-D has been used in cotton-producing areas indicate a similar incidence of injury. Although most cases of injury have resulted from drifting of spray or dust, there have been many instances where contamination of pesticides or pesticide application equipment has been the cause.

In Louisiana injury to cotton plants has been observed 35 miles from the point of application of 2,4-D. The cotton plant is so extremely sensitive to 2,4-D that it is difficult for one to appreciate it unless he has actually observed 2,4-D injury to cotton. The sensitivity of the cotton plant to 2,4-D and its effects on the cotton plant have been adequately described by Brown, Holdeman, and Haygood (*2*) and others (*3*, *5*); however, at the time this work was begun no information was available on the effect of 2,4-D on the yield of cotton under field conditions. It was later learned that Baskin (*1*) and Goodman (*4*) were concurrently engaged in similar experimental work.

When cotton plants are affected with 2,4-D a number of questions arise. Will the yield be affected; if so, how much; should the crop be abandoned or should cultivation be continued; will there be a loss in quality of crop in addition to loss in yield? This work was undertaken in an effort to find an answer to these questions.

### *Experimental Work*

Each experimental plot consisted of four 124-foot rows spaced 42 inches apart. Checks and treatments were replicated three times in a random manner. Insect control was maintained by use of 3-5-40 when necessary. Louisiana 33 variety of cotton was planted and fertilized at the rate of 600 pounds of 8-8-8 per acre on May 17, 1952. 2,4-D ethanolamine salt in sufficient water just to wet the foliage was applied at rates of 0.5, 0.2, and 0.05 pound per acre of 2,4-D acid on June 21. Application was made to the two inner rows, thus leaving two buffer rows next to each treatment. The cotton plants were twelve inches tall at this time and had not begun to form squares. On August 2, a second series of treatments was made at rates of 0.2, 0.05, and 0.01 pound per acre of 2,4-D acid. The rate was scaled down because 0.5 pound per acre gave a complete kill of the young cotton plants. The cotton plants at this time were approximately 5 feet in height and showed all stages of fruiting from newly formed squares to partially mature bolls. The cotton was picked and weighed on October 11. Lint and seed were separated on a roller-type gin and sent to the laboratory for analysis.

### *Injury to Cotton*

All cotton treated in the leaf stage showed severe bending of the stems the day after treatment. At the end of 5 weeks all plants treated at the rate of 0.5 pound per acre were dead, a few plants receiving 0.2 pound per acre had survived but were making little growth, and plants to which 0.05 pound per acre had been applied had vigorously growing side branches and had begun to produce normal leaves. Very little growth and no fruit were produced on the 0.2-pound-per-acre plots. The plants receiving 0.05 pound per acre, after recovery, made good growth and were almost as tall as the untreated cotton plants at harvest; however, little cotton was produced.

Dead squares were found 3 days after treatment on all cotton plants treated at the fruiting stage. As the plants were not in a state of active vegetative growth, typical leaf deformation was slow to de-

**Table I. Effect of 2,4-D on Cotton**

| Treatment, Lb. 2,4-D /Acre | Seed Cotton, Lb./Acre | Lint, % | Seed Index | Nitrogen, % | Oil, % | Fiber Length, Inches | Perimeter, μ | Wall Thickness, μ |
|---|---|---|---|---|---|---|---|---|
| Check | 875 | 33.4 | 11.5 | 3.15 | 24.69 | $1^{5}/_{32}$ | 48.2 | 2.91 |
| 0.5 [b] | 0 | .. | .. | .. | ... | .. | .. | .. |
| 0.2 [b] | 0 | .. | .. | .. | ... | .. | .. | .. |
| 0.05 [b] | 23 | 31.8 | 11.0 | 2.87 | 24.95 | $1^{3}/_{32}$ | 50.1 | 2.89 |
| 0.2 [a] | 132 | 43.8 | 7.9 | 3.09 | 13.56 | $1^{1}/_{32}$ | 56.9 | 2.37 |
| 0.05 [a] | 292 | 34.7 | 9.5 | 3.36 | 19.40 | $1^{3}/_{32}$ | 53.5 | 2.57 |
| 0.01 [a] | 565 | 34.2 | 10.6 | 3.45 | 23.44 | $1^{4}/_{32}$ | 53.4 | 2.61 |

[a] 2,4-D applied after fruiting.
[b] 2,4-D applied before fruiting.

velop. Twisting of stems, partial defoliation, reddening and cracking of branches and stalks, cylindrical squares, and "daisy-type flowers" were found in proportion to the amount of 2,4-D applied. Cotton affected with 2,4-D during the fruiting stage was difficult to pick.

The data in Table I show that yield of cotton is seriously reduced by as little as 0.01 pound per acre of 2,4-D. Baskin (*1*) found significant reduction in yield at all rates of application down to 0.0024 pound per acre of 2,4-D. Goodman (*4*) found yield reduction when 0.01 pound per acre or more was applied and apparent stimulation at the level of 0.001 pound per acre. Greatest reduction in yield was noted by Baskin when 2,4-D was applied during the flowering stage. Goodman found most damage when application was made in the seedling stage. Because of the many variables involved, it is doubtful that a satisfactory correlation can be made between time and rate of application and yield. Broadly speaking, the principal effect of 2,4-D in sublethal amounts is to delay maturity. Although sensitive to 2,4-D, the cotton plant has remarkable ability to recover from its effects. If sufficient growing time is available, cotton plants can make good recovery from moderate amounts of 2,4-D. Of course, secondary effects such as unfavorable weather conditions and insect infestation may accompany delayed maturity and reduce yields. Under ordinary conditions of usage of 2,4-D, actual killing of cotton plants has not been observed. One half pound of 2,4-D per acre would be expected to kill young cotton plants completely and prevent any yield from older plants except that obtained from bolls already mature or nearly so at time of contact.

An amount of 2,4-D in excess of 0.2 pound per acre would be expected to reduce yields to negligible values. As a practical interpretation, it may be said that 2,4-D in excess of 0.01 pound per acre at any stage of growth except when bolls are essentially mature will produce significant decreases in yield in proportion to the quantity of 2,4-D involved. Much of the 2,4-D injury observed on cotton in Louisiana has apparently been caused by drift on the order of 0.01 pound per acre. It is commonly believed that extremely small amounts of 2,4-D exert a stimulating effect on yield of cotton, but there seems to be little supporting evidence for such belief at this time. It is anticipated that the concentration range which would produce stimulating effects, if existing, would be very narrow.

A factor which exerts so profound an effect on the vegetative parts of a plant might also be expected to affect the composition of the fruit. The data in Table I show that oil content and consequently seed weight are reduced in proportion to the amount of 2,4-D where it is applied during the fruiting stage. Reduction in oil content would materially reduce the value of the seed. Where there are only slight reductions in yields due to 2,4-D, the oil content would not be affected. The nitrogen content of seeds is apparently but little affected by 2,4-D. This is, in part, due to decreased oil content. However, low rates of application seem actually to increase the nitrogen content. The data indicate that 2,4-D applied before fruiting has but little effect on oil or nitrogen content.

As 2,4-D produces such marked formative effects on the leaves of the cotton plant, it was suspected that fiber characteristics might also be affected. The data on fiber length, perimeter, and wall thickness indicate trends but are not believed to be significant because of the great variation in these characteristics found under normal conditions. Perhaps more detailed experiments involving carefully timed applications and measurements on fiber from individual bolls would be more revealing.


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