

# Pesticide Rates, Water Volumes & Nozzles

Tom Wolf and Brian Caldwell  
Agriculture and Agri-Food Canada, Saskatoon, SK

## Introduction

Low water volumes save time, and low-drift nozzles reduce drift. But can we use them together to get the best of both worlds? To help answer this question, let's look at the basics first: If we keep water volume constant, then the coarser the spray, the fewer the number of droplets it will contain. If we keep droplet size constant, the less water we apply, the fewer the number of droplets. If we combine an increase in droplet size with a decrease in water volume, we may have insufficient coverage. But there is some room for movement before disaster strikes, so the challenge is to provide information on how far the system can be pushed. 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. Tame oats 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). These sprays were not air-induced.

**Table 1:** Treatment list for field trials

Nozzle Type	Volume (L/ha)	Capstan Duty Cycle (%)	Pressure (psi)	VMD <sup>1</sup> (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		

### <sup>1</sup> Volume Median Diameter

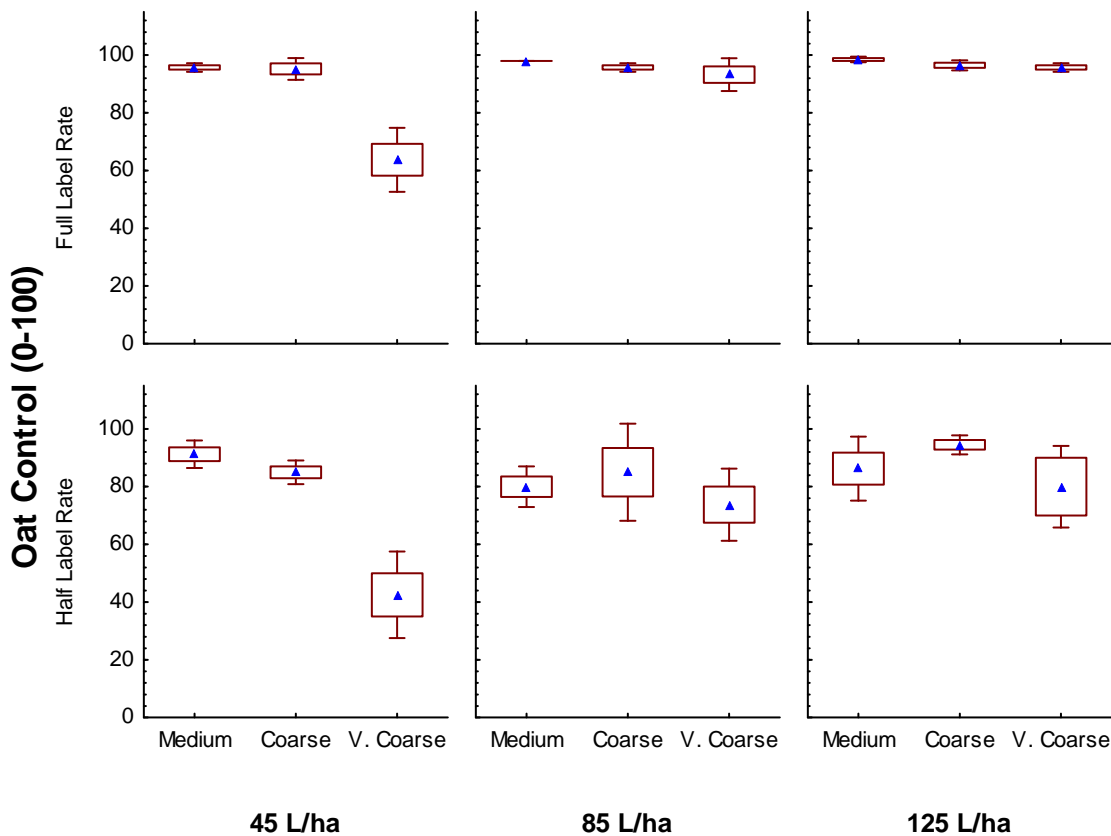
Each nozzle had a nominal flow rate of 1000 mL/minute at 40 psi. Three water volumes for each nozzle were achieved through a pulse-width-modulated nozzle solenoid (Capstan Synchro). By intermittently shutting off the flow to a nozzle 15 times per second, this system made it possible to reduce the flow 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 were consistent within the three years of testing, therefore only one year's data are represented.

