EVALUATION AND COMPARISON OF SPINNING DISC (CDA) AND LOW PRESSURE (LP) NOZZLES WITH CONVENTIONAL FLAT FAN NOZZLES

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INTRODUCTION:

Although current high pressure nozzle systems do an adequate job of applying herbicides in a safe and cost efficient manner, there is room for improvement. In applying post-emergent herbicides the objective is to provide an even application of chemical to the leaf surface while minimizing the loss of chemical due to drifting and runoff from the plant surface. A modified nozzle, the low pressure nozzle and a radical new nozzle design, the spinning disc, offer potential advantages.

Currently used hydraulic nozzles produce a large range of droplet sizes. With herbicides the small droplets are lost due to the effects of drift and evaporation while the large droplets tend to merge and run off the plant.

The low pressure nozzle (LP), a modified hydraulic nozzle, is now being marketed in an attempt to reduce chemical drift. By operating at reduced pressures the LP nozzle produces larger, less drift sensitive droplets than standard hydraulic nozzles. Although a range of droplet sizes are produced the average droplet size is larger. The efficacy of some herbicides when applied through these LP nozzles is in question however, since the larger droplet size may reduce the amount and distribution of herbicide remaining on the plant surface.

The spinning disc (rotary atomizer or controlled droplet applicator) is a radical new innovation in nozzle design developed in Europe. The spinning disc system employs a small electric motor which spins a cone, sending out a circular pattern of relatively uniform sized droplets. The size of the droplets produced is determined by the dimensions of the unit, the rate of liquid flow into it, and the speed of rotation of the cone. This controlled droplet size has the potential for reducing chemical drift and runoff from the plant surface and providing more even coverage of the leaf surface. As a result, the potential exists for decreasing the amount of chemical and water required per acre.

Any new nozzle system must be field tested to determine how it compares to those currently being recommended in terms of ease of operation, mechanical reliability, and efficacy of herbicides when applied through it. Over the past season, we embarked on a program with the following objectives:

1) To determine the best way of installing spinning disc nozzles on a conventional sprayer. This includes a 20 ft. sprayer and a 60 ft. sprayer.

2) To evaluate the mechanical reliability and ease of operation of the spinning disc nozzle under field conditions.

3) To compare the weed control efficacy of both the spinning disc and low pressure nozzles to that of conventional nozzles using a number of herbicides at various rates.

The results that will be presented here are the results of our first years herbicide efficacy trials with the various nozzle systems.

MATERIALS AND METHODS

Three separate experiments were conducted to evaluate selected broadleaf herbicides, Hoe-Grass, and products for chemical fallow. Each experiment was designed as a randomized complete block of six metre by six metre plots replicated three times. The effect of the following parameters on herbicide efficacy were compared.

1) Water Volume
   a) standard volume TEEJET 8002 and 8002 LP nozzles.
   b) ½ standard volume TEEJET 8001 and spinning disc.

2) Droplet size
   a) standard TEEJET 8002
   b) low pressure TEEJET 8002 LP
   c) spinning disc

3) Herbicide rates - both recommended rates and half the recommended rates of each herbicide were applied through 8001 and spinning disc nozzles.

All treatments were applied with a 20 ft. boom sprayer equipped with separate booms for low pressure, standard and spinning disc nozzle system. To evaluate the effect of water volume the standard 8002 nozzles were replaced with 8001 nozzles. For the low pressure and standard nozzles the nozzle spacing and height were set according to current recommendations. Three spinning discs were set at a height of 28 cm and spaced 1.8 meters apart. These nozzles were tilted 15^{0} backwards as recommended by the manufacturer. The centre disc had to be set back from the boom so that the pattern would not be affected by contact with the sprayer. A speed of 8 kmph was used for the application of all treatments. The spinning disc was operated at 2000 rpm. Volumes and pressures used are indicated in Tables I, II, and III.

