

# Growth Regulators on Beans

studies in southern California indicate properly applied sprays may increase yields of dry limas under some conditions

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**Field experiments** designed to study the possible uses of plant growth regulators on several different varieties of beans grown under the diverse conditions of southern California had three general objectives: 1, to investigate the possibility of increasing yield of green or dry lima beans, bush or pole snap beans by the application of sprays of plant hormones; 2, to delay the maturity of lima beans grown for the freezing process by spray applications 10 days to two weeks before the expected maturity of the plants; and, 3, prevent the shedding of pods from the early sets of fruit as a result of adverse weather conditions. Test plots were established, beginning in 1949, in the bean growing regions of Ventura, Orange and San Diego counties during all seasons of the year where beans were grown in commercial quantities.

Treatments of 2,4-D—2,4-dichlorophenoxyacetic acid—were included in most of the experiments. At various times other compounds—including NAA—naphthaleneacetic acid—ortho-chlorophenoxyacetic acid—2,4,5-T<sub>p</sub>—2,4,5-trichlorophenoxypropionic acid—rhodanine acetic acid and N-metatolylphthalamic acid were tested for their effectiveness.

Results soon demonstrated that it was not possible to bring about a significant delay in the maturity of green Concentrated Fordhook lima beans by application of sublethal concentrations of 2,4-D at any time less than one month before the expected maturity of the crop. Because the main purpose of delaying maturity in beans intended for freezing would be to spread harvesting operations over a longer period when otherwise adverse weather tends to hasten the maturation of all beans—regardless of different planting dates—and weather conditions could not be anticipated that long in advance of harvest, this aspect of the problem was discontinued.

Applications of 2,4-D and some other compounds two to four weeks after seedlings emerged gave some initially promising results, particularly in Ventura County. The results of one experiment in the Oxnard area are summarized in the accompanying table. The application of either 10 ppm—parts per million—or 20 ppm—acid equivalent—of 2,4-D in

**Influence of Treatment with 2,4-D on Yield of Shelled, Green Concentrated Fordhook Beans**

Treatment	Yield as % of untreated check
None	100
2,4-D, 10 ppm 2 weeks after emergence	136**
2,4-D, 20 ppm, 2 weeks after emergence	134*
2,4-D, 10 ppm, 4 weeks after emergence	26**

\* , \* Significantly different from no treatment at the 5% and 1% levels, respectively.

the form of an emulsion of the ester in water two weeks after the emergence of the seedlings resulted in approximately a 35% increase in the yield of shelled green beans. There were more pods per plant and the size of individual beans was increased. The probable physiological immaturity of the shelled beans at the time of harvest was demonstrated by tenderometer readings made of samples. Less pressure was required to crush the bean from treated plants. This fact indicates a less mature or more succulent condition in spite of the larger average size of the beans. An example of the difficulties is shown in the table. The application of 10 ppm of 2,4-D four weeks after emergence, resulted in a significant decrease in the yield of marketable shelled beans. The total yield was only 26% of that from the untreated control. Examination of these plants showed that

the total number of pods per plant was not affected by the 2,4-D treatment, but that at the time of harvest the pods were almost all immature with very small beans, and that the plants still had a heavy bloom, indicating a considerable delay in maturity.

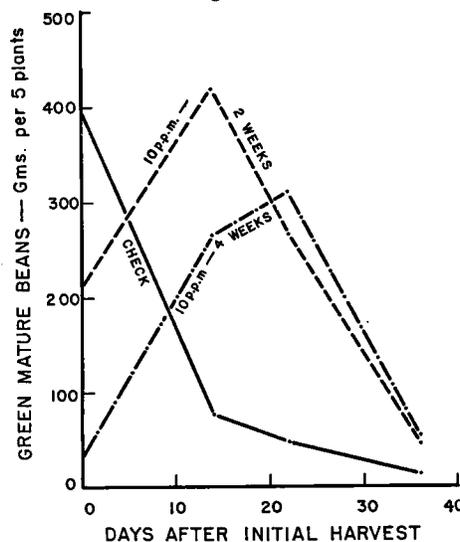
The result of the Oxnard experiment was fairly typical of the experience over the entire area. In some years, and in some locations the application of 2,4-D at 5 ppm to 20 ppm resulted in increased yields of green and dry lima beans and snap beans as great as 70%.

In other experiments the same treatments have resulted in decreases of as much as 75%, while more frequently it has been impossible to demonstrate any significant effect on yield. An example of this is another experiment on lima beans in Ventura County where 0.7 acre was sprayed with 2,4-D and the harvest from that portion of a 10-acre field handled separately. The yield from this test plot was 4,080 pounds of shelled green beans per acre while the remainder and untreated portion of the field yielded 4,072 pounds per acre.

The other compounds tested—in other plots—and used at concentrations approximately comparable in their formative effects on plants to 10–20 ppm of 2,4-D, gave occasional significant increases in yield, but more frequently showed no effect. Neither did they cause a significant decrease in yields.

Observations of treated plots indicate that when 2,4-D is applied to young seedlings in the manner used in these tests the initial effect is to nearly stop all further development for 10 to 14 days. When the plant resumes growth the new leaves are twisted and otherwise deformed, showing typical 2,4-D induced growth effects. The plants develop more slowly than untreated ones, and usually have a bushy, stunted appearance. The appearance of flowers is delayed on the treated plants, but they ultimately develop in greater abundance than on untreated plants, probably due to increased branching. This produces a larger set of pods, even in those cases where development of the green bean was incomplete at the time of harvest, resulting in a decreased yield. Later treatments and higher concentrations tended to further

**Yield of green mature Fordhook 242 lima beans from plants treated with 2,4-D two and four weeks after emergence. Initial harvest date August 26.**



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## BEANS

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delay both floral initiation and maturity of the fruit.

