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

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Background

Low-drift nozzles that emit coarser sprays have become widely available and are very popular with applicators across Canada. Air-induction nozzles use venturis to draw air into the spray, increasing coarseness but also changing droplet behaviour on impaction. Concerns about weed control with larger droplets, particularly on grassy weeds, have raised questions about the use of such sprays in some situations. Applicators require information on whether coarse sprays are appropriate in specific weed control situations. The need for air-induction must also be objectively assessed.

Objectives

1. Study relationships between weed species and application method on weed control effectiveness;
2. Identify opportunities for increasing weed control stability.

Materials and Methods

Nozzles:

Sprays were applied with six different nozzles. Three were air-induced (Air Bubble Jet, Greenleaf TurboDrop XL, and Delavan Raindrop Ultra), and three were of conventional or pre-orifice design (Wilger ComboJet ER, Delavan RF, and Wilger ComboJet DR). Within each group, nozzles produced approximately medium, coarse, and very coarse spray qualities. Conventional nozzles were of the 02 flow rate and were operated at about 40 psi. Air-induced nozzles were of the 015 flow rate, and operated at about 60 psi. Nozzles were calibrated and pressures adjusted so all nozzles had the same flow rates. Thus, travel speed could be kept constant.

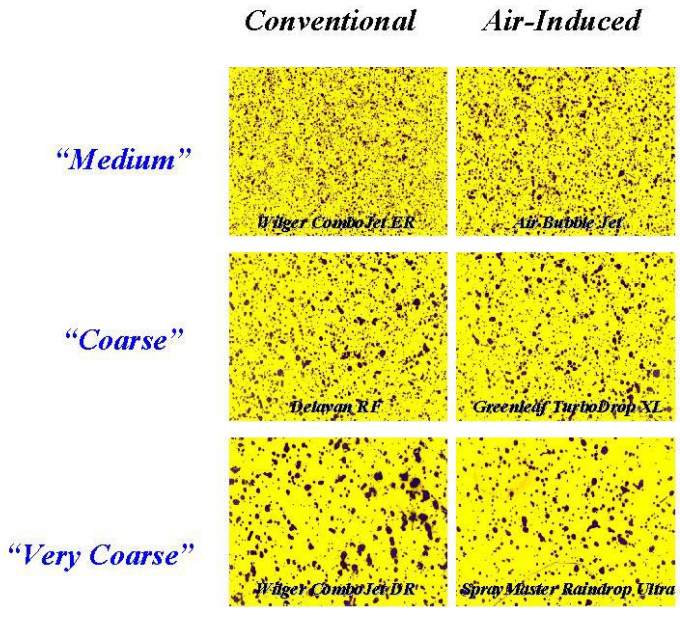

Figure 1: Spray qualities used in experiments

Experiments were conducted at the U of S Kernen farm near Saskatoon, SK, the AAFRD farm at Ellerslie, AB, and the U of M farm at Carman, MB. Three years of study were completed at each site (2000 to 2002).

Herbicides and Weeds:
A total of 16 herbicide active ingredients representing herbicide mode of action groups 1, 2, 4, 6, 8, 9, 10, and 22 were applied alone or in tank mixes at 2 rates (1x and 0.5x or 0.75x. Applications were done in 100 L/ha carrier at the recommended weed stage.

The main grassy weeds analyzed were wild oat (*avena fatua*), green foxtail (*setaria viridis*), and barnyardgrass (*echinochloa crusgalli*). The main broadleaf weeds were wild mustard (*sinapsis arvensis*), wild buckwheat (*polygonum convolvulus*), redroot pigweed (*amaranthus retroflexus*), green smartweed (*polygonum persicaria*), cleavers (*galium aparine*), chickweed (*stellaria media*), hempnettle (*galeopsis tetrahit*), lambsquarters (*chenopodium album*), dandelion (*taraxacum officinale*), and Canada thistle (*cirsium arvense*).

