A LOW-VOLUME, GAS-POWERED, SPRAY GUN FOR APPLICATION OF HERBICIDES TO BLACKBERRY AND OTHER WOODY PERENNIALS

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Summary: A low-volume, gas-powered, spray gun was developed which was used effectively to control blackberry (*Rubus fruticosus agg.*) and lantana (*Lantana camara*). This spray gun was more efficient than conventional high-volume spraying as the amount of chemical needed and the cost of application of three herbicides was considerably reduced when using the gun. The special spray gun would seem to be especially useful in treating blackberry in inaccessible terrain as the volume of application was reduced by 50-60 times with no reduction in effectiveness. Also the technique allowed a reduction in the amount of chemical needed to control bushes by one quarter compared to high volume spraying.

INTRODUCTION

Results published at the 6th Australian Weed Conference (Toth et al., 1981) indicated that conventional high volume and low volume application methods for spraying blackberry were applying two to four times the amount of chemical needed to control bushes. The results indicated that a much lower rate of chemical could be used at a considerably reduced cost to effectively control blackberry.

The most commonly used herbicide for control of Blackberry (*Rubus fruticosus agg.*) 2,4,5-T is cheap but controversial and a number of councils have banned its use in their areas. To find a suitable replacement, a number of new herbicides have been tested over the last five years. All the new herbicides performed better than 2,4,5-T, but they cost four to thirteen-fold more.

One of the main reasons for their higher cost is that the present application technique and application equipment does not suit these new types of herbicide.

This paper reports on a low-volume, gas-powered, spray gun which has been developed to deliver low volumes of concentrated herbicide solution to blackberry and other woody perennials at a reduced cost.

MATERIALS AND METHODS

A special gas-powered, spray gun was constructed by Mr Alan Murphy formerly of the Department of Agriculture in consultation with Mr John Toth to spray blackberry. The gun is now the subject of a patent application but an illustration of one of the prototypes is shown in Figure 1.

