EFFECT OF DICHLOFOP METHYL ON THE GROWTH AND DEVELOPMENT OF WHEAT, BARLEY, WILD OATS AND GREEN FOXTAIL

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"EFFECT OF DICHLOFOP METHYL ON THE GROWTH AND DEVELOPMENT OF WHEAT, BARLEY, WILD OATS AND GREEN FOXTAIL"

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ABSTRACT

Owino, Martin Geoffrey. M.Sc., The University of Manitoba, May, 1977. Effect of Dichlofop Methyl on the Growth and Development of Wheat, Barley, Wild Oats and Green Foxtail. Major Professor: E. H. Stobbe.

Field experiments were conducted to investigate the efficacy of dichlofop methyl, 2 [4-(,4-dichlorophenoxy) phenoxy] methyl propionate in controlling wild oats (Avena fatua L.) and green foxtail (Setaria viridis (L.) Beauv.) in wheat (Triticum aestivum L. 'Napayo') and barley (Hordeum vulgare L. 'Bonanza'). The effect of dichlofop methyl on the shoot and coronal root development of the four species was also investigated.

Laboratory experiments were conducted to determine the effect of dichlofop methyl on cell division and growth of coronal roots of wheat, barley and wild oats.

Adequate control of both wild oats and green foxtail with dichlofop methyl at the rates of 0.8-1.4 kg/ha at the 2-4 leaf stage of wild oats resulted in increased barley yields. Control of both weeds at the 5-6 leaf stage of wild oats, required rates higher than 1.1 kg/ha of dichlofop methyl, which caused injury to barley resulting in lower yield increases.

In wheat, satisfactory control of both wild oats and green foxtail with dichlofop methyl at the rate of 1.1 kg/ha at the 2-3 leaf stage

of wild oats gave greater yield increases than similar control at the 3-4 leaf stage or 5-6 leaf stage. Control of wild oats required at least 1.1 kg/ha of dichlofop methyl, while green foxtail was adequately controlled with 0.8 kg/ha of the herbicide.

Dichlofop methyl at the rate of 0.8 kg/ha with surfactant gave satisfactory control of both wild oats and green foxtail. Under the same infestation of both weeds, the rate of 1.1 kg/ha of dichlofop methyl was required to give similar control.

When dichlofop methyl was tank-mixed with MCPA, for controlling both grassy and broadleaf weeds, there was an antagonism which resulted in inadequate control of wild oats. The combination of dichlofop methyl with bromoxynil gave excellent control of both wild oats, green foxtail and broadleaf weeds.

The optimum spray volume was found to be 116 l/ha for purposes of controlling both wild oats and green foxtail with dichlofop methyl. The growth of coronal roots of wheat, barley, wild oats and green foxtail was more sensitive to soil applied dichlofop methyl than foliar application. Wheat outgrew the effects of dichlofop methyl at rates as high as 2.0 kg/ha.

Dichlofop methyl reduced the number of green foxtail seeds per square meter, and seeds per plant head. Wild oat seeds per panicle were not reduced. The coronal root mitotic index of wheat, barley and wild oats was severely reduced by short duration treatment with dichlofop methyl. Wheat showed partial recovery from the effects of dichlofop methyl.

The concentration of dichlofop methyl accumulated in the plant

was the major factor affecting the sensitivity of both cell division and cell elongation of coronal roots in wheat, barley and wild oats.

INTRODUCTION

Competition from wild oats and green foxtail cause reduced yields of wheat and barley. Fifty-four wild oat plants and 400 green foxtail plants per square meter have been considered a moderate infestation, but as few as 12 wild oat plants and 200 green foxtail plants per square meter can cause significant yield losses of wheat and barley (Friesen, 1965; Bowden and Friesen, 1967; Sturko, 1977). It has been estimated that 17.5 million hectares of grain crops in Western Canada are infested with wild oats, and 75% of that has a moderate or heavy infestation (Alex, 1966).

