OPERATOR VARIABILITY IN THE APPLICATION OF HERBICIDES TO WOODY SHRUBS

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Summary. Experiments were conducted at two locations to compare the application of herbicides to woody shrubs by different spray operators. At each site 15 operators with varying degrees of spraying experience were compared. Each operator treated identical blackberry bushes with a water/surfactant mixture and was instructed to spray the bushes as though applying herbicide. At the first site, there was a threefold difference between operators in application volumes. At the second site, differences were up to 11 fold.

This suggests that current label directions for spraying woody shrubs with herbicides result in variable and incorrect rates of application.

INTRODUCTION

High volume spraying is the most comon method of applying herbicides to woody weeds in Australia. In most situations herbicide spraying rates are specified in terms of product or active ingredient per unit of target size. However, for woody shrub spraying, herbicide labels usually specify only the herbicide concentration and brief details of application method. This is true also of research reports (1, 2, 3, 6, 7). Only a few more recent reports specify application rates adequately (4, 5, 8).

It has long been suspected that variable control of woody shrubs with herbicides is partially due to differences between operators in application rates. The aims of this experiment were to determine the magnitude of operator variation and to demonstrate the need for accurate specification of rates in research reports and on herbicide labels.

There are two distinct techniques recommended for spraying woody shrubs, depending on the herbicide used. The experiments described in this paper compared each operator using both techniques. The traditional technique is to apply herbicide "to the point of run off" (1, 2, 6, 7) and is used when applying phenoxy herbicides and picloram formulations. The objective is to thoroughly wet both leaves and stems. A different approach is recommended for the newer herbicides glyphosate and metsulfuron; the labels for these herbicides specify foliar coverage only and state that run off is to be avoided.

METHODS

Experiments were conducted at two sites. Fifteen operators were compared at each site. Operators included local government weeds inspectors, farmers, farm hands, chemical company representatives, and spray contractors. Only the author and his technical assistant (operators 1 and 2 respectively) were common to both sites.

Operators sprayed the twelve blackberry bushes chosen at each site with a mixture of water and surfactant (0.1% v/v). The spray volume was measured by a Davies-Kent^{R} water meter. Spray equipment consisted of a Hardi twin diaphram pump and a Spraying Systems 43 Gunjet^{R} fitted with a Spraying Sytems

"D" series nozzle plate. Fifty metres of 12.5 mm ID hose connected the pump and the handgun.

At Site 1, three experiments called "Glyphosate", "Five-T", and "Operator Choice" were conducted.

Glyphosate. Operators were instructed to spray bushes as they would when applying Roundup^R. Pump operating pressure was 550 kPa and a D5^R nozzle was fitted to the handgun.

Five-T. Operators were instructed to spray the bushes as they would when applying 2,4,5-T. Pressure was 1100 kPa and a D8^R nozzle was fitted.

Operator choice. Instructions for spraying were identical to those for the Five-T experiment, but operators were allowed to select pressure and nozzle size.

At Site 2 the operator choice experiment was deleted. Operators sprayed four bushes or replicates in each experiment at Site 1, and six bushes at Site 2. Bushes of various sizes were chosen for each experiment. At each site bushes were assigned to each experiment so that individual and mean bush sizes were similar.

RESULTS AND DISCUSSION

The results of these experiments are given in Table 1.

Table 1. Spray volumes applied (ml/m^2) applied to blackberry bushes using different techniques

	Site 1			Site 2	
Operator	Five-T	Glyphosate	Op. Choice	Five-T	Glyphosate
1	458	178	502	792	215
2	412	162	369	757	224
3	403	94	426	818	241
4	520	87	529	801	140
5	270	88	324	503	234
6	343	91	277	638	188
7	292	56	295	141	51
8	224	86	194	363	97
9	182	53	248	357	122
10	640	141	671	507	94
11	524	166	189	1024	543
12	333	171	217	202	119
13	333	122	391	337	194
14	317	136	385	284	134
15	310	117	340	422	174
Mean	371	117	357	530	183
s.e.	38	11	42	43	21

In each experiment, spray operators consistently applied spray volumes in proportion to bush surface area (r^2 = 0.69 to 0.98). Results are presented as

spray volume per unit bush surface area to give a comparitive measure of application rates and to improve statistical comparisons.

Site 1. Within each experiment, there was about a threefold difference between the heaviest and the lightest operator. For the "Five-T" experiment only two operators were within 10% of the mean volume and seven operators were within 20% of the mean volume applied. The author and his technical assistant were 23% and 11% respectively, above the mean. For the "Glyphosate" experiment, two operators were within 10% of the mean volume and four were within 20% of the mean volume applied. The author and his technical assistant were 52% and 38% respectively, above the mean.

Results of the "Operator choice" experiment were similar to those for "Five-T", except for operator 11, who was in fact simulating metsulfuron application with a D6^R nozzle plate. This suggests that pressure and nozzle size are less important than application technique and variation between operators.

Site 2. The range in spray volumes applied to the bushes was even greater than those obtained in Experiment 1. There was an 8 fold difference in application rates for the "Five-T" experiment, and an 11 fold difference for the "Glyphosate" experiment. The extremely high rates were applied by a totally inexperienced operator (operator 11), but even neglecting his contribution, the variation was 6 fold and 5 fold respectively. Only three operators were within 20% of the mean for both the "Five-T" and "Glyphosate" treatments.

The ratios of "Five-T" to "Glyphosate" gives a comparison of the two spraying techniques. At Site 1, the average ratio was 3.2 and at Site 2 it was 2.9. At Site 1 ratios ranged from 1.9 to 6.0 and at site 2, from 1.7 to 5.7. At both sites, most operators applied between two and five times as much spray when applying 2,4,5-T and similar products, compared to glyphosate and metsulfuron.

Application rates were higher at Site 2 than Site 1. This is probably because operators apply in proportion to foliage area rather than the geometric surface area used to calculate application rates. Bushes at Site 2 were in full foliage and had some peripheral growth whereas those at Site 1 had been severely defoliated by drought and heavy grazing by sheep.

Given the herbicide concentrations specified on the labels, the rates of herbicides applied by the majority of operators would give high levels of regrowth with growth regulator herbicides such as 2,4,5-T, and very poor results with glyphosate (4, and McMillan, unpublished data). These results demonstrate that current label directions are not achieving desired or uniform application rates. They may also explain many inconsistencies in both commercial and experimental results with herbicides on woody shrubs.

Although there was great variation between operators, the mean spray volumes applied during a repeat application by the same operator (data not presented) and by a few specially trained operators during the experiments were very similar. This suggests that a great improvement in operator uniformity is feasible and that herbicide manufacturers should provide more detailed instructions for spot application of their products to woody weeds. Instructions for calibration based on bush size should also be included.

Experiments in which application rates are not related to some measure of bush size are clearly undesirable since comparisons within the experiments are dubious, comparisons between experiments are impossible and commercial

extension of results is likely to be highly misleading.

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