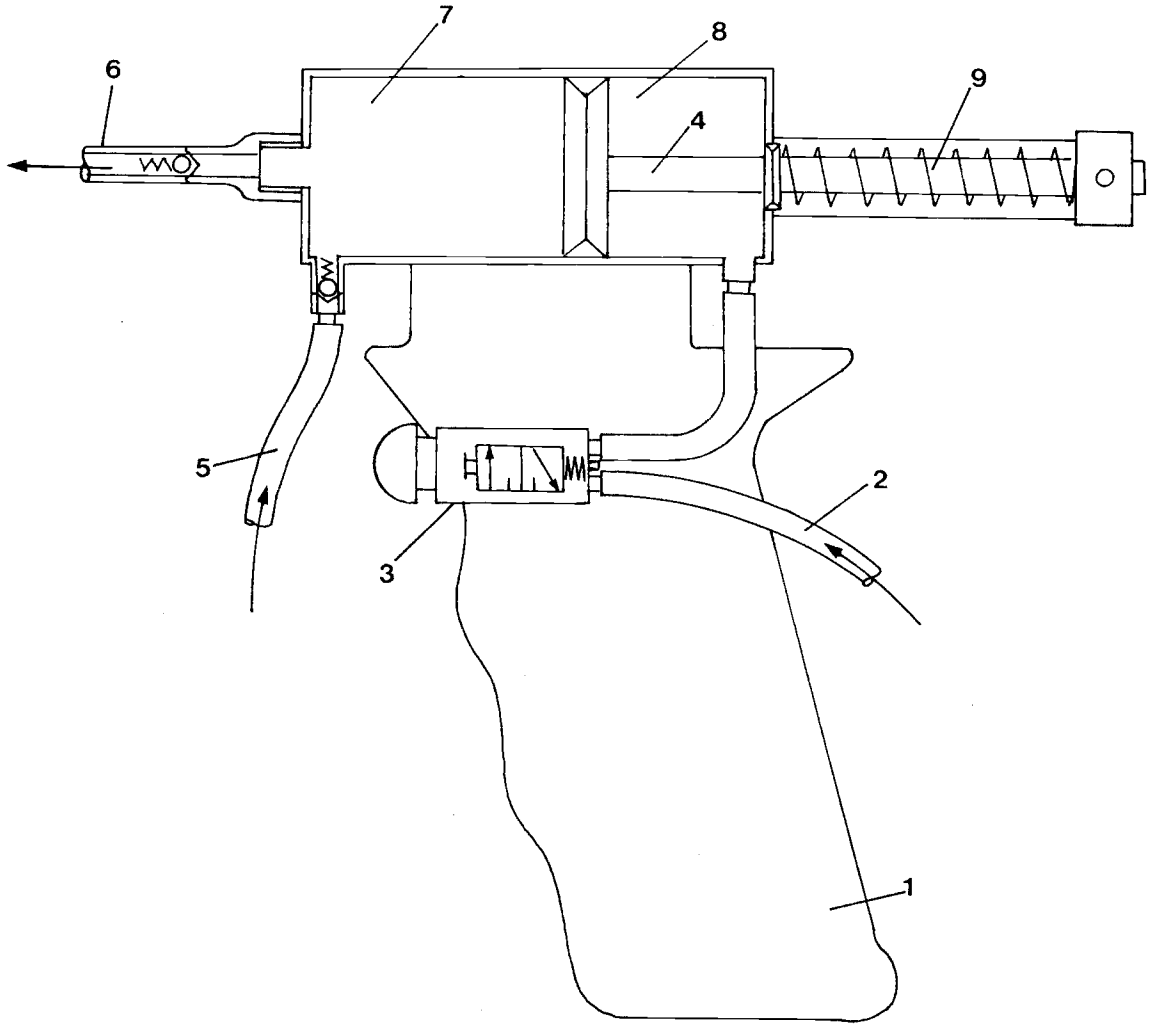

Figure 1: Diagram of protype, low-volume, gas-powered spray gun.

1. pistol grip handle,
2. gas inlet for L.P.G. cylinder,
3. trigger mechanism,
4. plunger
5. herbicide inlet from backpack
6. spray outlet to nozzle
7. liquid chamber
8. gas chamber
9. returning spring and volume adjustment

The gun can deliver a variable amount of solution from 20 to 60 mL on each activation of the trigger. Preliminary testing with different nozzles and pressures resulted in selection of "T-jet" nozzle number 8003 and pressure of 300 kPa as giving best spray cover in relation to arm movement of the gun. The gun delivers 14 mL with the nozzle and pressure indicated. A 50 mL shot covers approximately $5m^2$ of blackberry bush when a steady sweeping movement of the arm is used.

Initial screening trials using several herbicides indicated that blackberry bushes treated with the gun were controlled to the same extent as when bushes were sprayed by normal high volume applications.

Three preliminary trials using a prototype spraygun were carried out in December 1981 and March and October 1982 at Castle Hill. These trials tested three herbicides (glyphosate, fosamine and triclopyr) at various dilutions[1] from 1 to 1 to 1 to 60 to establish the range of dilutions at which the chemicals were effective when applied by the special gun.

To compare application methods a trial was commenced at Walcha, N.S.W. in April 1983 using the following methods of application with glyphosate as the herbicide:-

- high volume application, spraying to thoroughly wet the bush using a D-8 nozzle and 2000 kPa (30 L/bush at dilution of 1.3 to 100)
- medium to low volume application, spraying to use approximately half to a quarter of the high volume with a D-4 nozzle and decreasing pressure to 400 kPa (5 L/bush at dilution of 1.3 to 100)
- the special gun, with "T-jet" 8003 nozzle and 200 kPa set at 50 mL per shot (dilutions of 1 to 7.5, 1 to 10 and 1 to 12.5)

A comparison of 3 herbicides (glyphosate, fosamine and triclopyr) using the special gun was commenced in March 1983 at Castle Hill.

Bushes were selected at random, measured by stepping the circumference (1 step = 0.7m) and recording the height with a specially marked stick. Also a visual description of each bush was recorded i.e. flowering, drought stressed, new growth and amount of dead canes.

The volume and concentration of spray used per bush was recorded for each treatment.

