Techniques

DEVELOPMENT AND USE OF A HERBICIDE SPOT-GUN APPLICATOR

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Summary

A commercially available drenching gun was modified with special delivery lances and nozzles to apply the herbicide hexazinone precisely. Control of sweet brier (*Rosa rubiginosa*) along with selective treatment to radiata pine (*Pinus radiata*) is discussed.

INTRODUCTION

The spot-on gun applicator was primarily designed for the spot treatment of hexazinone herbicide for low density noxious plant control, where high volume hand gun spraying was undesirable due to the non-selective properties of the herbicides and the high labour content of spraying high volumes of water in inaccessible areas. The marginal selectivity of hexazinone was further demonstrated when applied above recommended rates for tree releasing over the top of radiata pine (Bowers and Porter 1975, 1977; Coackley and Moore 1977; Cameron and Stokes 1978). The standard practice of hand operated knapsacks can be inaccurate as, in most instances, the operator has little precise knowledge of what dosage is being applied. Thus the need for an exact dosage applicator. This paper describes the adaptations developed to fit the drench gun and typical field evaluations of performance.

METHODS

The Phillips 20ml Mark III automatic drench gun was chosen for adaption to suit three methods of application. Two lances were built to a length of 20 cm, one bent to an angle of 22.5° and the other bent to an angle of 45°. Spraying Systems nozzles and tips were used throughout. Hexazinone in the form of a water soluble powder containing 900 g/kg was applied in an aqueous solution at a concentration of 22.5 g /litre.

Application to sweet brier

The 22.5° angle lance was fitted with a D-7 disc and was used to apply a direct jet of spray solution to the base (collar root area) of the plant. The 22.5° angle lance was chosen as the most suitable to operate under field conditions. Initial work commenced in December 1976 in Central Otago. Rates of application per bush was adjusted by dose volume (Table 1). Treatments were applied monthly except for January, April and May.

Table 1:

Hexazinone application per bush at the dilution rate of 22.5g/litre

Dosage Volume	Hexazinone applied
10 ml	0.225 g
20 ml	0.450 g
40 ml	0.9 g
80 ml	1.8 g

Proc. 32nd N.Z. Weed and Pest Control Conf.

Techniques

Forestry - tree release spraying radiata pine

The 45° angle lance was initially fitted with a Tee-Jet 11005 fan nozzle which applied two squirts of 10ml, in a 1 x 1 m square pattern centred on each radiata pine seedling. Field testing demonstrated that this method could possibly lead to overdosing if applied by an inexperienced operator. A further adaption was to fit a wide angle solid cone nozzle, No. G.G. 4 3W. This delivered the most even droplet size at either the 10 or 20 ml dosage rate with a minimum amount of plunger pressure. The spray pattern showed a 1.2 m diameter circle on flat ground when the nozzle was held at 50 cm above the ground, however when used under field conditions with the weed growth up to 25 cm in height, the circle diameter was reduced to approximately 1 m. The most distinct advantage of using the solid cone nozzle over the fan type nozzle was that the operator could hold the spot-gun in a stationary position rather than making two passes to cover approximately the same area.

Using the spot-gun fitted with either the fan or solid cone nozzle, rates of application could be calculated on a sprayed area basis. One square metre was chosen to be the ideal area for tree releasing. Treatments of hexazinone were applied at the 10 ml and 20 ml dosage volume /m². The solution was contained in a calibrated 5 litre back pack.

Trials were laid down to evaluate the application technique, times and rates of application for both tree tolerance and control of a wide range of weed and brush species.

Soil injector lance

The lance was developed to allow the injection of hexazinone directly into the soil around the base of brush weeds. The lance was made of 5 mm internal diameter stainless steel tubing fitted with a sharp nozzle which delivered the spray at right angles to the tip. The direct injection of hexazinone into the soil may overcome any washing which could occur if the herbicide was applied on the soil surface. This is especially the case under saturated soil conditions or prior to heavy rainfall.

