HERBICIDE RATES, APPLICATION PARAMETERS AND EFFICACY

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Introduction

Herbicides continue to be a major expenditure in crop production. In 2003, Saskatchewan producers spent over 600 million dollars on pesticides, the bulk of which are herbicides. Fertilizer is the only cash input that exceeds pesticide expenditures.

Reducing herbicide rates are of interest to growers as they look at ways to reduce input costs. However, reducing rates also increases the risk of product failure and eliminates the company's responsibility for product performance.

Many factors interact to influence the efficacy of herbicides. Factors such as water quality, carrier volume, weed growth stage, weed susceptibility and environmental factors influence the efficacy of low rates of several herbicides. This paper reviews research on herbicide rates and discusses the interaction of low-drift nozzles with herbicide efficacy.

Do Producers Reduce In-Crop Herbicide Rates?

Weed survey questionnaires conducted in Alberta by Thomas et al. (2002) indicates that 38% of the area surveyed received in-crop herbicides at lower than recommended rates. Generally, it appears that growers are more willing to reduce rates in the more humid areas of Alberta, reflecting the better growing conditions and less likelihood of product failure.

Reducing Wild Oat Herbicide Rates

Research work done at the Scott Research Farm and the Crop Development Center in the mid-1990's investigated the impact of rate of a number of graminicides on wild oat control and economic return (Holm et al. 2000). A reduced rate of Achieve, Triumph Plus, and Assert (2/3 the label rate) resulted in the highest economic returns at Scott when wild oat population was low. At Saskatoon, where wild oat populations were high, best returns were achieved when the herbicides were applied at the label rate. Net returns from reduced rates of Horizon were not affected until rates were dropped to 1/3 of the label rate. Application timing according to wild oat leaf stage was as influential as rate, with early application providing more consistent control, particularly for Achieve and Assert. In these studies, there were no broadleaf tank-mix partners so there was no potential for antagonism. Some registered broadleaf tank-mixes can reduce the efficacy of wild oat herbicides, so growers should be cautious of reducing rates when tank-mixes are applied.

Kirkland et al. (2001) investigated the effect of reduced herbicide rate on the efficacy of Everest. Reducing the rate to 2/3 the label resulted in 32% higher wild oat biomass compared to the full rate, however, there was no detrimental effect on crop yield (Fig. 1).

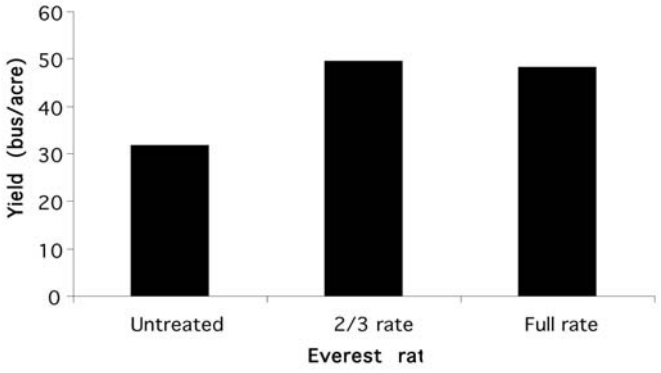

Fig. 1: Effect of Everest rate on spring wheat yield. Data adapted from Kirkland et al. (2001). Studies were conducted at the Scott Research Farm from 1996-1999.

Reducing herbicide rates may be of less risk in competitive crops. Kirkland et al. (2000) reported that lentil yield and net returns decreased by 11% and 46% as herbicide rate was reduced by 25 and 50%, respectively; however, reduced herbicide rates did not affect net returns for competitive wheat and barley crops.

Application parameters such as water volume and water quality can have an impact on herbicide efficacy. Reducing water volume below 5 gallons per acre resulted in reduced wild oat control with Achieve (Stevenson et al. 2000). In addition, evening application was superior to morning application since the "dim" herbicides can be sensitive to ultraviolet light. High bicarbonate levels in the spray water also had a negative effect on Achieve efficacy.

