EVALUATION OF A BRUSH WIPER FOR APPLICATION OF HERBICIDES

B.G. Wills, M.M. Campbell and D. Fleming
Department of Agriculture and Rural Affairs,
Agricultural Engineering Centre, Werribee, Vic.3030

Summary. The performance of a brush wiper for applying herbicides was evaluated in a series of laboratory and field tests. The unit consists of an enclosed spray boom that distributes herbicide spray onto the top of a brush. Herbicide runs down the brush and is wiped onto foliage in its path. Results show that the brush has considerable potential.

INTRODUCTION

Drift, or airborne movement of herbicide spray onto non-target species, is a well known problem that has led to the development of various wiper-applicators.

Herbicide wipers normally use rope, carpet, felt or other absorbent material to wipe translocating herbicides onto plants. The absorbent material is usually wrapped around a bar or roller, or slung between frame members. When weeds are growing above and well clear of a desirable crop or pasture a good degree of selectivity can be achieved with a wiper. However, low lying weeds, particularly those in ground depressions, may be missed as the wiper passes over at a higher level. In practice, uniform wetting of the wiping material is difficult to achieve, which may result in dry or dripping areas on its surface. This effect is compounded if pores in the material become blocked by soil or other contaminants. The material may also be torn by sharp objects such as thorns or sticks. Most wipers,therefore, are not suited for prostrate or low growing weeds where there will be a significant amount of contact with the ground.

This paper reports an evaluation carried out in 1987 of an applicator that uses a brush to apply the herbicide, which overcomes many of the problems associated with conventional wipers.

The Wipe-A-Pest^{R} herbicide applicator (Wipe-A-Pest International Pty Ltd) has two functional components: a set of hydraulic nozzles, and a long brush onto which herbicide is sprayed. The nozzles and the head of the brush are enclosed within an aluminium casing. Herbicide runs down channels on the outside of cruciform-section brush filaments and is wiped onto foliage.

METHODS

Two versions (dubbed Mark I and Mark II) of the Wipe-A-Pest (Fig. 1) were analysed for uniformity of liquid distribution from the nozzles, from the brush, onto plants and for effectiveness of weed kill. The versions differed only in the shape of the casing, and the gap between nozzles and the brush.

The ability of the nozzles to uniformly distribute liquid onto the top of the brush filaments was tested by suspending individual nozzles 50 mm above a spray patternator (1) that had channels spaced 35 mm apart. Liquid (water) collected in the channels was funnelled into graduated cylinders, the levels of which showed the uniformity of distribution.

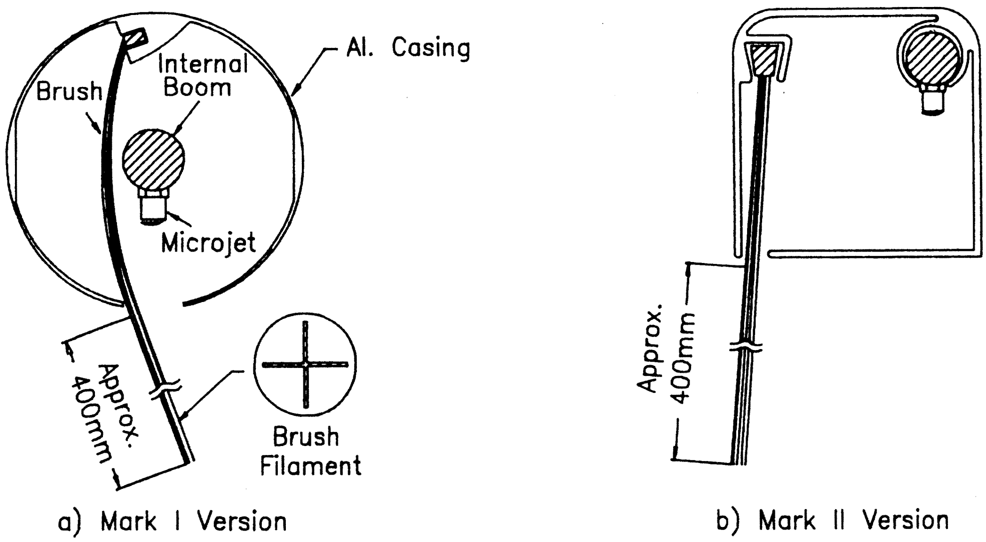

Figure 1. Cross sections of Wipe-A-Pest^R brush applicators.

The output from the brush was assessed in a similar manner, by allowing the bristles to distribute themselves approximately evenly above the channels. Distributions were measured at a range of pressures. The effects of including emulsifier in the spray mixture were also investigated.

Field testing of the Mark I version was undertaken to analyse the distribution of spray mixture onto weeds.

A mixture of 1 g Fluorescein dye and 178 g Toximul 8360 surfactant (Nufarm Pty Ltd) in 100 L of water was used to simulate a mixture of 1 L glyphosate herbicide in 100 L water.

The mixture was applied in a two metre wide swath to dense ryegrass pasture at 4 km/h, 28 kPa and 200 L/ha. Two hundred whole plants were sampled on a 100 mm grid from a one metre wide strip across the swath.