RESULTS AND DISCUSSION

Sweet brier

Assessments of this trial work demonstrated 40 ml of hexazinone solution (0.9g hexazinone) was required to gain control of bushes up to 1 m in height and 80 ml of solution (1.8g hexazinone) to control bushes over 2 m in height. Complete control of sweet brier depends on the height of the bush treated with 12 months required for total kill of bushes up to 2 m in height.

For optimum results it was found the application was best made during early spring.

Forestry - tree release application

The adaption of the spot-gun to deliver an exact measured dose over 1 m² and trials using the 22.5 g/litre mixture commenced in 1977. While the fan jet applying two doses of 10 ml in opposite directions over a square metre area proved satisfactory for both tree tolerance and weed control at rates equivalent to 4.5 kg/ha, operator technique played some part in inconsistencies of application and over-dosing, and larger areas than 1 m² were occasionally treated. The further adaption of fitting a solid cone nozzle did allow the operator to apply the 10 ml or 20 ml dosage rate in a one squirt operation while stationary.

Although the spray pattern resulted in a circle and the circle diameter would vary slightly, depending on what height the nozzle was held above the ground, the use of this nozzle was preferred as it gave a more consistent pattern and instructions on its operation were simple.

Techniques

Table 2

Post-Planting application (release spraying)				
Weed species	Chemical rate kg/ha	Dosage volume ml	Time of application	Comments
grasses and broad leaf weeds	N. Island 3.5 - 4.5 S. Island 2.25-3.5	10-20 10-15	August - April	Use low rate where pasture has been closely grazed and on sandy soils.
paspalum (<i>paspalum dilatatum</i>) Kikuyu grass (<i>pennisetum clandestinum</i>)	4.5	20	October - March	
toetoe (<i>Cortaderia fulvida</i>)	4.5	20	August - April	
bracken (<i>Pteridium aquilinum</i>) blackberry (<i>Rubus spp.</i>)	4.5 - 5.5	20 - 25	September - March	Good release has been achieved at 4.5kg/ha, 5.5kg/ha for total kill
buddleia (<i>Buddleia davidii</i>)	4.5	20	October - February	
seedling gorse (<i>Ulex europaeus</i>) up to 14cm high.	4.5	20	October - February	Good coverage and even germination necessary for complete control

Field experience has shown that with the spot-gun fitted with the solid cone nozzle and held at the correct height above the ground, approximately 50 cm, a metre diameter circle can be achieved with good margins of safety to the radiata pine seedlings on most soil types. Problems have been experienced with toxicity to young radiata pines when the nozzle is held below 50 cm, thus decreasing the circle diameter and increasing the dosage per unit area of hexazinone quite considerably. This has resulted in tree death, especially on light sandy soils.

From field experience during the 1977/78 season it is clear that the spot-gun application technique is quite satisfactory as long as sufficient operator training is carried out before spraying operations are undertaken.

Provisional rates of application for applying hexazinone using the spot-gun technique are listed in Table 2.

Techniques

Spot-gun on work study

The staff of the N.Z. Forest Service, South Island Works Team carried out a work study using the solid cone nozzle to examine the efficiency of applying 2.5 kg/ha of hexazinone in single spots at right angles to the direction of travel. Tree spacings were at 5 x 2m (1,000/ha). Interim time standards were:-

1. Walk and spray = 0.058 min/tree.
 2. Refill container = 0.0187 min/tree.
 3. Change rows = 0.0040 min/tree.
 4. Mark the rows = 0.002 min/tree.
- Time taken = 0.0829 min/tree or = 4.974 sec/tree.

CONCLUSION

Experience with using the modified spot-gun applicator since December 1976 has shown the method application has many advantages over the established techniques of hand-gun, knapsack and aerial application. The main advantages are :-

The chemical is applied at the exact dosage rate to the precise target area.

Eliminates the necessity for large volumes of water.

The unit is small and light to carry.

Ease of operation and calibration of the dosage rate required.

Lower equipment cost.

Very cost efficient in comparison with other forms of application.

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