Pesticide Rates, Water Volumes & Nozzles

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Introduction:

Low water volumes save time, and low-drift nozzles reduce drift. Can we use them together to get the best of both worlds? Probably not. Very coarse sprays provide fewer droplets than conventional sprays, and if we also use less water, we may have insufficient coverage. What is the point beyond which an applicator should not venture? This paper will report on research conducted to answer this question.

Methods:

Field and laboratory trials were conducted near Saskatoon in 2003, 2004, and 2005. Simulated grassy of broadleaf weeds were treated with Horizon (clodinafop-propargyl), Assure II (quizalofop), Puma (fenoxaprop-p-ethyl), and Everest (flucarbazone-sodium). Spray application was done with three nozzles, offering three spray qualities: TeeJet DG11003 (ASAE Medium), Delavan RF 11003 (ASAE Coarse) and Delavan RF11003 with RF11004 exit tip (ASAE Very Coarse) (Table 1).

Table 1: Treatment list for field trials

Nozzle Type	Volume (L/ha)	Capstan Duty Cycle (%)	Pressure (psi)	VMD[1] (µm)	Spray Quality
DG 11003	45	25	32	295	Medium
	85	60	36		
	125	100	36		
RF 11003	45	25	42	370	Coarse
	85	60	36		
	125	100	39		
RF 11003/04	45	25	38	510	Very Coarse
	85	60	41		
	125	100	40		

[1] **Volume Median Diameter**

Each nozzle had a nominal flow rate of 1000 mL/minute at 40 psi. Three water volumes for each nozzle were achieved through a pulse-width-modulated nozzle solenoid (Capstan Synchro). By intermittently shutting off the flow to a nozzle 15 times per second, this system made it possible to reduce the flow rate of each nozzle below its nominal value without adjusting spray pressure. Nozzles were operated at 100%, 60%, and 25% duty cycle, for application

volumes of 125, 85, and 45 L/ha. Spray pressures were near 40 psi, adjusted so that travel speed for all treatments was 10 km/h based on tip calibrations. Boom height was set to 50 cm above target height for all treatments. Applications were made when grassy weeds were at the two to four-leaf stage. Weed control was assessed through visual ratings and biomass samples.

Results and Discussion:

Horizon

Overall oat control was very good, remaining above 90% at the full label rate in all but one case. At 45 L/ha water volume, oat control was significantly lower (about 60% control) when applied in a Very Coarse spray. At 85 and 125 L/ha, there was no effect of spray quality on Horizon performance.

