DEVELOPMENT OF SIMPLE RELIABLE C.D.A. EQUIPMENT FOR USE IN RANGELANDS

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Summary. A controlled droplet applicator called a sprinkler sprayer was developed to apply low volumes of herbicide as scattered large droplets to floating water weeds. This concept has worked successfully in applying specific herbicides to a range of other weeds, and offers certain advantages over conventional methods. Sprinkler sprayers are now being produced commercially.

INTRODUCTION

In 1979, a novel herbicide (AF100) was developed to control floating water weeds such as salvinia (*Salvinia molesta*) (Diatloff et. al. 1979). This material gave good results when applied at low volume rates to the water surface as scattered large droplets (1200-1500 μm). Many types of conventional equipment including spinning disc C.D.A.'s and various nozzles were tested, but failed to adequately perform this task. A new type of applicator described as a sprinkler sprayer was developed to meet this requirement (Diatloff & Anderson, 1980). This method of spraying has now been applied to many other weeds.

DESCRIPTION OF THE SPRAYER

The spray pattern is produced by a small turbine driven directly by the pressurised spray fluid. This unit is an under tree micro sprinkler. It is attached to a hollow fibre glass wand which is attached to the fluid supply requiring low pressures (50 to 200 kPa) Fig. 1. Any equipment supplying 0.5 to 2 L min^{-1} at these pressures can be used, pressure regulators can be fitted if necessary.

Spray heads of various design have been used. Droplet size, spray pattern, and swath width are governed by jet size, rotor shape, and pressure. A pressure restricting jet can be fitted to the spray head to prevent drift if supply pressure is too high. Typical construction and rotor types are shown in Fig. 2. Swath widths and approximate droplet sizes at various pressures are set out in Table 1.

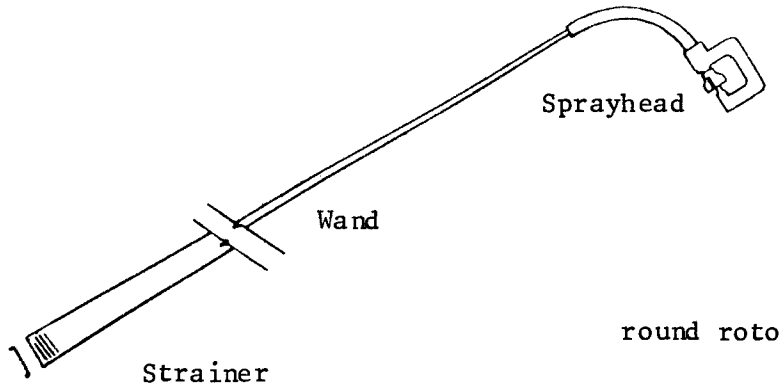

Figure 1

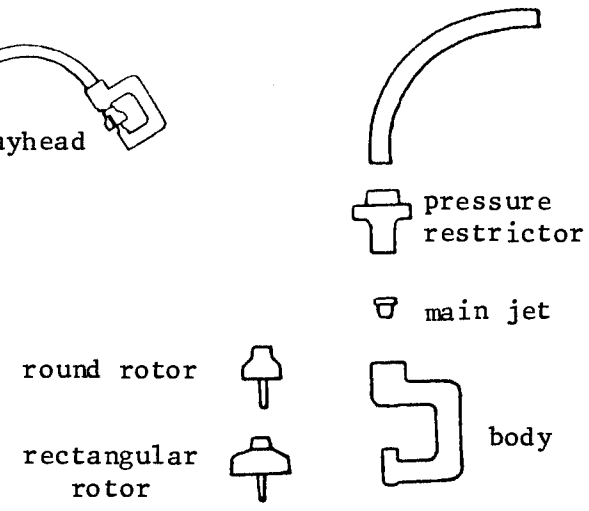

Figure 2

Table 1. Flow rates, swath widths and droplet sizes for different main jets and rotors

Jet/Rotor	Pressure (kPa)	Width m	Flow mL/min	Droplet size µm*
Green 1.5 mm	50	2.5	760	2400
round rotor	100	3.0	1020	1900
	200	3.5	1360	1000
Green	50	3.5	760	3500
rectangular rotor	100	4.5	1020	2300
	200	6.0	1360	2000
Red 1.4 mm	50	3.0	520	1800
round rotor	100	3.25	700	1000
	200	3.75	1060	900
Red	50	4.5	520	3000
rectangular rotor	100	5.75	700	2000
	200	6.0	1060	1600
Violet 0.8 mm	50	2.5	300	1000
round rotor	100	2.75	420	950
	200	3.0	600	800

* volume median diameter

Wand length is governed by intended use. A 5 m wand was made for treating water weeds in ponds. For most other situations, lengths of 2 m to 3 m are useful, telescopic versions are easier to carry in vehicles.