## 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.

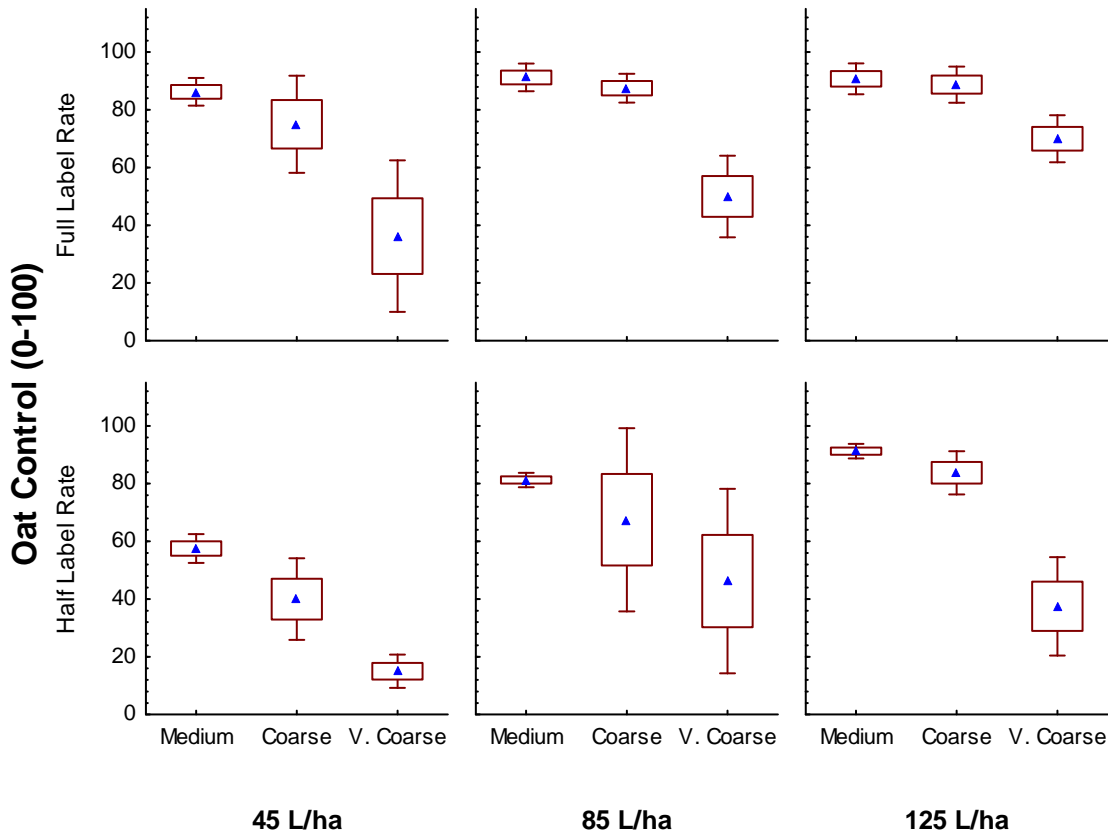


**Figure 1:** Interactive effect of water volume and droplet size on Horizon oat control (2005).

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 spray quality became Very Coarse at all water volumes. This effect was most pronounced at the lowest water volume. Using higher water volumes reduced the sensitivity to spray quality and increased consistency of control, but the Very Coarse sprays still did not provide satisfactory control.

