FOREST WEED CONTROL WITH DIFFERENT FORMULATIONS OF ATRAZINE, PROPYZAMIDE AND AN ATRAZINE/CYANAZINE MIXTURE APPLIED BY HAND-HELD CONTROLLED DROP APPLICATOR

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Summary Experiments were carried out in 1975 testing low volume applications applied by hand held controlled drop applicator. Two formulations of propyzamide and atrazine plus one of an atrazine/cyanazine mixture were tested.

Weed control on various grasses was tested plus crop tolerance, height growth and survival of a few conifers.

Weed control was acceptable on only two of the five sites tested. The conifers treated were unaffected by the low volume applications.

Differences between the various suspension concentrates were indicated by the different swath width produced when weed control became evident.

INTRODUCTION

The recent development of hand-held controlled drop applicators (Bals 1975, Rogers 1976, and Johnstone, et al 1977) for use with herbicides has virtues obviously attractive to the forestry situation. In previous work by the Forestry Commission (Brown and Thomson 1976), C.D.A. equipment has been used to produce small drops of oil solutions that drift onto target weeds. In this manner 2,4-D and 2,4,5-T can be used but there are limitations restricting this technique for general herbicide usage. In the establishment of young trees soil applied herbicides may be used which for reasons of product cost and reliability of performance need to be predictably placed as a swath. The Micron "Herbi" (Bals 1975) is one such machine that may enable some herbicides to be applied in very low volumes of spray liquid with drops whose trajectory is more controlled and less prone to drift.

The development of suspension concentrates suitable for use with this equipment has opened up new avenues. Jones and Allen(1976) have described some findings with atrazine and cyanazine applied in this manner but treatment was more expensive than was required by the Forestry Commission before full-scale adoption.

The purpose of this report is to compare the weed control obtained by controlled drop application (C.D.A.) using the suspension concentrate formulations with that obtained from conventional medium volume applications and wettable powder formulations.

METHODS AND MATERIALS

Suspension concentrates of propyzamide, atrazine and an atrazine/cyanazine

mixture were applied, after suitable dilution with water to offer a range of doses, through a "Herbi" at between 10 and 40 litres per hectare (l/ha). Applications of the same herbicides as wettable powders were made at medium volume using a semi-pressurised knapsack sprayer.

Dominant weeds on each site were noted prior to application of the herbicides (Table 1). Weed control score and ground cover was assessed at mid-summer and at the end of the growing season. Weed control scores were based on 1 = no weed control, 2 = less than adequate control, 3 = adequate control, 4 = good weed control and 5 = almost total weed control.

Initial tree height assessed before herbicide application prior to bud burst. Tree growth, health and survival was assessed at the end of the growing season.

Table 1.

Vegetation and Herbicide Treatment Details

	Dominant Weed Species	Conifer Crop Species
Site 1.	Calamagrostis epigejos	Pinus nigra v. maritima (Corsican pine)
Site 2.	Dactylis glomerata Arrhenatherum elatius Agrostis tenuis Agrostis gigantea Holcus lanatus	Picea sitchensis (Sitka spruce)
Site 3.	Dactylis glomerata Deschampsia spp. Molinia caerulea Agrostis spp. Holcus lanatus	Picea sitchensis (Sitka spruce)
Site 4.	Holcus lanatus Agropyron repens Agrostis spp. Poa spp.	Picea abies (Norway spruce)
Site 5.	Deschampsia caespitosa Dactylis glomerata Agrostis spp. Juncus effusus	Pseudotsuga menziesii (Douglas fir)

Site	Herbicide	Application Date	Dose (kg ai/ha)	Volume rates (l/ha)
Site 1 & 2	Propyzamide (s.c)	Dec. 1975	1.0, 1.5, 2.0, 2.5	10, 15, 20, 25
	(w.p)	Dec. 1975	2.0	300
	Paraquat	June 1976	1.0	300
Site 3, 4 & 5	Propyzamide (s.c)	Dec. 1975	1.0, 1.5, 2.0, 2.5	10, 15, 20, 25
	(w.p)	Dec. 1975	1.5	300
	Atrazine (s.c)	March 1976	2, 4, 6, 8	10, 20, 30, 40
	(w.p)	March 1976	4 or 6	300
	Atrazine/ cyanazine (s.c)	March 1976	2, 4, 6, 8	8, 12, 18, 24
	(w.p)	March 1976	4 or 6	300

RESULTS

At sites 1 and 2 neither Calamagrostis epigejos nor Dactylis glomerata was controlled by propyzamide. The other grasses which were present on site 2 were well controlled by both suspension concentrates and the wettable powder treatment.