An example of this effect in delaying maturity may be seen in the graph on page 4. These data were taken from an experiment on Fordhook 242 lima beans near Santa Paula in which four successive harvests were made from the check and treated plots. At each harvest the beans were shelled into immature, mature and overmature beans on the basis of acceptability for freezing purposes. The line for the check indicates that the peak of maturity for these plants occurred at or just before the initial harvest, which took place on the 26th of August. At this time both 2,4-D treated groups had fewer green mature beans than the check. The peak yield of green mature beans came two weeks later in those plants treated with 10 ppm of 2,4-D two weeks after emergence, and it was not significantly greater than the check yield. An additional seven days were required for the plants—treated with 10 ppm of 2,4-D four weeks after emergence—to reach their maximum production of green mature beans.

The total production of these same three plots on a dry bean basis resulted in a 63% increase for the 10 ppm of 2,4-D applied two weeks after emergence and a 46% increase for 10 ppm of 2,4-D applied four weeks after emergence—both differences significant at the 5% level.

The variability encountered in the use of plant growth regulators to increase yield of beans can probably be attributed to many environmental factors, but observations made over several years indicate that one important factor is an adequate water supply at the end of the growing period. If the plants become deficient in water near the time when the

fruit are normally maturing, the treated plants—delayed in maturation—are prevented from reaching their maximum size and weight. This results either in no effect on yield, or an actual decrease in spite of the larger number of pods produced. This fact was verified in experiments conducted in fields where beans were grown without irrigation during the growing season.

Under conditions of severe moisture stress in the maturing plant—brought about by periods of exceptionally warm weather and low soil moisture availability—there was usually either no effect of the hormone treatments or a reduction in yield.

Other factors which may influence the effect of growth regulators on yield are nutrient level—particularly nitrogen—and unfavorable growing conditions in the early part of the season causing a prolongation of the inactive period following the application of the growth regulator sprays.

Sprays of several growth regulators applied to pole beans in San Diego at the time of the first spring bloom resulted in as much as 58% increase in yield from the first three harvests, but at the end of the harvest period there was no longer a significant difference between the untreated and the sprayed plots. The increased early yield appeared to result from a decreased drop of flowers and small pods during a period of warm weather occurring soon after spray applications. Other treatments of the same type in this area have resulted in no effect on either the early or the total yield.

From these studies it appears possible to increase yields of dry lima beans 50% to 70% by the application of sprays of plant growth regulators in low concentrations. However, timing of the spray application and the concentration of the material used seem to be extremely critical. This is particularly true in the case

of 2,4-D, where a decimal error might result in a concentration 10 times too high that could easily kill the plants and would certainly result in a greatly reduced yield.

Both lima and common beans appear to be somewhat more tolerant of some other synthetic plant growth regulators than 2,4-D, but all of these materials require higher concentrations to achieve the same effect as induced by 2,4-D.

Because of the delayed maturity aspect and the importance of maintaining adequate soil moisture and fertility throughout the maturation period, production costs are higher. Therefore, it must be determined whether the potential increase in bean yield will be of sufficient quantity to offset increased costs. The possibility of unfavorable weather conditions or other factors either eliminating the expected increase in yield or even resulting in an actual decrease from the treatment, together with the possible harmful effects from improper application, make it appear that this treatment is not to be recommended for general use in the southern California area.

At least two materials—alpha-orthochlorophenoxypropionic acid and N-meta tolylphthalamic acid—seem to offer promise in preventing premature fruit drop in beans when applied over the blossoms. While the effectiveness of this treatment—tried in San Diego County only—appears to depend on adverse conditions bringing about drop of the untreated fruit, no evidence of an over-all decrease in yield resulting from treatments has been found.

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## MILK

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markets to the United States average before and after the advent of control.

As far as the effect of control on resale prices in California is concerned, the price spreads are compared, because the difference between farm and customer prices represents the return for distributor services. Based on existing spreads during January 1956 and on the average, the home-delivered price spreads were narrower in California than in 137 U. S. markets by 1¢ per quart, while wholesale price spreads were narrower in California than in other markets by 1.2¢ per quart, but price spreads to cover store operations were wider in California than

the average in the other 47 states by 0.3¢ per quart. Store differentials—the difference between home-delivery and store prices to consumers—are lower in California by 0.1¢ per quart. There seem to be indications that resale price control has tended to retard some innovations, such as the use of multiunit containers with lower prices, the development of volume discounts, and relatively large store differentials. These inflexibilities are also observed in many uncontrolled markets, however, and volume pricing programs are beginning to be adopted in some California markets.

The major impact of milk control has probably not been to increase prices to distributors and consumers but seems to be in terms of stability and certainty.

Farmers know they will receive payment for milk according to well-defined procedures and distributors know they are on equal grounds with their competitors.

Perhaps the most important element of stability is that the Bureau of Milk Control provides a mechanism through which orderly relationships have been maintained. The dairy industry is highly dynamic. It affects a great number of people, and it has large economic significance. Through control procedures, conflicts of interest are solved without resorting to the more violent types of controversy, such as price wars and milk strikes.

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