Visual assessments were made of the bushes using a score of 1 to 10 where 1 equals 10 per cent or less control and 10 equals 100 per cent control.

Weather conditions were very dry at Castle Hill and bushes exhibited severe drought stress except for a few bushes in the creek bed. At Walcha the bushes were unstressed and very healthy.

In one trial lantana bushes approximately 1 to 2m high were sprayed with glyphosate and fosamine using the special spray gun and results compared to high volume application.

[1] dilutions of herbicide relate to amount of product mixed with water.

RESULTS

Preliminary trials: These trials established that the special gun was capable of applying herbicides in low volumes which gave control of blackberry similar to high volume applications. The range of dilutions found to be effective were 1 to 4 up to 1 to 10 for fosamine, 1 to 5 up to 1 to 15 for glyphosate, 1 to 10 up to 1 to 40 for triclopyr. All dilutions are expressed as ratio of product to water.

Comparison of application methods: All application methods tested at Walcha gave the same degree of control which was very effective on blackberry (Table 1).

Table 1: Comparison of application methods 12 months after treatment for spraying blackberry using glyphosate

Method of Application	Ratio (Product to Water)	Bush Size (Steps by height)	Application Volume (L/bush)	Control rating	Cost ($/bush)
High Volume	1.3 to 100	25 by 2.5m	30	10	6.00
Low Volume	1.3 to 100	13 by 1.5m**	5	10	1.00
LPG Gun	1 to 7.5	23 by 2.25m	0.6 *** (12 shots)	10	1.60
LPG Gun	1 to 10	26 by 1.75m	0.65 (13 shots)	10	1.30
LPG Gun	1 to 12.5	19 by 2.25m	0.5 (10 shots)	10	0.80

* 1 step = 0.7m

** The bushes in these treatments were approximately ½ size of other treatments.

*** Number of shots per bush is the number of 50 mL shots needed to cover surface of bush.

Cost of glyphosate $20 per litre.

Figures are the average of 3 replicates.

In this trial there was considerable variation in the size of bushes between treatments but this is inherent in all trials undertaken on blackberry. The cost of treatment (chemical cost) was considerably reduced by the use of the medium volume application (5 L/bush) although these bushes were only about half the size of other bushes in the trial. However use of the special gun at all dilutions used resulted in significant cost savings compared to the high volume application. The most cost effective treatment was the special gun treatment using glyphosate diluted 1 to 12.5 which on average cost $0.80 per bush of size 19 steps by 2.25m high.

Comparison of chemical treatments using the special gun: The results in Table 2 at Castle Hill show there was considerable variation in the average size of blackberry bushes used as indicated in the previous trials. In this trial the bushes were drought stressed except for a few bushes in a creek bed and results were not as good as at Walcha

However glyphosate gave similar results (15 - 25% regrowth) at all dilutions used (1 to 5 to 1 to 15). Fosamine was just as effective as glyphosate when dilutions were in the 1 to 4 to 1 to 7.5 range but the 1 to 10 dilution was considerably less effective (44% regrowth). Triclopyr (15 - 20% regrowth) gave similar or better results to glyphosate at all rates tested.

Table 2: Effectiveness of three herbicides 12 months after application applied by the low-volume, gas-powered, spray gun on blackberry at Castle Hill in March 1983.

Herbicide	Ratio (Product to Water)	Bush Size (Steps by height)	Application Volume (mL /bush)	Control Rating	Cost ($/bush)
glyphosate	1 to 5	21 by 1.3m	400 (8 shots)	7.5	1.60
glyphosate	1 to 7.5	20 by 0.9m	350 (7 shots)	7.8	0.93
glyphosate	1 to 10	24 by 1.0m	475 (9.5 shots)	7.2	0.95
glyphosate	1 to 12.5	20 by 1.1m	350 (7 shots)	7.2	0.56
glyphosate	1 to 15	18 by 0.8m	300 (6 shots)	8.5	0.40
fosamine	1 to 4	32 by 1.25m	500 (10 shots)	7.2	2.13
fosamine	1 to 5	25 by 1.35m	400 (8 shots)	8.4	1.36
fosamine	1 to 75	23 by 0.6m	300 (6 shots)	7.8	0.68
fosamine	1 to 10	27 by 1.0m	650 (13 shots)	5.6	1.10

triclopyr	1 to 7.5	25 by 1.0m	350 (7 shots)	8.5	1.59
triclopyr	1 to 10	25 by 1.1m	400 (8 shots)	8.1	1.36
triclopyr	1 to 20	25 by 1.25m	375 (7.5 shots)	8.3	0.64
triclopyr	1 to 40	22 by 0.75m	250 (5 shots)	8.0	0.21