Dichlofop methyl became commercially available in 1976, and was found to be the only postemergent herbicide that could control both wild oats and green foxtail by killing them directly. Dichlofop methyl has given effective control of both wild oats and green foxtail from the one to six leaf stage of growth.

Dichlofop methyl at herbicidal rates has caused variable contact leaf burn to wheat, but has shown phytotoxic effects on barley, especially in the late stages of barley growth. Application of dichlofop methyl at relatively low rates in the early stages of growth of both wheat and barley may cause less injury to both corps and give effective control of wild oats and green foxtail.

Field experiments were conducted to determine the factors affecting

the activity of dichlofop methyl in wheat, barley, wild oats and green foxtail. The factors investigated included, time of application of dichlofop methyl, the rate, surfactants, broadleaf herbicides, spray volume and nozzle angle.

Laboratory experiments were conducted to determine the effect of dichlofop methyl on coronal root cell division, root growth and development in wheat, barley and wild oats.

LITERATURE REVIEW

Competition

Research has been carried out to determine the density of wild oats and green foxtail plants that will reduce crop yields. In all cases wheat and barley yields declined drastically as wild oats and green foxtail densities increased (Friesen and Shebeski, 1960; Bowden and Friesen, 1967; Bell and Nalewaja, 1968; Friesen, 1973; Sturko, 1977).

Friesen and Shebeski (1960) found that 12-48 wild oat plants per square meter will reduce yields in a grain field. In the same study they found that at a level of 60 wild oat plants per square meter, yield depressions occurred in 89% of the fields tested. They also found that 350-400 green foxtail plants per square meter caused yield reduction of wheat.

Friesen (1965) found that barley competition with green foxtail resulted in loss of vigor and a reduction in height of the foxtail and that densities as high as 400 green foxtail plants per square meter were required to cause yield reductions.

Bowden and Friesen (1967) found in their experiments that wheat yields were reduced by as few as 12 wild oat plants per sqare meter under low fertility. In the same experiments, no reduction in wheat yields occurred with wild oat densities less than 70 plants per square

meter, under low fertility one year later. They also found that wild oats influence wheat growth very early. Yield reductions had occurred in wheat before wild oats were removed as early as the two leaf stage. They found that once wild oats reached a density of 120 plants per square meter, fertilized or non-fertilized wheat yielded equally. The wild oat populations appeared to reduce utilization of fertilizer by the crop.

Bell and Nalewaja (1968) found that at two different locations in North Dakota, yield reductions varied under the same wild oat densities. They found that yields of wheat under fertile conditions were reduced to a greater extent than under non-fertile conditions and concluded that wild oats prevented the crop from fully utilizing the fertilizer. They suggested that the exact density of wild oats that cause yield reductions of economic importance is dependent upon the environment.

Friesen (1973) found that crops varied in their competitive ability with wild oats. In his experiments, barley was found to be more tolerant to wild oat competition than wheat. At a wild oat density of 180 plants per square meter barley yield was reduced by 33% and wheat yields by 48%.

Sturko (1977) found that 100 green foxtail plants per square meter caused reductions of late seeded spring wheat. One hundred to two hundred green foxtail plants per square meter caused yield reductions of early seeded semi-dwarf spring wheat. He also found that 400-800 green foxtail plants per square meter reduced the yield of early seeded normal height wheat. He concluded that both time

of seeding and the type of wheat influenced the competitive ability of the crop with green foxtail.

Dichlofop methyl

Dichlofop methyl was first field tested in Western Canada in 1973 (Chow, 1973; Sexsmith, 1973; Stobbe and Nelson, 1973; Friesen, 1974). Adequate control of wild oats and green foxtail has been achieved with 1.12 kg/ha of dichlofop methyl applied at the 2-4 leaf stage of both weeds (Chow, 1973; Miller and Nalewaja, 1974; Behrens et al., 1974; Friesen, 1975; Todd and Stobbe, 1974; Delage, 1975). Miller and Nalewaja (1974) and Chow (1974) have indicated that the growth stage of wild oats and green foxtail at the time of application of dichlofop methyl is important. The optimum stage of application when both wild oats and green foxtail were most sensitive was at the 2-4 leaf stage.