Interactive Effects of Spray Quality, Air Induction, and Herbicide Mode of Action

Wolf et al. (2003) conducted studies across the Prairies to investigate the interaction of spray quality (medium, coarse, and very coarse), air induction, and herbicide mode of action. A total of sixteen active ingredients were applied alone or in tank mixes at 2 rates (full and ? or ? rate). Sprays were applied with six different nozzles: three were air-induced and the other three were a conventional or pre-orifice design. A total of 266 studies were conducted. Herbicide rate was found to be the most important determinant of weed control, having significant effects in 49% of cases. Of this, rate had the most effect on grass weed control (63%) compared to broadleaf weed control (44%). Herbicide groups 1, 8, and 9 were most sensitive to changes in rate for grass weeds, while groups 4, 9, and 22 were most sensitive for broadleaf weeds. Spray quality had a significant effect on weed control 21% of the time, with most of the effects evident on grass weeds. Groups 1, 9, and 10 were most sensitive to spray quality for grasses while Groups 6 and 9 were most sensitive to broadleaves. In other words, grass weed herbicides such as Horizon, Achieve, Select, and Puma Super and contact broadleaf herbicides such as Buctril-M were more sensitive to coarse sprays. On grassy weeds, Group 2 products were generally less affected by low-drift sprays compared to Group 1 products (Fig. 2).

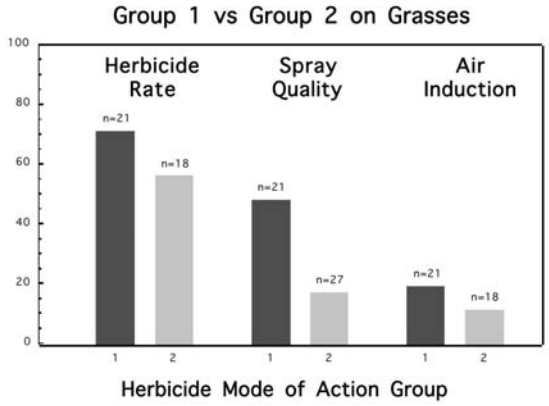

Fig. 2: Frequency of reduced efficacy effects from herbicide rate, spray quality, and air induction with Group1 and Group 2 graminicides (from Wolf et al. 2003).

Preliminary results from an experiment conducted at the Scott Research Farm in 2003 indicate that concerns over efficacy from coarse sprays may be overcome by early application. When herbicides were applied early (7 days after emergence) with a coarse spray, yields of canola, barley, and flax were not significantly different than a medium or fine spray quality, and were significantly higher than a medium or fine spray applied late (17 days after emergence) (Fig. 3). Low-drift nozzles may provide growers with more flexibility in application timing since they can be used in slightly windier conditions.

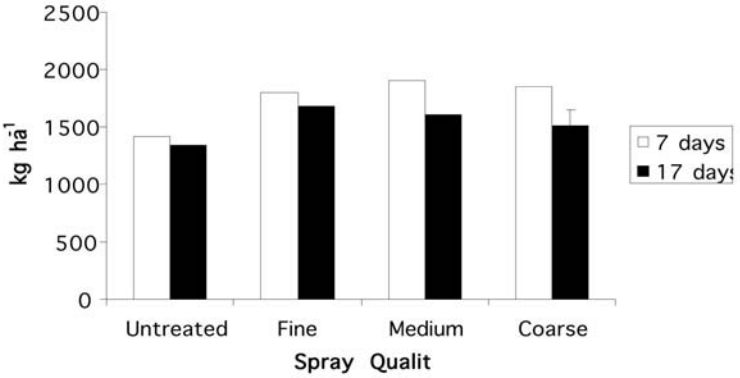

Fig. 3: Interaction of spray quality with timing of herbicide application on crop yield (mean of barley, canola, and flax). Bar represents the LSD0.05 for the nozzle type X timing interaction. Scott Research Farm. 2003.

The importance of application timing cannot be overstressed in order to maximize yield benefits from herbicide application. In a Saskatchewan study, benefits of early weed removal in field pea was observed in 7 of 14 site-years, with no yield penalty observed with early applications in the remaining site years (May et al. 2003).

To summarize, when considering a reduced rate, growers need to consider application timing, crop competitiveness, potential for antagonism from tank-mix partners, growing conditions, and expectation of acceptable weed control. New spray nozzle technologies can provide acceptable levels of herbicide efficacy while reducing the potential for drift to non-target organisms.

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