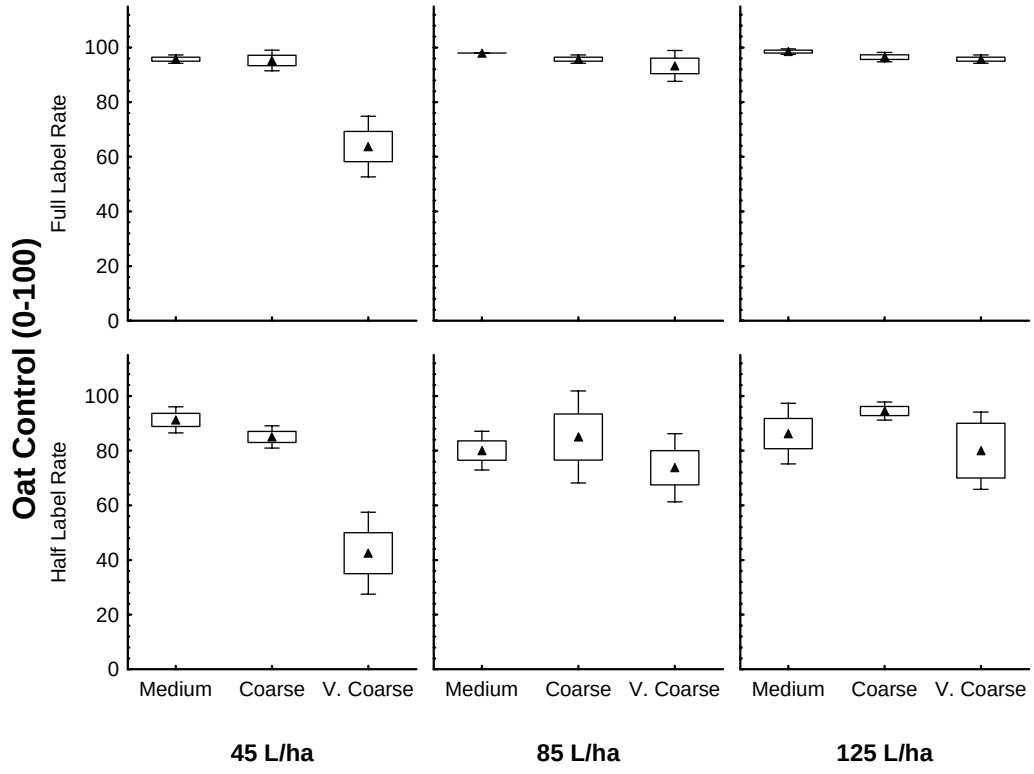

Figure 1: Interactive effect of water volume and droplet size on Horizon oat control (2005).

Oat control was reduced to about 80% when the herbicide rate was reduced to 50% of label recommendations. Weed control also became more variable at the lower rate. Similar responses to spray quality were observed as were seen at the full rate: a significant decrease in weed control with the coarsest spray at 45 L/ha, but no effect of spray quality at the higher volumes.

Assure II

Assure II was more sensitive to droplet size than Horizon. While oat control was very good at the full label rate and Medium to Coarse sprays for all water volumes, control was significantly reduced when when spray quality became Very Coarse at all water volumes. This effect was most pronounced at the lowest water volume.