Weed control was visually assessed using the weed control rating scale (0-9) as outlined by the Expert Committee on Weeds. Crop tolerance was rated by the standard 0-9 scale.

RESULTS AND DISCUSSION

Hoe-Grass

In the Hoe-Grass experiment wild oat and green foxtail infestations were light. Spraying was conducted at the 3-5 leaf stage of the crop at which time wild oats were in the 3-5 leaf stage and green foxtail was at the 1-2 leaf stage. A hail storm at the end of July destroyed all yield data.

Table I presents the weed control rating for wild oats, green foxtail, and overall grassy weed control. A 9 represents complete control while 0 represents no effect This is a qualitative visual rating system. Treatment number 8 (TEEJET 8001 with ½ the recommended herbicide rate) was sprayed at a date later than the rest of the treatments and beyond the desired leaf stage, resulting in a decreased level of control as indicated in Table I.

All other treatments offered excellent to complete control of wild oats and green foxtail. However, some differences in control are indicated. When half the recommended herbicide rate was used, there was an increase in the time required for the herbicide to show an effect on the weeds. For wild oat control, the standard rate of chemical applied with 8002 or 8001 nozzles gave the quickest kill. For green foxtail control the spinning disc at standard rates gave the highest early weed control rating.

Neepawa wheat showed complete tolerance to all treatments evaluated.

Broadleaf Herbicides

All treatments were applied at the cotyledon to 2 leaf stage of the broadleaf weeds at which time the crop (Neepawa wheat) was at the 3-5 leaf stage. This experiment with broadleaf herbicides included 2, 4-D, Buctril M and Glean. The efficacy of 2, 4-D was decreased by a rain two hours after it was applied and therefore this herbicide will not be included in this discussion.

Broadleaf weeds present included: wild buckwheat, green smartweed, lamb's quarters wild mustard, cow cockle, stinkweed, and knotweed, but populations were variable.

Wild buckwheat, green smartweed, and overall weed control were rated and the results are presented in Table II.

Buctril M and Glean both provided excellent or greater control of wild buckwheat and green smartweed at all rates, water volumes and nozzle types evaluated. However, some differences in control were noticeable.

The best overall control was attained with recommended rates and water volumes (TEEJET 8002 nozzles.)

A slight reduction was evident in wild buckwheat control with Buctril M when applied through 8001 or spinning disc nozzles (½ the water volume). Glean when applied through these nozzles at recommended rates showed no reduction in the final control attained. However, the data indicates that there was some reduction in the speed at which wild buckwheat was controlled with Glean when applied at recommended rates and ½ the standard water volume.

The low pressure nozzles (TEEJET 8002 LP) offered excellent early control of both wild buckwheat and green smartweed when either Buctril M or Glean was applied at recommended rates. Wild buckwheat exhibited some regrowth under the Buctril M treatment applied through the LP nozzles, indicating a slightly decreased level of control compared to standard 8002 nozzles.

When the amount of herbicide used was cut to half the recommended rate as well as half the water volume (8001 or spinning disc) the control of wild buckwheat with Buctril M was reduced.

No crop damage was associated with any of the herbicides, rates, water volumes, or methods of application.

Chemical Fallow

The experiment to assess the performance of Roundup, Roundup + Agsurf, and Sweep through the various nozzle types was conducted in the zero tillage area of our research site. The weed infestation was medium and included a wide spectrum of weeds including: dandelion, narrowleaf Hawk's beard, goat's beard, sow thistle, lamb's quarters, and Russian thistle, and wild oats. The weeds present were generally beyond the desired stage for spraying.

Roundup + Agsurf offered superior control to Roundup alone or Sweep for all methods of application evaluated (Table III). The addition of Agsurf to Roundup was more important when the rate of herbicide and volume of water was reduced.

Roundup + Agsurf offered the best control when applied through the 8001 or 8002 LP nozzles. The data indicates the poor performance of this herbicide through the spinning disc nozzle related to poor penetration into the lower 'levels' of the relatively mature weed stand. Possibly this was due to the greater interception of the herbicide by the upper layers of the canopy.

