Effect of 2,4-D on Yield and Bushel Weight of Oats

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When 2,4-D is used as a selective herbicide in wheat, oats and barley, yields generally are increased due to the elimination of weed competition. Direct injury to the crop by the herbicides is usually small. However, severe yield reductions have occurred occasionally when 2,4-D was applied at recommended dosages during certain stages of crop growth. The yield reductions are due largely to various abnormalities in the growth of the spike which result in fewer kernels.

A number of investigators, including Andersen and Hermansen (1), Derscheid (2), Foster (4), Freisen and Olson (5), Frieseen (6), Olson, et al. (9), Shaw and Willard (10) and Slife and Fuelleman (11) have reported varying abnormalities in plant growth and yield reductions resulting from the application of 2,4-D to spring-seeded wheat, oats and barley at various stages of growth. Yield reductions resulting from 2,4-D applications are commonly associated with two critical periods in the growth of barley and wheat; (a) an early seedling period when the plants are 1 to 5 inches tall and (b) a later period extending from the early boot stage to a few days before heading. A similar though less distinct pattern has been observed in oats.

Andersen and Hermansen (1) found that the occurrence of spike abnormalities in oats, wheat and barley depended on the stage of development of the various plant parts at the time of the 2,4-D treatment. From this they concluded that the effect of the 2,4-D was on the differentiation of cells forming the first rudiments of a plant organ. Derscheid (2) working with oats and barley, showed that stage of the growth of the crop plant at the time of 2,4-D application was the most important single factor affecting subsequent injury as measured by yield of grain. He found that 2,4-D treatments to seedling barley reduced yields severely whenever the treatments were made during a period of floral initiation. The yield reductions were manifest by a reduction in numbers of tillers, spikes and seeds per spike. When floral initiation was rapid, the yield reduction was severe only at one or two dates of treatment, but when the floral initiation was slow the yield reductions were less severe at any one date of treatment. Floral initiation in the tillers occurred later than in the central culm of the plants. Thus, yield reductions were evident at several dates of 2,4-D treatment after floral initiation had occurred in the central culm. Derscheid (2) also found that yield reductions from 2,4-D spray treatments made during the second susceptible period, before and during heading, were not as clear-cut as for the earlier seedling period. He speculated that embryonic development and/or gamete differentiation was reduced the number of seeds formed.

Frieseen and Olson (5) treated barley plants in the greenhouse with 2,4-D and found two periods during which the plants were very susceptible to injury. The first period occurred during the time of floral initiation in the growing point; the second period included anther and stigma differentiation and continued through the growth stages of the flowering parts.

Staniforth (12) has shown that 2,4-D in corn at or near the time of tassel initiation strongly inhibited the development of the tassel, and that application of 2,4-D 1 to 4 days prior to silking inhibited seed set. These susceptible periods appear to be morphologically similar to those reported for small grains.

Many investigators have reported differences in the response of oat varieties to 2,4-D spray applications. Derscheid (3), Helgeson (7), and Olson (8) have summarized the results of recent investigations with spring oats. Results are not in complete agreement but such differences are evident. Minde appears rather susceptible, immediate, and Ajax somewhat resistant to immediate applications of 2,4-D.

**MATERIALS AND METHODS**

The experiments reported here were conducted during growing seasons of 1948, 1949, and 1950 at Ames, Iowa. Six varieties of oats were sprayed in the early boot stage of growth. In 1949 and 1950, six varieties were sprayed at the time of floral initiation on culms, and (b) at the early boot stage. Three formulations of 2,4-D were applied at currently recommended dosages as follows: sodium salt, 4 pounds per acre, amine ester, 1 pound per acre, and the butyl ester, 2 pounds per acre, all on an acid equivalent basis. The time of floral initiation in the center row of each variety was determined by dissection and examination of each variety. All varieties were sprayed on the center row while there were probably small differences in the degree of floral initiation, all varieties having floral initiation at the time of first treatment.

Herbicides were applied in 40 gallons of water per plot on a small power sprayer. Plots consisted of three rows, the center row harvested. Four replicates of each variety were grown in all three seasons. Yields and bushel weights obtained and are recorded in the tables as percent of check plots. The experimental design in all plots consisted of randomized block with varieties as the subplots. The plots were kept weed-free by hand cultivation during the growing season.