Miller and Nalewaja (1974) and Behrens et al. (1974) indicated that at 5-6 leaf stage of both weeds, fewer plants were killed by the same rate of dichlofop methyl. At the 2-4 leaf stage of wild oats, 1.12 kg/ha of dichlofop methyl gave excellent control of wild oats and green foxtail, but 1.68 kg/ha was required to give the same control at 5-6 leaf stage of wild oats.

Miller and Nalewaja (1974) also found that this high rate of dichlofop methyl causes contact injury to wheat. Grain yield increases due to control of wild oats and green foxtail with dichlofop methyl were higher at the 2-4 leaf stage of application than at 5-6 leaf stage. Todd and Stobbe (1974) similarly found that the higher rate of 1.68 kg/ha of dichlofop methyl required to control both weeds beyond the

five leaf stage caused contact damage to wheat. Yield increases due to control of wild oats and green foxtail at the five leaf stage were lower than those at the 2-4 leaf stage of application.

Chow (1974) tested rates that range from 0.84 to 2.24 kg/ha of dichlofop methyl and found no significant reduction in grain yield of wheat at the higher rate applied at 3-4 leaf stage of the crop. He obtained excellent control of green foxtail with 0.84 kg/ha of dichlofop methyl applied at the 2-4 leaf stage of foxtail. The same level of control of wild oats was achieved with 1.12 kg/ha of the herbicide at the same stage of application. He concluded that green foxtail was more sensitive to dichlofop methyl than wild oats and that because of the occurrence of both weeds, at least 1.12 kg/ha of the herbicide was required at the 2-4 leaf stage of wild oats.

Behrens et al. (1974) found that 0.84 kg/ha of dichlofop methyl applied at the 2-4 leaf stage of barley caused foliar injury to the crop. The grain yield of barley was not different from the non-treated plots. At 1.12 kg/ha of dichlofop methyl applied at 2-4 leaf stage there was a yield reduction. They indicated that barley was more susceptible to dichlofop methyl than wheat.

Todd and Stobbe (1974) found that barley was more sensitive to dichlofop methyl applied at the five leaf stage than at the 2-4 leaf stage of the crop. Todd and Stobbe (1974), Friesen et al. (1974) and Putman et al. (1974) have indicated that dichlofop methyl at 2.24 kg/ha applied pre-planting and soil incorporated gave some control of wild oats and good control of green foxtail, which was inadequate for commercial use. While this evidence pointed to both foliar and

soil activity of dichlofop methyl, soil surface application without incorporation into the soil gave no control of both weeds.

Sexsmith (1973) found that 1.5 kg/ha of dichlofop methyl applied at 2-4 leaf stage of wild oats gave satisfactory control, but 2.24 kg/ha of the herbicide when applied pre-plant and soil incorporated did not give adequate control. He also found that roots of wild oats were severely pruned although this did not interfere with seed setting of the wild oats.

O'Sullivan and Vanden Born (1975) tested rates that range from 1.12 to 5.60 kg/ha of dichlofop methyl applied at the 3-leaf stage of wheat and barley. They found that 1.68 kg/ha of the herbicide caused a reduction of barley height and dry weight. There was also a delay in maturity of barley. The same extent of damage to wheat required 2.24 kg/ha of dichlofop methyl. They concluded that barley was more sensitive to the herbicide than wheat at the 3-leaf stage of application.

O'Sullivan and Vanden Born (1975) also found in other experiments that damage to barley could be reduced when a rate of 0.7 kg/ha of dichlofop methyl to which had been added 0.5% of the surfactant Rennex 36, and applied at the 3-4 leaf stage of the crop. The same rate of the herbicide also gave adequate control of wild oats and green foxtail when applied at the same leaf stage.

Friesen (1975) found that there was no difference in control of wild oats and green foxtail when spray volume was increased from 60-150 l/ha with 1.0-1.5 kg/ha of dichlofop methyl. Although there was good control of both weeds, barley yields were not increased, indicating that damage to the crop had occurred.