A vehicle mounted version with 2 spray heads and covering swaths of 10 m was constructed.

AWKWARD WEED CONTROL SITUATIONS WHERE THE SPRINKLER SPRAYER IS CONSIDERED A SUPERIOR DEVICE

a) AQUATIC WEEDS, such as salvinia and water hyacinth, can be treated from the bank or from a small boat.

b) DIFFICULT TERRAIN - because of its light weight, operator fatigue is minimised. Where a man can walk, plants can be sprayed, e.g. steep hillsides, creek banks, swamps, sand dunes and dense thickets; it can also be used from horseback.

c) SPRAY DRIFT onto non target plants can be eliminated by using low pressures. Fitting of the pressure restrictor (Fig. 2) virtually eliminates spray drift.

d) PUBLIC IMAGE - sprinkler sprayers are a soft approach to weed control, large trucks, red poison tanks, noisy engines, and high pressure spray guns are replaced by a quiet unobtrusive 1 man operation.

ADVANTAGES

a) Simple design, little or no power requirement.

b) Operator safety. Spray heads are 2 m or more away from the operator; held in the operating position droplets are cast away from the operator. Droplets are large and easy to see.

c) Low cost. Spray heads cost ca. 80¢. A basic hand held wand costs ca. $40.00.

d) Low weight. A 6 L plastic pneumatic knapsack with 3 m sprinkler sprayer filled ready to use weighs 7 kg. Calibrated to apply 100 L ha^{-1}, this would treat 600 m^{-2}. Spare spray heads can be carried in the pocket.

e) Spray drift is eliminated when the equipment is used at suitable low pressures (pressure restricting jet).

f) Sprinkler sprayers treat weeds faster than most hand held sprayers and brush guns. The vehicle mounted version is comparable with standard boom spray operations in rangelands treating 1 to 4 ha hr^{-1} and can be used on rough ground with high weeds.

g) Reach. The length of spray wands allows the operator to reach over the top of tall shrubs, out over water, down over banks, and into gullies; walking is minimised.

DISADVANTAGES

a) Operators need to be trained in a new concept of spray application.

b) Small isolated plants waste spray; narrowest swath width is 1 m.

c) Rotor can be fouled by spider webs - interfering with spray pattern.

WHICH HERBICIDES WORK USING THIS TECHNIQUE

Most work suggests that sprays applied as small droplets are more effective than those less finely divided, e.g. (Ennis & Williamson 1951). Richardson 1981, working with patersons curse showed that compared with dose rate, differences in droplet size and spacing caused only minor differences in kill. Similarly, Walker 1981, found the efficacy of certain herbicides was maintained when the spray liquid volume was reduced from 200 to 20 L/ha. Ambrock & Ashford 1981 showed concentrated single drop applications of glyphosate produced greater phytoxic effects than did dilute overall applications to barley plants.

Screening trials using the sprinkler sprayer have shown that if plants are highly susceptible to a particular herbicide, then this method of application will work, e.g. noogoora burr and 2,4-D amine. An acid formulation of 2,4-D (AF201) has proved effective on many plants previously considered difficult to kill with the amine salt. Similar results for other weeds have been obtained using a new formulation of dichlorprop also as the acid (AF302). Trials with glyphosate have produced excellent results.

Table 2 lists plants sprayed with certain herbicides using the sprinkler sprayer.

