Sensitivity of Wheat and Barley at Different Stages of Growth to Treatment with 2,4-D

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IT HAS been recognized for some time that cereals, while resistant to 2,4-D, do suffer damage at some growth stages. The general recommendation that the chemical be applied during a period between a well advanced seedling stage (6 or more inches tall) and the boot stage (upper sheath beginning to swell with enlarging head) appears sound and seems to provide a good margin of safety. Just what the stages are that are most vulnerable during the seedling and boot stages has not been established. The object of this investigation was to establish those stages in wheat and barley, if possible, and thereby furnish a basis for more precise recommendations as to periods during which 2,4-D may be safely applied.

Review of Literature

Many workers have reported results from the application of 2,4-D to cereal crops. Most of the investigations have been concerned with formulations and rates, and have stressed those factors rather than stage of growth. An extensive piece of work involving the influence of stage of growth has been done by Andersen and Hermansen (1). They applied a sodium salt of 2,4-D (also a sodium salt of 4K-2M) to barley, oats, and wheat, twice a week to barley and once a week to wheat and oats (with variations due to weather). The rates of application were 1, 4, and 16 kg per hectare (approximately 0.9, 3.5, and 14 pounds per acre). The treatments began in April when barley and oats were in the two-leaf stage (wheat was fall sown), and continued until shortly before heading. The two workers found that wheat was least affected by treatment and that barley showed the highest number of culm abnormalities (tubular leaf, mainly) following treatment. Spike abnormalities appeared in greatest numbers following treatment applied 8 days later in barley and 17 days later in oats, when the plants had respectively 3 and 5 leaves and the height of plants was respectively about 5 and 8 inches. The dates for greatest number of abnormalities and lowest yield were identical under 2,4-D treatments. Oats and barley also showed a large decrease in yield when sprayed about a fortnight before heading. Friesen (4), Olson (10), and Friesen (7) summarized the reports of a large number of investigators. Many of these are rather difficult to coordinate and compare from the standpoint of the influence of stage of growth, because the stages employed vary widely and are variously described. A few of the workers emphasized stages of growth and compared sensitivity at various stages. Friesen (7) applied an ester, an amine, and a sodium salt in the form of aqueous spray to oats, barley, and wheat at 16 kg per acre at nine stages, beginning at pre-emergence and continuing at weekly intervals until the late boot stage.

Experimental Procedure

The plan of this investigation was to apply 2,4-D to wheat and barley at several stages of growth, beginning between seedling and emergence and continuing at short intervals until well treatments with the ester and amine. They also showed significant damage from later treatments applied during the boot and through the early heading stages. Foster (6) applied a butyl ester, a triethanolamine, and a sodium salt spray on each of 64 days during the period between May 23 and August 13 to wheat, oats, and barley. Only 2 days were missed in June and the longest interval between spray applications was 5 days. Damage to wheat and barley was most severe during the period from 13 to 20 days after emergence. Oats was reported damaged during a somewhat longer period. The damage from the ester was emphasized. Shaw, Warren, and Willard in 1948 (13) observed no significant reduction in yield of Clinton oats treated with triethanolamine and butyl ester at rates up to 1 pound acid equivalent per acre at nine stages, beginning at pre-emergence and continuing to the milk stage. Shaw and Willard (14), in 1949, applied butyl ester and triethanolamine salt to Clinton oats at rates from 1/4 to 4 pounds acid equivalent per acre at eight stages beginning with the two-leaf and continuing to the late milk stage. They obtained highly significant injury at the two-leaf stage (26 days after planting) from all rates above 1/4 pound. The least injury was recorded at the four-leaf and late milk stages.

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Shafer (12) sprayed Nemaha oats at four stages, jointing, early boot, late boot, and flowering, with an ester and sodium salt. (The type of ester and sodium salt used is not indicated.) The ester, at all rates above 1/4 pound, applied at the jointing stage reduced yields significantly. At the other stages no damage was suffered. Davidson (2) sprayed oats at three stages, three-leaf, early boot, and early heading, with sodium salt, amine, and ester formulations of 2,4-D at 2, 4, 6, and 8 ounces acid equivalent per acre. Applications made at the three-leaf stage caused the greatest reduction in yield. Practically no damage was discernible from applications made at the other stages.

Godbout (8) applied an amine and an ester to wheat, oats, and barley at the three-leaf, five-leaf, and early boot stages at 1/4-, 1/2-, and 1/4-pounds acid equivalent per acre. The ester reduced yields at all stages, but the damage was greatest where the application was made at the three-leaf stage.

Most of the literature cited reported damage to wheat, oats, and barley in early growth stages, variously described as seedling, two-leaf, and three-leaf, especially where an ester of 2,4-D was used. Several reported damage at later stages. These ranged from 12 inches in height through boot, early heading, and early post-heading stages. Many of the results from treatments at later stages were inconsistent.

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