The use of half the recommended rate of Roundup and water through 8001 nozzles offered excellent weed control indicating no efficacy advantage in using the spinning disc for this particular type of application.

Sweep did not offer good overall weed control with any of the treatments or nozzles evaluated. Sweep offered the best control of Hawk's beard and dandelions when applied through either 8002 or 8002 LP nozzles. However, only the standard 8002 nozzles offered acceptable overall weed control with this product.

Any reduction in water volume as occurs with the spinning disc or 8001 nozzles resulted in a marked decrease in the efficacy of this herbicide. When half the recommended rate of herbicide was used, there seemed to be no advantage in the spinning disc over 8001 nozzles.

CONCLUSIONS

The results presented represent data collected over one growing season, and as such it is difficult to draw conclusions from it.

This year's data indicated that with the use of TEEJET 8001 or spinning disc nozzles many translocated herbicides can be applied at half the recommended rate and water volumes and still maintain a high level of weed control. However, herbicide rates are established on the basis of many years of research. Recommended rates are designed to provide excellent weed control over a wide range of environmental conditions and weed and crop situations. In the 1981 season weed pressure was low in many of the experiments at our research site. Also, environmental conditions were ideal for the activity of herbicides that require movement in the plant to produce the desired level of weed control. Thus in the past year we were able to get away with only a slight decrease in weed control when half the recommended rate of many of the herbicides was used. The fact that the 8001 nozzle provided such a high level of weed control at these half rates indicates that this wasn't a typical year.

Many slight differences in weed control attained were apparent in this data. It is likely that under less ideal conditions these differences would be increased. I hope that over the next few years the potential and problems with each of these nozzle systems will become more clear.

I think that this year's research indicates that there are differences in the way different herbicides perform through the different nozzle systems. There is need for research on each herbicide, over a number of years, before any of the new nozzles can be recommended over those currently being recommended.

TABLE I: Nozzle types, Rates of Chemical and Water, and Weed Control Ratings with Hoe-Grass

Treatment No.	Rate (kg./ha.)	Nozzle	Volume (l/ha)	Pressure (kpa)	Weed Control Rating (0-9) July 7 Wild Oats	July 7 Green Foxtail	July 7 Overall	July 27 Wild Oats	July 27 Green Foxtail	July 27 Overall
1	.7	8002	110	280	7.3	7	8	8.7	8	8.3
2	.7	8001	55	280	7.8	7.3	7.3	9	9	8.3
3	.35	8002	110	280	7	7	7	8.7	8.3	8.7
4	.7	disc	45	140	7.3	7.7	8	9	8.3	8.7
5	.35	disc	45	140	7	6.6	7.3	8	8	8
6	.7	8002 LP	110	140	7.7	7.3	7.3	9	8.7	8.7
7	check	-	-	-	0	0	0	0	0	0
*8	.35	8001	55	280	-	-	-	6.7	6.3	6.3

*Treatment 8 was sprayed 10 days after the rest - Wild oats beyond desired leaf stage.

TABLE II : Herbicides, Nozzles, Rate of Water & Chemical, and Mean Weed Control Rating for Broadleaf Weeds