The Fluorescein was recovered by shaking each plant in a plastic bag with 20 mL of distilled water, and was measured in a fluorometer (Turner model 112) with excitation light at 375-490 nm and reading emitted light at wavelengths longer than 510 nm.

For comparative purposes, a test using the same mixture and analysis technique was carried out with a normal spray boom. The boom specifications were: 2 m length, delivering 216 L/ha at 3 km/h speed, with Lurmark 015-F80 nozzles at 500 mm spacing, 500 mm height and 250 kPa operating pressure.

The Mark II, which gave a similar distribution on the patternator to the Mark I, was tested on weeds using glyphosate at 5 L/ha, applied in late April on three roadside sites near Colac. The effects of travel speed (4, 6, 8 km/h), volume rate (200 L/ha, 400 L/ha), number of passes (one direction or two directions) and additional surfactant, were evaluated in thirty-three plots at each site. Visual assessments were made on days 18 and 61 after treatment.

RESULTS AND DISCUSSION

Static distribution from nozzles. The nozzles supplied with the units were Hardie-Pope 1/2 circle irrigation microjets with an 0.8 mm bore. They were spaced 145 mm apart along the 1.8 m spray boom, and were approximately 20 mm from the brush for the Mark I and 60 mm for the Mark II.

Calibration of the Mark I at the applicator manufacturer's recommended 28 kPa operating pressure gave flow rates in the range 0.176-0.220 L/min with an average of 0.196 L/min amongst the 12 nozzles fitted.

Spray uniformity for single nozzles was measured at 50 mm rather than 20 mm distance, which covered too few channels on the patternator to be meaningful. Distribution patterns were found to vary greatly between nozzles (Fig. 2) and within each nozzle with changes in pressure.

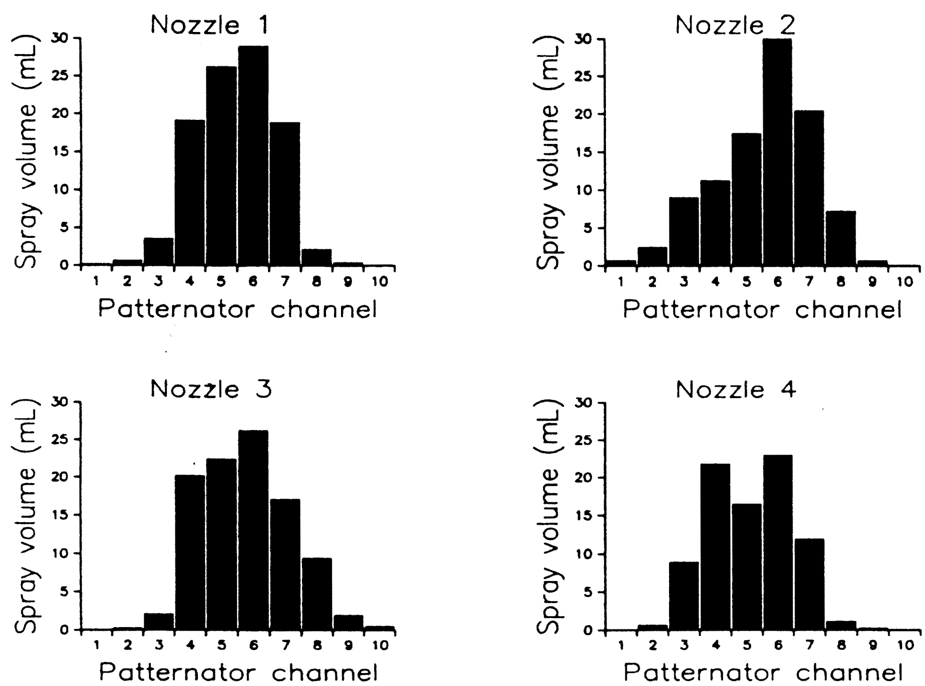

Figure 2. Spray distribution from four typical nozzles from the internal boom of the Mark I at 28kPa.

Distribution patterns from the entire internal boom, with the cover removed, were measured at 50 and 70 mm from the nozzles and gave coefficients of variation (c.v.) of 30.8 and 25.1% respectively. This compares unfavourably with the 10-15% c.v. expected of a well calibrated conventional agricultural spray boom (2). The variation would increase as nozzle to brush distance becomes smaller, because of the reduced overlap between nozzle spray patterns.

Static distribution from brush. The liquid distribution from the complete unit is shown in Fig. 3 and Table 1. Over the 28-150 kPa pressure range evaluated, c.v. of 53.7-68.9% were recorded. Adding emulsifier to the water increased the c.v. slightly. This variation would be considered unacceptable by comparison with a conventional boom, however the results of the field testing on pasture reveal an interesting paradox.