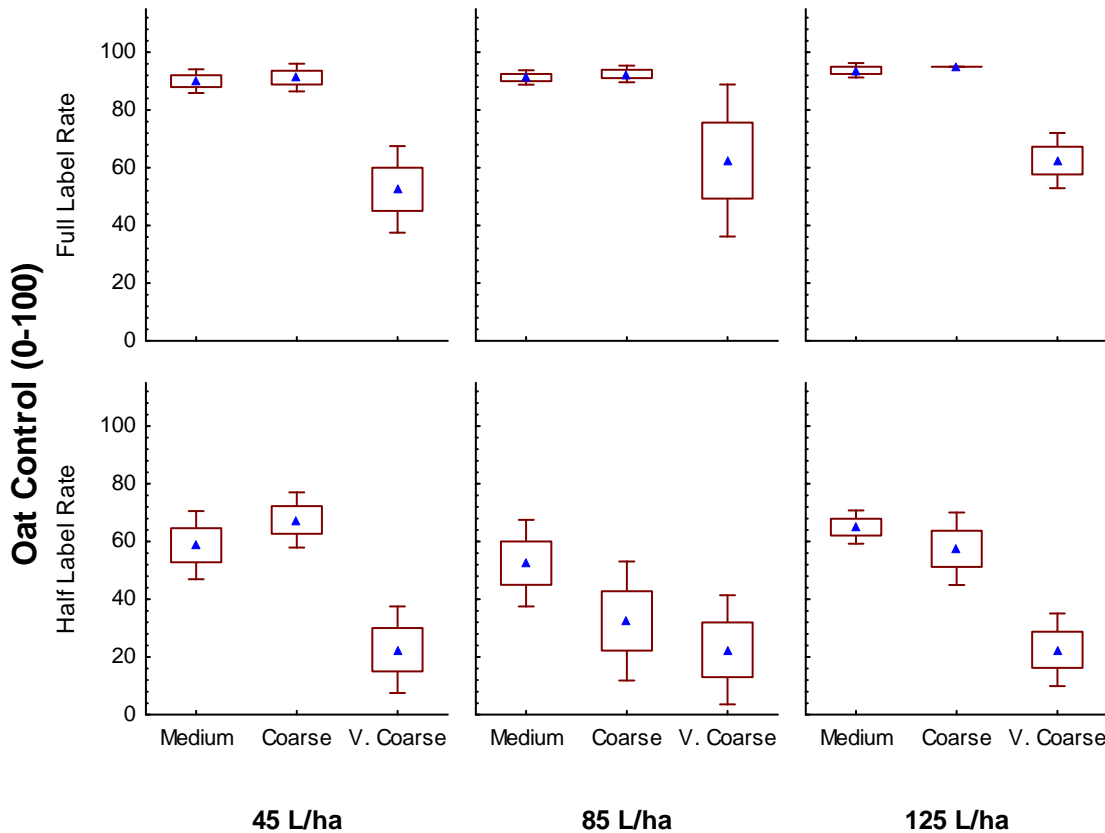


**Figure 2:** Interactive effect of water volume and droplet size on Assure II oat control (2005).

At the half-label rate, weed control was reduced significantly and variability in control increased compared to the full rate. Poorest control overall was obtained at the 45 L/ha water volume. Control increased as water volumes were increased. Reductions in control with the Very Coarse sprays were greater at the half label rate than they had been at the full rate.

### Puma Super

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 lowest water volume, oat control was better and more consistent with Puma Super than it had been for Assure.