None of the conifers was affected by the overall spray of the suspension concentrate or the wettable powder of propyzamide at any rate.

At site 3 Dactylis glomerata was dominant and was largely unaffected by the three suspension concentrate formulations applied containing atrazine. Only the higher rates of the propyzamide suspension concentrates gave adequate weed control. The wettable powder at 1.5 kg ai/ha failed to control the Dactylis glomerata adequately.

The conifer crop was unaffected by any treatment.

At site 4 Holcus lanatus was abundant while on site 5 Deschampsia caespitosa was the dominant grass species.

Mid-summer assessments in 1976 indicated that the atrazine/cyanazine suspension concentrate would only give adequate control at the higher rates while the wettable powder was equally effective at 4 kg ai/ha. Atrazine suspension concentrates were supplied by Fisons and Ciba Geigy. The latter gave adequate control at 4 kg ai/ha while the former was only adequate at 6 kg ai/ha. The wettable powder applied at 4 kg ai/ha and at medium volume gave adequate control on both sites.

The propyzamide suspension concentrates were supplied by Shell and PBI, the latter supplying a "make-it-yourself" kit. They both gave adequate control at the lowest rate but the P.B.I. formulation gave better control throughout. The wettable powder at 1.5 kg ai/ha gave almost total weed control.

End of season assessments indicated that weed control had decreased. The atrazine/cyanazine suspension concentrate gave adequate control of Holcus lanatus on site 4 at 6 kg ai/ha but barely gave adequate weed control of Deschampsia caespitosa at site 5 at the higher rates. The wettable powder at 4 kg ai/ha was still giving good weed control.

The atrazine suspension concentrates gave adequate weed control at 6 kg ai/ha. The Ciba Geigy formulation was slightly better than the Fisons formulation. The wettable powder at 4 kg ai/ha gave adequate weed control at both sites.
The propyzamide suspension concentrates gave adequate to good control at 1.0 kg ai/ha with the exception of the Shell formulation on site 5, which was effective at the higher rate of 1.5 kg ai/ha. The P.B.I. "make-it-yourself" kit was still giving slightly superior weed control. The wettable powder at 1.5 kg ai/ha applied at medium volume in December 1975 was still giving excellent grass control at both sites.

Due to damage caused by the 1976 drought to the planted Douglas fir no assessment of height or health was done at the end of 1976. Propyzamide treated plots gave the best survival and treated plots survived better than the untreated control on site 5.

Treated Norway spruce on site 4 grew taller than untreated controls and height growth improved as rates increased. Health was unaffected by any of the herbicides. The propyzamide wettable powder treatment gave good survival at 88% and was better than propyzamide suspension concentrate plot survivals. Table 2 gives end of season results.

Table 2

End of season assessments 1976

Crop Species Herbicide Firms Initial	Site 4 Picea abies (Norway spruce)						Site 5 Pseudotsuga menziesii (Douglas fir)						Controls	
	Rates kg/ha		A C	A F	*A/C S	Pr P	Pr S	A C	A F	*A/C S	Pr P	Pr S	4	5
	A	Pr											1.0	1.0
Weed Control Scores for grasses. 1 = no control 3 = adequate 5 = excellent (total)	2	1.0 s.c	1.5	1.3	1.0	3.7	2.5	2.5	1.7	1.7	4.8	3.3		
	4	1.5 s.c	2.5	2.3	2.3	4.2	3.2	3.0	2.5	2.2	4.8	4.7		
	6	2.0 s.c	4.3	3.7	3.0	4.3	3.2	3.7	3.0	3.0	5.0	5.0		
	8	2.5 s.c	4.5	4.5	4.3	4.7	3.5	4.2	3.2	2.5	5.0	4.5		
	4	1.5 w.p	3.3		3.2		4.2	3.8		3.7		5.0		
	A	Pr											88	75
% ground cover of grasses	2	1.0 s.c	72	78	85	18	38	48	67	50	4	18		
	4	1.5 s.c	37	45	52	13	32	39	33	38	3	4		
	6	2.0 s.c	7	14	29	8	23	17	20	22	0	1		
	8	2.5 s.c	5	6	9	9	19	5	18	37	2	5		
	4	1.5 w.p	20		17		8	12		17		2		
	A	Pr											15.1	-
Height of crop species (cms)	2	1.0 s.c	14.4	15.4	17.8	16.9	18.0	No assessment due to crop damage caused by drought						
	4	1.5 s.c	17.4	16.0	17.3	15.5	19.6							
	6	2.0 s.c	18.3	17.8	18.4	18.2	17.3							
	8	2.5 s.c	18.1	18.5	19.0	16.4	15.2							
	4	1.5 w.p	18.9		19.5		15.5							
	A	Pr											3.0	-
Health Score on crop 1 = healthy 5 = dead	2	1.0 s.c	3.5	3.5	2.1	3.0	3.2	No assessment due to crop damage caused by drought						
	4	1.5 s.c	2.3	2.4	2.0	2.8	2.3							
	6	2.0 s.c	1.6	2.4	1.9	2.2	3.0							
	8	2.5 s.c	2.8	2.1	1.7	2.1	2.9							
	4	1.5 w.p	2.8		2.0		1.8							
	A	Pr											63	8
Survival %	2	1.0 s.c	57	52	83	55	52	5	8	18	30	32		
	4	1.5 s.c	78	78	85	62	72	20	15	17	22	23		
	6	2.0 s.c	92	68	80	78	60	13	25	25	8	38		
	8	2.5 s.c	57	78	85	80	67	13	23	12	25	37		
	4	1.5 w.p	60		77		88	17		27		25		