Treatment No.	Herbicide	Rate (kg/ha)	Nozzle	Volume (l/ha)	Pressure (kpa)	Weed Control (0-9)					
						July 7			July 27		
						Wild Buckwheat	Green Smartweed	Overall	Wild Buckwheat	Green Smartweed	Overall
* 1	2,4-D	.35	8002	110	280	4.7	6	6	5.7	7.3	7
2	Buctril M	.56	8002	110	280	9	9	9	8.7	8.7	8.7
3	DPX4189	.02	8002	110	280	8.3	8	8	8.7	9	9
* 4	2,4-D	.35	8001	55	280	4.3	5.7	6.7	5.3	6.7	6.3
5	Buctril M	.56	8001	55	280	8.3	8.7	8.3	8	8.3	8
6	DPX4189	.02	8001	55	280	7.3	8	8	9	9	9
* 7	2,4-D	.175	8001	55	280	4.6	5.3	6.3	5.3	6	5.3
8	Buctril M	.28	8001	55	280	8	8.7	8.3	8.3	9	8.3
9	DPX4189	.01	8001	55	280	9	9	8.7	8.7	8.7	8.7
*10	2,4-D	.35	Disc	45	140	2.7	3.7	5.7	5.3	6.3	6
11	Buctril M	.56	Disc	45	140	8	8	8.3	7.7	8.3	8
12	DPX4189	.02	Disc	45	140	5.7	6.7	6.7	8.7	8.7	8.3
*13	2,4-D	.175	Disc	45	140	4	5.3	6.3	5.0	6	6
14	Buctril M	.28	Disc	45	140	7	7	7.7	8.3	9	8.3
15	DPX4189	.01	Disc	45	140	8.3	8.3	8.3	8.0	9	8.3
*16	2,4-D	.35	8002LP	110	140	5	6.3	6.7	5.7	6.3	6
17	Buctril M	.56	8002LP	110	140	8.7	8.7	8.7	7.7	8.7	8
18	DPX4189	.02	8002LP	110	140	8.7	8.7	8.7	8.7	9	8.7
19	Check	-	-	-	-	0	0	0	0	0	0

* The efficacy of 2, 4-D treatments was decreased by a rainfall two hours after its application.

TABLE III: Herbicides, Nozzles, Rate of Water and Chemical, and Mean Weed Control for Chemical Burnoff

Treatment No.	Herbicide	Rate (kg/ha)	Nozzle	Volume (l/ha)	Pressure (kpa)	Weed Control (0-9) July 7 N.L. Dandelion	Hawksbeard	Overall	July 27 N.L. Dandelion	Hawksbeard	Overa
1	glyphosate	.45	8002	110	280	7.5	9	7.5	7	3.9	7
2	glyphosate + agsurf	.45 + .5%	8002	110	280	7.5	9	8	7	7	7
3	paraquat	.54	8002	110	280	5.5	8.5	7	4.5	6	5.5
4	glyphosate	.45	8001	55	280	8.5	9	8	7.5	4.8	7.5
5	glyphosate + agsurf	.45 + .5%	8001	55	280	9	9	8.5	8	8.5	8
6	paraquat	.54	8001	55	280	3	6	4.5	4.5	5	3.2
7	glyphosate	.23	8001	55	280	7.5	4.4	6.5	6.5	8	3.9
8	glyphosate + agsurf	.23 + .5%	8001	55	280	8	9	8	8	7.5	7.5
9	paraquat	.27	8001	55	280	5	6	4.5	4.5	6	5.5
10	glyphosate	.45	disc	45	140	8.5	9	8.5	8	7.5	7.5
11	glyphosate + agsurf	.45 + .5%	disc	45	140	7	7.5	6	8	7	7.5
12	paraquat	.54	disc	45	140	4	5	4.5	5	5	5
13	glyphosate	.23	disc	45	140	5.5	6.5	5.5	6	7	7
14	glyphosate + agsurf	.23 + .5%	disc	45	140	7	8	6	8	7	7.5
15	paraquat	.27	disc	45	140	1	2.5	1	2.5	3	3
16	glyphosate	.45	8002LP	110	140	7	8.5	7.5	6.5	8.5	7.5
17	glyphosate + agsurf	.45 + .5%	8002LP	110	140	9	9	8.5	8	8.5	8
18	paraquat	.54	8002LP	110	140	5	7	4.5	6	5.5	5.5
19	check	-	-	-	-	0	0	0	0	0	0
20	check	-	-	-	-	0	0	0	0	0	0