Table 2. List of herbicide/plant combinations found to be effective with sprinkler sprayer application (screening trials)

Plant type	Common name	Scientific name	Herbicide	Rate kg ha^{-1}
Floating aquatic	Duck weed	*Spirodela* sp.	AF100 + 2,4-D	1 *
	Red azolla	*Azolla* spp.	AF100	- *
	Salvinia	*Salvinia molesta*	AF100	- *
	Water hyacinth	*Eichhornia crassipes*	2,4-D[a]	1
	Water lettuce	*Pistia stratiotes*	AF100	- *
Emergent aquatic	Bullrush	*Typha* spp.	glyphosate	3.6
	Common reed	*Phragmites australis*	glyphosate	3.6
	Frogsmouth	*Philydrum lanuginosum*	2,4-D	3
	Jointed twigrush	*Baumea articulata*	2,4-D	5
	Lepironia	*Lepironia articulata*	2,2-DPA	5
	Para grass	*Bracharia mutica*	glyphosate	3.6
	Parrots feather	*Myriophyllum aquaticum*	2,4-D	3
	Slender knotweed	*Polygonum strigosum*	glyphosate	3.6
	Smart weed	*Polygonum decipiens*	glyphosate	3.6
	Spiny mudrice grass	*Pseudoraphis spinescens*	glyphosate	3.6
	Tall spike rush	*Eleocharis sphacelata*	2,4-D	5
	Water primrose	*Ludwigia peploides*	2,4-D	3
	Water snowflake	*Nymphoides indica*	glyphosate	3.6
Herbs	Apple of sodom	*Solanum hermannii*	2,4-D	5
	Bathurst burr	*Xanthium spinosum*	2,4-D	1 †
	Blue billygoat weed	*Ageratum houstonianum*	2,4-D	3
	Cobblers pegs	*Bidens pilosa*	2,4-D	3
	Common verbena	*Verbena officianalis*	dichlorprop[b]	3
	Crofton weed	*Eupatorium adenophorum*	glyphosate	3.6
	Curled dock	*Rumex crispus*	dichlorprop	3

Plant type	Common name	Scientific name	Herbicide	Rate kg ha^{-1}
Herbs (cont.)	Japanese clover	*Lespedeza juncea*	glyphosate	3.6
	Milky cotton bush	*Asclepias* spp.	2,4-D	5
	Mistflower	*Ageratina riparia*	glyphosate	3.6
	Morning glory	*Ipomoea purpurea*	2,4-D	3
	Needle burr	*Amaranthus spinosus*	2,4-D	5
	Noogoora burr	*Xanthium pungens*	2,4-D amine	1 Δ
	Passion vine	*Passiflora subpeltata*	2,4-D	5
	Phasey bean	*Macroptilum lathyroides*	glyphosate	3.6
	Pigface	*Carpobrotus glaucescens*	amitrole	5
	Pimpernell	*Anagallis arvensis*	dichlorprop	3
	Pink shamrock	*Oxalis latifolia*	dichlorprop	3
	Sedge	*Fimbristylis dichotoma*	glyphosate	3.6
	Small nettle	*Urtica urens*	dichlorprop	3
	Scrub nettle	*Urtica incisa*	dichlorprop	3
	Stinking roger	*Tagetes minuta*	glyphosate	3.6
	Thickhead	*Crassocephalum crepidioides*	2,4-D	3
Grasses	African star grass	*Cynodon nlemfuensis*	glyphosate	3.6
	Blady grass	*Imperata cylindrica*	glyphosate	3.6
	Green couch	*Cynodon dactylon*	glyphosate	3.6
	Kangaroo grass	*Themeda australis*	glyphosate	3.6
	Kikuyu grass	*Pennisetum clandestinum*	glyphosate	3.6
	Mossman River grass	*Cenchrus echinatus*	glyphosate	3.6
	Paspalum	*Paspalum dilatatum*	glyphosate	3.6
	Setaria	*Setaria* sp.	glyphosate	3.6
	Water couch	*Paspalum paspaloides*	glyphosate	3.6
Shrubs	African boxthorn	*Lycium ferrocissimum*	glyphosate	3.6
	Bitou bush	*Chrysanthemoides monilifera*	glyphosate	3.6
	Groundsel bush	*Baccharis halimifolia*	2,4-D	4
	Kittatinny blackberry	*Rubus bellobatus*	dichlorprop	6
	Lantana	*Lantana camara*	glyphosate	3.6
	Raspberry	*Rubus idaeus*	dichlorprop	3

* product 50 L/ha^{-1} Δ water 25 L/ha^{-1}
† water 50 L/ha^{-1} all other applications made in water 100 L/ha^{-1}
[a] 2,4-D is acid formulation (AF201) unless stated
[b] dichlorprop is acid formulation (AF302)

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