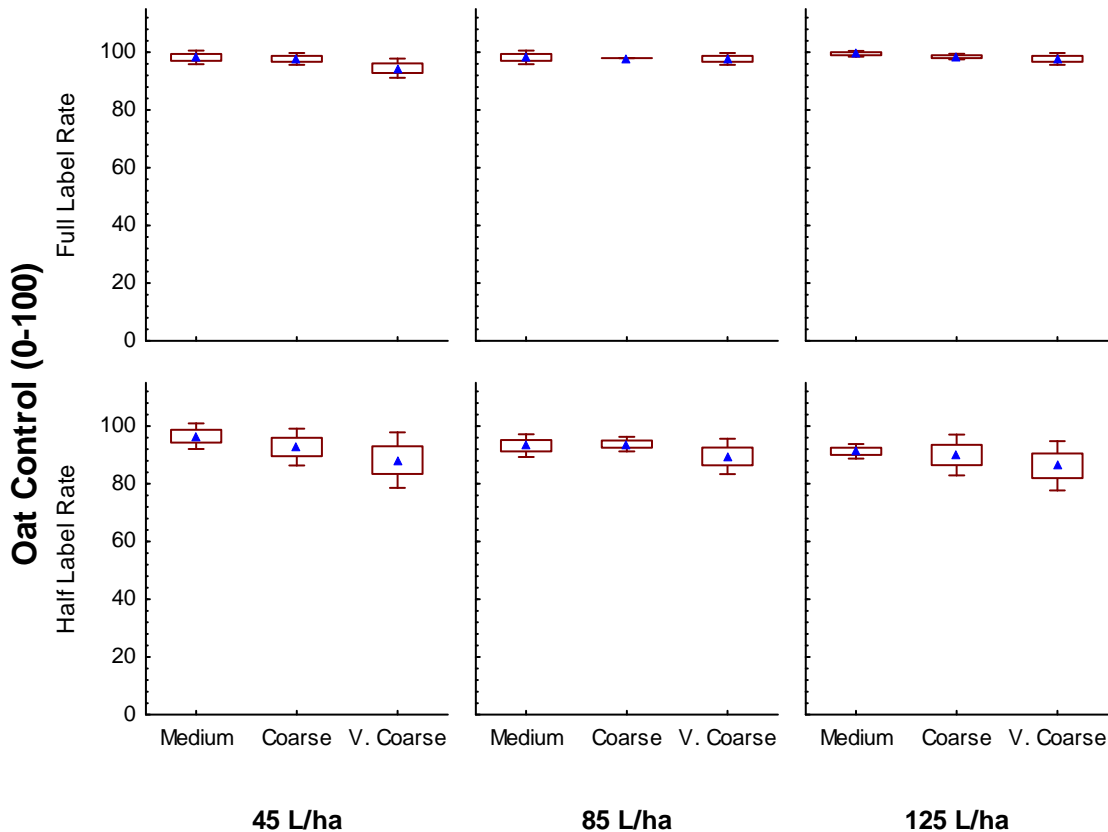


**Figure 3:** Interactive effect of water volume and droplet size on Puma Super oat control (2005).

At the lower herbicide rate, overall control was much 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).

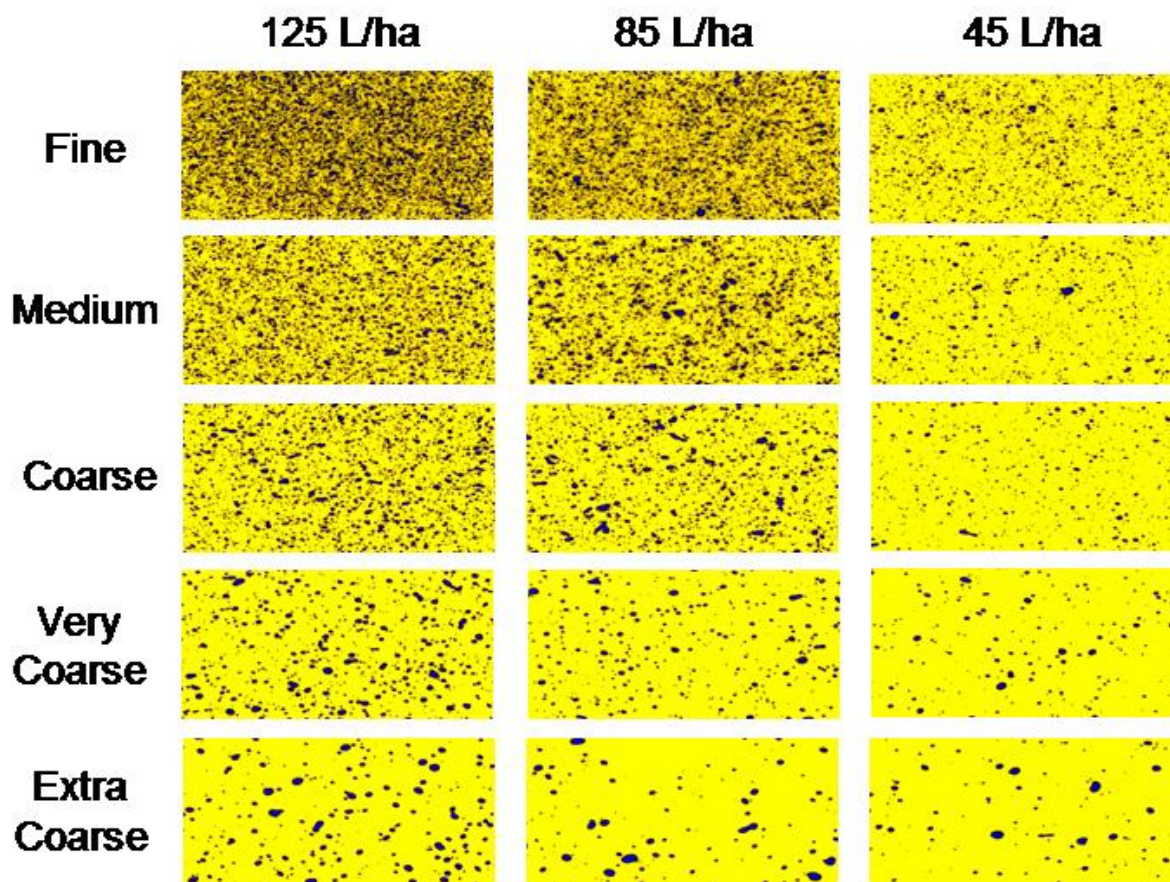
Even systemic herbicides require a minimum amount of spray coverage (droplets per square centimetre) to be effective. Although Group 1 products are considered systemic, they are not as easily translocated as other systemic products.

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.

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