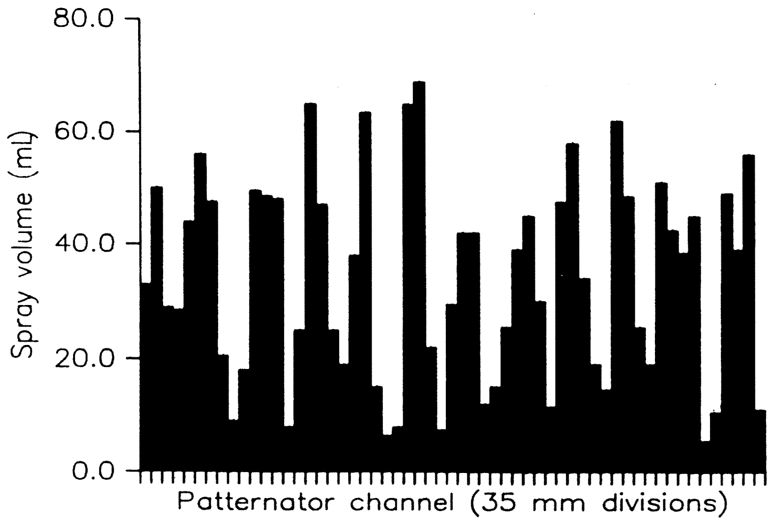

Figure 3. Distribution on patternator under the Mark I brush.

Table 1. Effect of pressure on liquid distribution for the Mark I model.

Pressure (kPa)	c.v. (%)
28	60.3
28	53.7
75	60.2
150	64.8
28[a]	68.9
150[a]	67.8

[a] Emulsifier added

Distribution on pasture. The distribution of fluorescent tracer on ryegrass pasture from the wiper had an average c.v. of 107% (range 90-108%), compared to 89% (range 56-141%) for the boomspray.

From patternator tests it was known that the boomspray produced a relatively even output, with a c.v. of 13% at 250 kPa.

The c.v. for the boomspray increased approximately 7 times from static (patternator) to dynamic (field) conditions with large variation between the samples. The c.v. for the wiper increased only 1.5 times and less variation was found between the samples. These results indicate that the wiper may be less subject to external influences and dynamic effects than a boomspray.

Weed control. Visual appraisal of the the plots showed no differences between the various treatments applied (travel speed, volume rate, number of passes, or extra surfactant). Results were essentially the same at both assessments on days 18 and 61.

This was attributed to the high rate of glyphosate (5 L/ha) which probably masked minor differences between plots. In all plots, no herbicide effects were visible outside of the wiper swath, indicating no detectable drift.

At the first site, which was 100% covered, mainly by grass species (300-400 colonies/m^2 phalaris, *Phalaris* spp., yorkshire fog grass, *Holcus lanatus*, cocksfoot, *Dactylis glomerata* and ryegrass, *Lolium* spp.) with some burr medic, *Medicago polymorpha* (10 colonies/m^2) there was 95-100% kill of the grasses. The only plants to survive treatment were those that would be expected to show tolerance to glyphosate, such as medics and clovers.

At the second site approximately 70% of ground area was covered by plants. Major species present were phalaris, wallaby grass, *Danthonia* spp., clover, *Trifolium* spp., sowthistle, *Sonchus oleraceus*, bristly ox-tongue, *Picris echioides*, and dock, *Rumex crispus*, all at various growth stages. Results were more variable, with an 80-100% kill. Herbicide effects were seen on all plants in the plots. This area differed from the first site by containing many medium sized clumps of grass, mostly phalaris, of 60-120 mm diameter and 600-800 mm high. A major problem, was a poor kill of most of the denser grass clumps. The original grass present had been killed but regrowth had commenced by day 61 in most clumps. This was due to diminished treatment as the brush spread or lifted to pass over the clump.

The third site was chosen to determine whether the wiper could perform better than a boomspray on hardy weeds. The dominant species, onion grass, *Romulea rosea*, is tolerant to glyphosate at the stage when treated. It was assessed on day 18 but was too wet for access on day 61. Observations indicated a poor result due to choice of herbicide and time of application.

General comments. Good weed control was achieved where the wiper brush could contact foliage. Control on tussocks or thick clumps of vegetation was unsatisfactory, although these would also present difficulties to other forms of wiper. On day 61, two strips of pasture, approximately 100 mm x 10 m that had escaped control were visible, apparently due to brush filaments being forced apart by grass clumps.

In operation, a self cleaning action of the cruciform-shaped brush filaments was noted. The external flow channels were not blocked by soil or other foreign matter, even though the brush frequently wiped the ground. Uneven ground presented no problems to the contour following ability of the brush.

A number of practical problems were noted. These include the the inaccessibility of the spray boom to check for blockages or replace nozzles, and dripping of spray liquid from the casing surrounding the boom.

Despite the problems identified, the brush wiper can be effective. There is scope for significant improvements in design.

ACKNOWLEDGEMENTS

This project was conducted in association with Nufarm Machinery Pty.Ltd. and Nufarm Chemicals Pty.Ltd.

REFERENCES

1. Richardson,R.G. 1986. Crop Protection 5, (1) pp. 8-11.
2. Wills,B.G. and Combellack,J.H. 1984. Proc. Conf. on Agricultural Engineering, Bundaberg. pp. 132-136.