Herbicides

A = Atrazine
A/c = Atrazine/cyanazine
Pr = Propyzamide

Firms

C = Ciba Geigy
F = Fisons
P = Pan Brittanic Industries
S = Shell

*The rates of the atrazine/cyanazine 50/50 mixture used were the same as for atrazine.

These trials had two main limitations. The two formulations of propyzamide and atrazine appeared to behave quite differently when sprayed under similar conditions on different sites, but behaviour remained the same within a formulation. This obviously led to different rates and different volumes of application to those predicted and this is not accounted for in the interpretation of the results.

In addition it was planned that volumes should vary between rates but that all sites would receive the same treatment. It is not possible to determine what effect this might have had on herbicide performance within a herbicide formulation. The rates and volumes tested were those which were found to be the most practical.

DISCUSSION

The performance of the suspension concentrates was not altogether encouraging due to the apparent decrease in activity of the triazine compounds and the unpredictability of swath width when using different herbicides and different formulations.

In addition productivity advantages associated with controlled drop application using the "Herbi" has not yet been clearly shown when comparing with medium volume applications.

It is accepted that there are several managerial advantages where supply and distribution of diluent for medium volume applications by hand is difficult as discussed by Rogers (1976). The protective clothing associated with low volume applications is similar to that required for medium volume applications described by Brown (1975) Rogers (1976) with the exception that a face shield may be desirable for mixing suspension concentrates to avoid splash back from containers. The task of weeding is made less arduous and more comfortable during warm weather due to the reduction in effort required to transport light weight c.d.a. equipment.

The advent of tractor mounted equipment as described by Taylor and Merritt (1975) and Taylor, Merritt and Drinkwater (1976) has provided a further field for development in the use of forest herbicides. There may be considerable managerial advantages and some reasonable productivity advantages to be gained from such a development. The operator safety and protection aspect would also be improved. The machine may have limitations with respect to ground conditions and slope, and equipment cleansing procedures not associated with medium volume equipment are necessary. Trials to date have been reasonably successful.

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SPOT SPRAYING WITH HAND-HELD CDA EQUIPMENT IN AUSTRALIA; A PROGRESS REPORT ON SUITABILITY OF EQUIPMENT AND HERBICIDES

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Summary The Micron Herbi, the Turbair Forester and the Union Carbide 'Sevin' rotary atomizers were examined for their suitability to CDA spot spraying in Victoria, Australia. Each machine had some desirable attributes and a compromise may be the most suitable. Field trials with the Herbi and the Forester, using specially prepared formulations of 2, 4-D amine and ester, 2, 4, 5-T and DPX 1108 demonstrated that some weeds can be controlled but others less so.

INTRODUCTION

The spot spraying of weeds, defined as "the treatment of plants on an individual basis with a constant concentration of herbicide", is widely practised in Australia. An estimated 100 million litres of herbicide spray solution is applied annually by spot spray techniques in the state of Victoria alone. This method of application is widely used and reflects the effort devoted to controlling noxious weeds, and weeds in non crop areas, e.g. industrial sites, road and rail easements and channels. Spray is usually applied by a hydraulic spraying system consisting of an engine, pump, tank, hose, hand gun and a suitable pressure atomiser such as a solid cone orifice with swirl plate. Normally target plants are sprayed until they are thoroughly wetted. It is probable that these systems are so widely used because they were the first manufactured and because they can be used to spray single plants or large clumps. Other application systems widely used for spot spraying are knapsack sprayers, which also use a pressure atomiser, and motorised misting machines which use twin fluid atomisers.