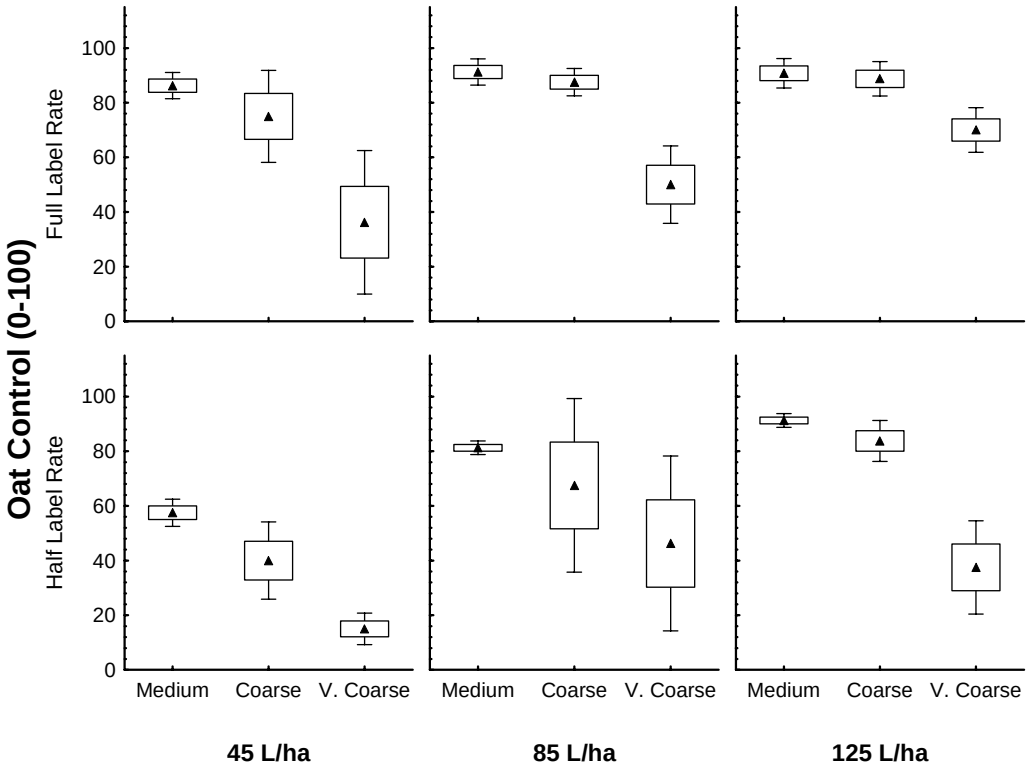

Figure 2: Interactive effect of water volume and droplet size on Assure II oat control (2005).

At the half-label rate, weed control was reduced significantly and variability in control increased. Poor control was obtained at the lower water volumes and the coarsest sprays.

Puma Super

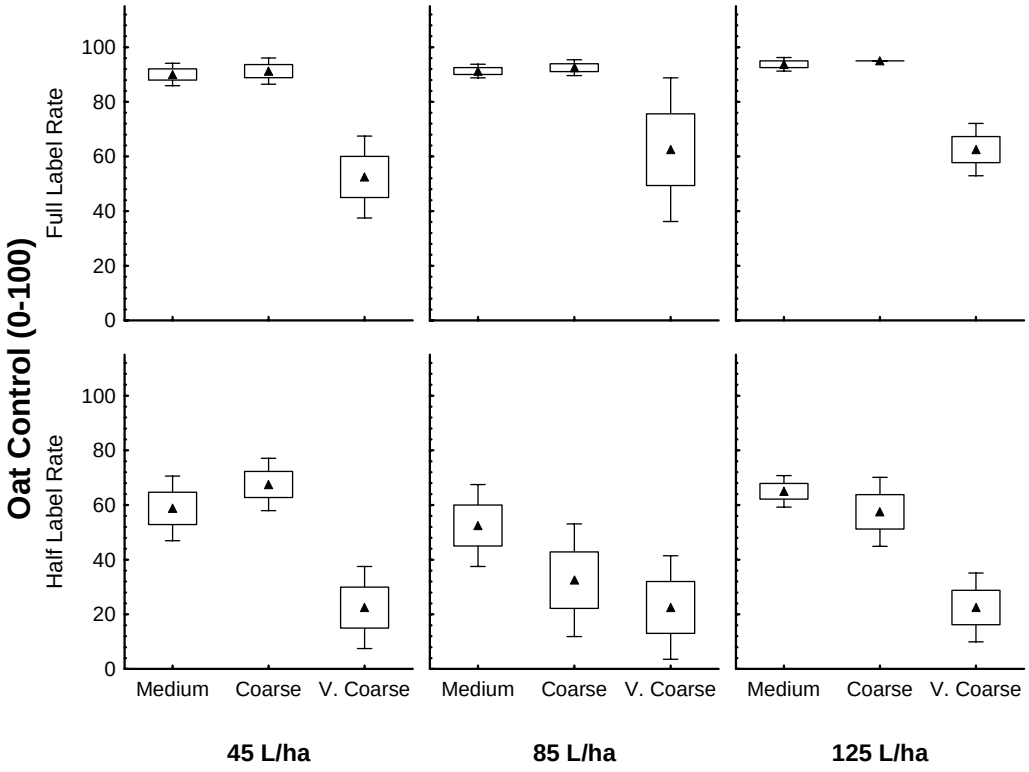

Figure 3: Interactive effect of water volume and droplet size on Puma Super oat control (2005).

Puma Super responded very similarly to Assure II: good control was maintained at Medium and Coarse spray qualities over all water volumes, but control was significantly reduced when the Very Coarse spray quality was used, even for the highest water volume. At the lower rate, overall control was lower and consistency of control was reduced, while responses to spray quality were similar to the full rate.