Table 1: Herbicide products used in experiments

Product	***Active Ingredient***	***Mode of Action Groups***	***Crop***	***Product Rates***
Horizon & DyVel tank mix	clodinafop-propargyl, dicamba, MCPAK	1 and 4	Wheat	**Horizon:** 0.238 L/ha & 0.119 L/ha; **Dyvel:** 1.25 L/ha & 0.63 L/ha**; Score:** 0.8 % v/v
Freedom Gold	quizalofop, thifensulfuron	1 and 2	"Clearfield " canola	**Freedom:** 20 g/ha & 10 g/ha; **Assure II:** 0.5 L/ha & 0.25 L/ha; **Sure-Mix:** 0.8% v/v
Sundance	sulfosulfuron	2	Wheat	**pH Adjuster (7% ammonia):** 0.25% v/v (1 L / 400 L); **Sundance:** 28 g/ha & 21 g/ha; **Merge:** 0.5% v/v
Everest & Buctril M tank mix	flucarbazone sodium, bromoxynil, MCPA	2, 4, and 6	Wheat	**Everest:** 43 g/ha & 32 g/ha); **Buctril M:** 1 L/ha & 0.75 L/ha; **Agral 90:** 0.25% v/v
Accord (SK & AB)	quizalofop	4	Canola	**Accord:** 150 g/ha & 113 g/ha; **Merge:** 1% v/v
Odyssey (MB)	imazamox, imazethapyr	2	Canola	**Odyssey:** 42 g/ha & 32 g/ha; **Merge:** 0.5% v/v
Avenge & Pardner tank mix	difenzoquat, bromoxynil	6 and 8	Wheat	**Avenge:** 4.25 L/ha & 3.19 L/ha; **Pardner:** 1 L/ha and 0.75 L/ha
Roundup pre-seed, Rustler chem-fallow	glyphosate, glyphosate & dicamba	9 9 and 4	Stubble	**Roundup (1st application):** 1.25 L/ha & 0.625 L/ha; **Rustler (2nd & 3rd applic.):** 2.5 L/ha & 1.25 L/ha
Liberty	glufosinate-ammonium	10	Canola	3.38 L/ha & 2.53 L/ha
Reglone Pro	diquat	22	Lentils or peas	2 L/ha & 1 L/ha; water volume 100 L/ha & 200 L/ha

Analysis
ANOVA was conducted on weed control for each weed/herbicide combination at each site, each year (90 site-years). A total of 266 ANOVAs were summarized (73 on grassy weeds, 193 for broadleaf weeds). The frequency of statistically significant effects (p=0.05) for each weed type and herbicide mode of action was calculated for all site-years. A total of 798 statistical effects were analyzed. In this type of

analysis, herbicides which provided more consistent results were also more likely to show significant effects.

Results

Herbicide Rate

Herbicide rate was the most important determinant of weed control, having significant effects in 49% of cases (63% for grasses, 44% for broadleaves). Groups 1, 8, & 9 were most sensitive to changes in rate for grasses, and group 4, 9, & 22 were most sensitive for broadleaves.

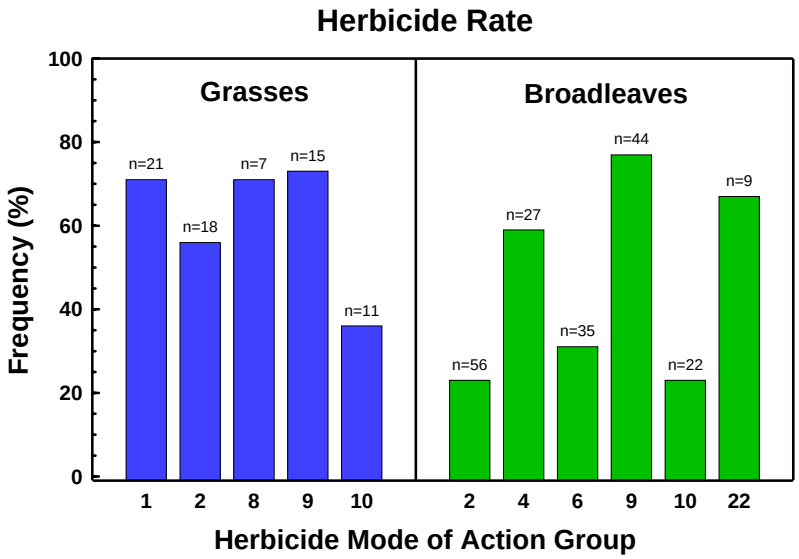

Figure 2: Frequency of herbicide rate effects for several modes of action.

Spray Quality

Spray Quality had a significant effect on weed control 21% of the time (34% and 17% for grasses and broadleaf weeds, respectively). Groups 1, 9, & 10 were most sensitive to spray quality for grasses, whereas Groups 6 & 9 were most sensitive for broadleaves.