Descriptions of available spot spraying systems have been made by Ripper (1956) and Potts (1958). Combellack (1978) suggested that an alternative spot spray application system could be considered in Australia and suggested the use of a hand held rotary atomiser in normal spot spray situations particularly where control over drift is essential or water supply restrictive.

Many papers have described hand-held rotary atomiser equipment and its performance (e.g. Bals, 1975; Rogers, E. V. 1975; Combellack and Shaw, 1977) but none have discussed its suitability as a spot spray system. This paper describes work in Australia which is developing such a technique (Combellack and Harris, 1978; Shaw and Combellack, 1978).

METHODS AND MATERIALS

Equipment

Table 1 Pre-spraying evaluation of three hand-held CDA sprayers for spot spraying in Victoria, Australia

Model	Herbi	Forester	Sevin	Comments
Manufacturer	Micron Sprayers, Three Mills, Bromyard, Herefordshire	Turbair Ltd, Britannia House, Waltham Cross, Hertforshire	Union Carbide (Aust) Ltd., St Kilda Road, Melbourne	
Construction of main body	Mainly plastic - too frail	Zinc coated steel tube- adequate strength	Moulded mild steel - very robust	Must be durable and resistant to corrosion.
Weight (kg)	2.43	Heavy but well distributed weight - 4.50	3.46	
Electrical - supply	8x1.5v dry cell batteries.	2x6v "lantern" batteries.	8x1.5v dry cell batteries.	Power source should be readily available.
- switch	Poor, not very positive	Positive but difficult to operate wearing gloves	Very positive and convenient	Switch must be easy to locate and be positive.
Motor - sealing from spray liquid	Well sealed with splash plate.	No splash plate & would probably leak spray liquid into motor after frequent stop/starts.	Not sufficiently effective.	Should use minimum power; be well sealed & controlled to revolve at 2000-3000 rev/min.
- speed control	Excellent control even down to 4 volts and insensitive to load	Voltage dependent and sensitive to load	Very high speed - spray drops too small for spot spraying herbicides.	
Spinning disc - number & design	1 cup shaped disc	3 pairs of dished discs	5 pairs of dished discs	Single disc type with toothed perimeter offered most controlled drop formation.
- located by	Push fit on to spindle.	Push fit on to spindle.	Retained by very weak screw.	
- drop production	Little variation in drop size.	Much variation in drop size.	Very poor control over drop size.	

Spray liquid reservoir - location and control of flow rate	Could not be used to spot spray weeds >2m high. Liquid supply altered to Micron Ulva type. For different rates of supply, tubes with differing orifice sizes supplied. Breather tube to reservoir frequently blocked.	One rate of liquid flow through brass orifice. Holding thread designed to leak air to reservoir. Very effective.	One rate of liquid flow - orifice integral part of moulding. Holding thread designed to leak air to reservoir. Very effective.	Feed tube orifice must be changeable so that flow rate can be varied with differing viscosities of liquids. Reservoir should be 1 - 1.5 l capacity with snap fit for speed.
Length of unit which affects reach of operator	1.55 m - too short	1.85 m - ideal	1.85 m - ideal	Overall length should be at least 1.8 m.
Transportation	1 m when collapsed - very convenient but advantage reduced by the need to remove batteries.	1 m when folded - very convenient and easy but electrical wires could be damaged.	1.35 m when folded - convenient and easy	Should be easily reduced in length to less than 1.2 m.
Hand-grip	4 cm diameter hand-grip - excellent	2 cm diameter hand-grip - too small	4 cm diameter hand-grip - excellent	Hand-grip must be 4 cm in diameter.

Table 2. The theoretical volume rates (as calculated from flow rates) used in the field

		2,4-D ester			2,4-D amine			2,4,5-T		DPX 1108		
	% concn of a.i.	5	15	20	5	15	20	5	10	20	31	36
Herbi	ml/sec	1.73	1.73	1.85	1.80	1.75	1.85	1.75	1.75	1.69	1.70	1.69
	l/ha	14.4	14.4	15.4	14.9	14.6	15.4	29.2	29.2	28.0	28.2	28.0
Forester	ml/sec	1.38	1.42	1.40	1.39	1.20	1.31	1.39	1.39			
	l/ha	11.5	11.8	11.6	11.5	10.0	10.9	23.0	23.0			

The volume rates cited are derived from swath widths of either 1.2m (2,4-D ester and amine) or 0.6m (2,4,5-T and DPX 1108) at application speeds of 1m/sec.