Everest

Everest demonstrated consistent and high oat control at all water volumes and spray qualities. There was no significant reduction in efficacy when spray quality was coarser or volumes were lower, even at the low herbicide rate. At the low rate, the consistency of control was not as great as it was at the higher rate. These results may be explained by the soil activity of Everest. Plots received a rain shower several days after spray application, permitting greater root uptake of herbicide. Unlike foliar uptake, root uptake is not dependent on spray quality.

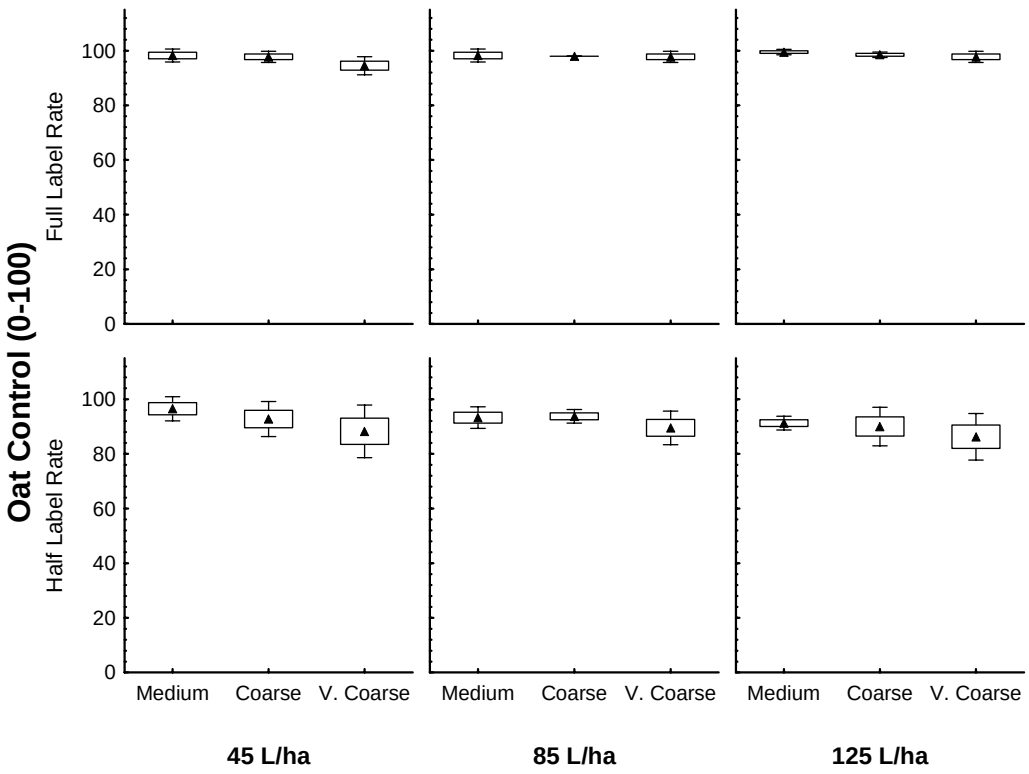

Figure 4: Interactive effect of water volume and droplet size on Everest oat control (2005).

Explanations for loss of herbicide performance on grassy weeds at low volumes and large droplet sizes focus on the following major factors.

- Grasses are difficult-to-wet and do not retain large droplets as well as they retain smaller droplets. Easy-to-wet broadleaf weeds are not affected by droplet size in this way.
- Vertically oriented plants or structures (grasses, stems) tend not to intercept larger droplets as efficiently as horizontally oriented structures (dicot leaves, cotyledons).
- Even systemic herbicides require a minimum amount of spray coverage (droplets per square centimetre) to be effective.
- Increased water volume is an effective way to maximize Group 1 herbicide performance, usually increasing consistency and reducing the effect of spray quality. Conversely, low volumes require finer sprays.
- Soil active products are less sensitive to all of these variables.

Coverage

Analysis of coverage on water-sensitive paper showed that the number of droplets per square centimetre decreased when water volumes were decreased or droplet size was increased. Combining low volumes with coarse sprays resulted in the largest droplet density reduction.