Cost calculation:- glyphosate \$20 L^{-1}
fosamine \$17 L^{-1}
triclopyr \$34 L^{-1}

Results on lantana: Glyphosate was very effective in controlling lantana (Table 3) whether applied by special gun or high volume application. Fosamine was more effective when applied with the special gun than with high volume application, but was very slow acting and further improvement in results may occur with time.

Triclopyr was ineffective on lantana

Table 3: Comparison of the effectiveness of 3 herbicides 8 months after application applied by the low-volume, gas-powered, spray gun and high volume application on lantana.

Application method and herbicide treatment	Ratio (product to water)	Control rating
LPG Gun Application		
glyphosate	1 to 7.5	10
glyphosate	1 to 10	10
glyphosate	1 to 12.5	10
fosamine	1 to 7.5	10
fosamine	1 to 10	10
fosamine	1 to 12.5	8
High Volume Application		
glyphosate	1 to 100	10
fosamine	1 to 66	4
triclopyr	1 to 250	0

DISCUSSION

When used to spray blackberry and lantana the low-volume, gas-powered gun gave results which were just as effective as conventional high volume and medium to low volume applications. Moreover the cost of chemical used for treatments with the gun was considerably reduced compared to the cost of both conventional high volume and low volume applications. The cost of treating blackberry bushes with glyphosate approximately 2m high and 20 paces (14m) in circumference can be as low as $0.50-0.80 per bush compared to $6-$7.80 per bush for high volume application. The economics in favour of using the special gun are considerable.

Observations when using the gun have indicated that it is essential to include a marker dye in the spray solution to see where spraying has taken place. Tests with different coloured dyes have indicated that a white or yellow coloured dye is to be preferred to indicate where spraying has occurred. The dye currently used is titanium dioxide which has slight detrimental effects on the use of glyphosate, but the effect on other herbicides is unknown. The use of a more suitable dye is being investigated.

The use of the low-volume, gas-powered, spray gun has several advantages over current high volume and low volume application techniques. These include:-

- the ability to work in inaccessible areas
- it is not necessary to carry large quantities of water or other carrier material
- high quality water can be used with less chance of deliterious spray-water interactions
- a 1 litre gas cylinder gives 960 shots of spray solution (3¢ - 16¢/100 shots)
- the gun accurately measures the amount of herbicide applied to bushes and adjustments can be made in chemical applied depending on bush size
- spray drift associated with conventional high or low volume applications is reduced to a minimum.

Experiments conducted in the last five years (Toth et al.) have indicated that:

- the application equipment currently used is using far too much herbicide
- no herbicide treatment gives 100 per cent kill after one application
- the second year application (regardless of equipment used) require proportionately more herbicide to kill the small percentage of escaping runners. This is due to interfering old (dead) canes from the previous year and weed growth from under the bush. For example, for a very big bush, the first year's application was 50L spray (cost $10.00) and re-growth prior to second application was about 5 - 6 per cent. The re-spray volume required was 35L spray (cost $7.00) and resulted in 2 per cent regrowth 12 months later
- other means of destruction of the bushes after initial chemical treatments to be considered are: slashing, crushing and burning
- the cost of treating blackberries can be reduced by using the special gun or if high volume spraying equipment is used, at least with glyphosate then reduce the nozzle size to D-4 and decrease the pressure to 400 kPa to effectively decrease the volume at least to half the conventional spray volume
- experiments with the new low-volume, gas-powered, spray gun indicate that up to 80 per cent cost reductions in chemical cost can be achieved when using the gun.

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