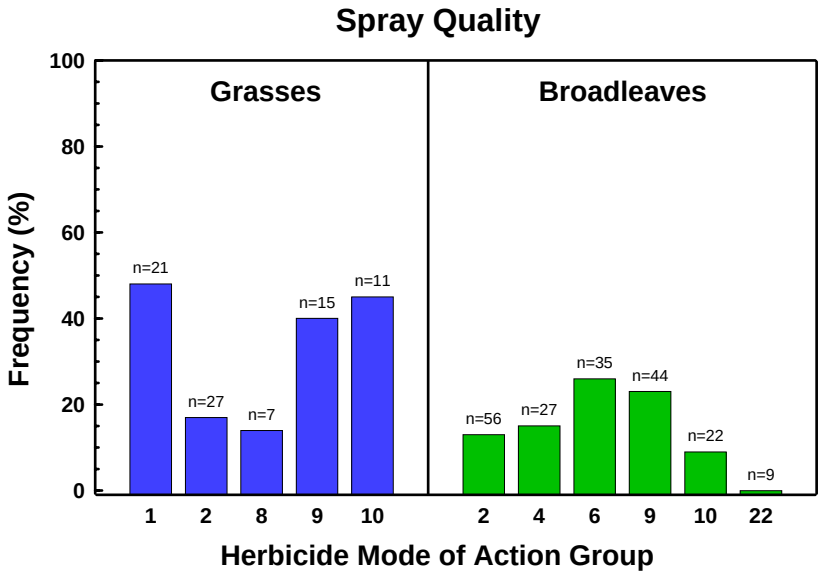

Figure 3: Frequency of spray quality effects for several modes of action.

Air Induction

Air induction had relatively minor effects, being significant in only 15% of cases for both grasses and broadleaves. Groups 2, 8, & 9 were least sensitive to air-induction on grasses, Groups 2 & 10 were least affected for broadleaves.

Air-induction may provide a benefit on weeds that are difficult-to-wet, as these appear to retain coarser droplets containing air more easily than conventional droplets of equal size.

Grassy Weed Control

On grasses, Group 2 products were less sensitive to herbicide rate, spray quality, and air-induction than Group 1 products. Group 2 products appear better suited than Group 1 products for the use of low-drift sprays.

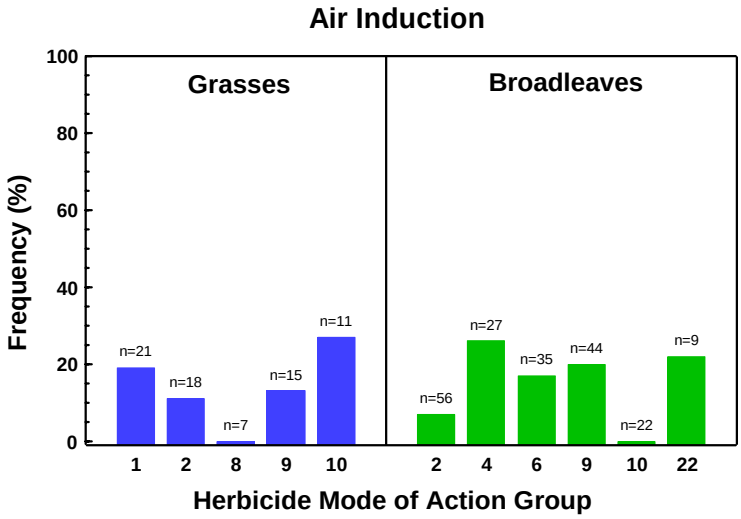

Figure 4: Frequency of air-induction effects for several modes of action.

Conclusions

1. Herbicide rate affected weed control more frequently than spray quality;
2. Grassy weeds were more sensitive to application method than broadleaf weeds;
3. Group 1 and Group 9 products were most sensitive to application method, Group 2 products were least sensitive for both grassy and broadleaf weed control.

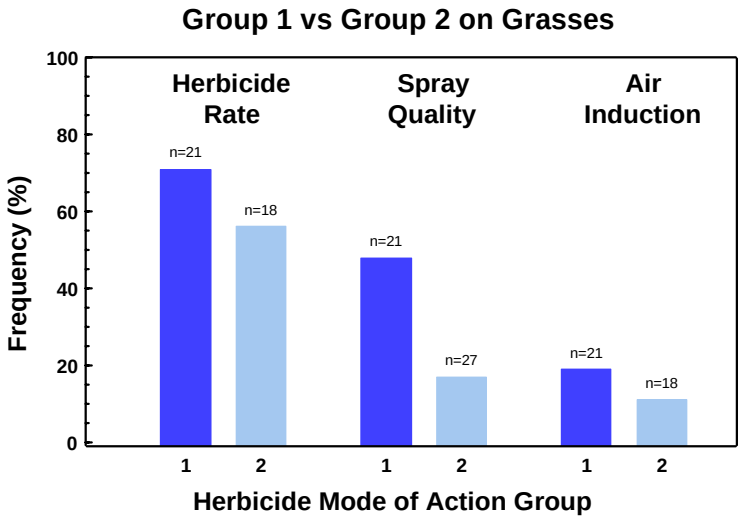

Figure 5: Frequency of application effects for Groups 1 and 2 on grassy weed control.

Acknowledgements

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