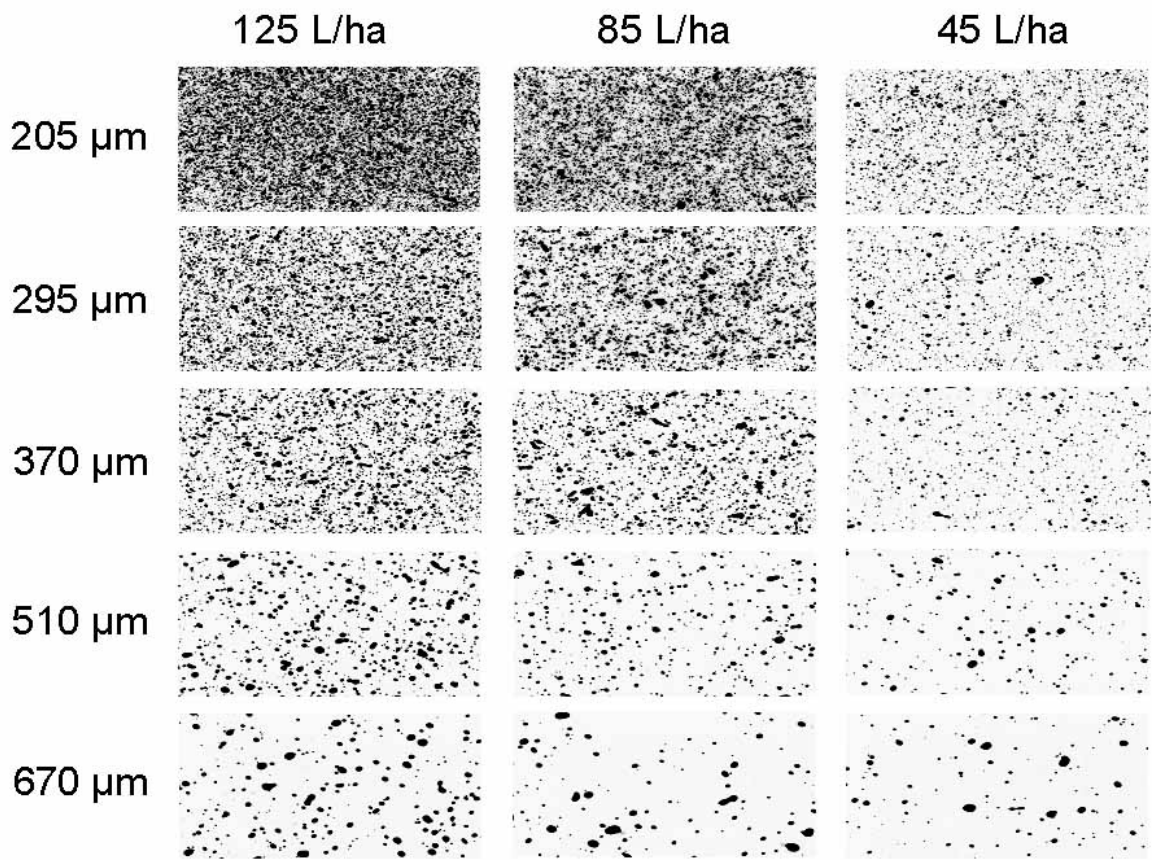

Figure 5: Effect of water volume and droplet size on spray coverage on water-sensitive paper.

Recommendations:

- Low-drift sprays are an effective tool for reducing off-target drift and widening windows of opportunity for spraying in more marginal conditions. However, they must be used cautiously with low water volumes and grassy weeds
- It is not recommended that grassy herbicides be applied below 50 L/ha.
- At low volumes, Medium sprays or finer should be used.
- At 85 L/ha or higher, Coarse sprays can be used.
- Very Coarse sprays should be avoided with Group 1 products.

Acknowledgements:

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