Three CDA hand-held spraying units have been tested, viz Micron "Herbi", Tubair "Forester" and Union Carbide "Sevin". Each machine, although in many respects very similar, had differing attributes for spot spraying. Table 1 presents these various criteria. To establish the plants' response to this contrasting application method some of those factors (e.g. evenness of drop production and herbicide supply) are considered by us to be more important in the short term than others (e.g. robustness and transportation) in selecting equipment for field trials. However, before general adoption of such a technique, all these factors need careful scrutiny. Eventually it may appear that a compromise machine based on the Sevin battery holder and extension tube, a Herbi head, motor and rotary atomizer with an ULVA feedtube and reservoir attached to it, offers the best available CDA system.

For field trials, the "Herbi" (after modification) and the "Forester" were used. The rotary atomiser was held 15-20 cm above herbaceous weeds by the operator who walked at a speed of 1m/sec. A swath of 1.2 m was sprayed with each pass. When thickets of woody weeds were sprayed, e.g. Ulex europoeus and Rubus fruticosus, the rotary atomiser was moved at 1m/sec over the canopy face at a distance of 25-50cm and each successive pass was made at 0.6 m intervals. Table 2 presents the relevent calibration data for each machine.

A Spraying System handgun fitted with a D6 nozzle and No. 45 swirl plate at a pressure of 7 bars was used for conventional hydraulic nozzle spot spraying of woody weeds, whereas a "Capri" knapsack sprayer, fitted with their own brand of hollow cone nozzle and pressurised at 2 bars, was used for herbaceous weeds.

Weeds

Replicated trials, with weeds representative of those spot-sprayed in Australia were laid out. Three woody weed species were selected - viz.

Rubus fruticosus (blackberry), Ulex europoeus (furze), Rosa rubiginosa (sweet briar), and four herbaceous species - viz.

Silybum marianum (variegated thistle), Carduus tenuiflorus and C.pycnocephalus (shore thistle), Echium plantagineym (Patterson's curse) and Senecio jacobaea (ragwort)

Herbicides

Commercially available formulations of 2, 4, 5-T (80% a i) and DPX 1108 (ammonium ethyl carbonyl phosphate - 40% a i) were used, after appropriate dilution for conventional treatment of the woody weeds. Special formulations of the two active ingredients were also applied by rotary atomiser to the same species.

Similarly, two commercial formulations of 2, 4-D ester (80% w/v ai) and amine (50% a i) were applied to the herbaceous weeds, and again special formulations of the same being used for the CDA treatments.

In the preparation of the special CDA formulations consideration was given to the fact that temperature changes may alter viscosity and this may in turn affect flow rates and hence drop size (Bals,1969); that surfactants must be added to aqueous formulations to wet the surface of the disc; that the carrier must be physically and chemically stable with the active ingredient (Wrigley, 1973).

One important extra requirment for the formulations used for spot spraying is the inclusion of a suitable marking agent to enable the operator to determine which plant, or part of the plant has been treated. A number of marking agents have been tested and the most suitable was found to be titonium dioxide for both oil and aqueous formulations (Shaw and Combellack 1978). To ensure that this material can be suspended the addition of a fumed silica is necessary and high shear mixers must be used to prepare the formulations.

RESULTS

Woody species

Rubus fruticosus, (Table 3) At all three sites CDA applications of 2, 4, 5-T at 5 and 10% ai gave comparable control to the conventional method as judged by both foliage reduction and cane dieback. 2, 4, 5-T applied at a 10% concentration by CDA showed significantly better cane dieback at one site. DPX 1108 was more variable in performance with all treatments worse than the 2, 4, 5-T. At one site however foliage reduction was very good. This general lack of performance may be due to the slowness with which the product exhibits herbicidal effect - sometimes 12 - 15 months after spraying being a necessary time interval.

Ulex europaeus (Table 4) Control with 2, 4, 5-T was poor at both sites with the CDA treatment and at one of them for the conventional. The time of application, though not the optimum according to Parsons and Amor (1968) is still considered to be favourable by the same author. The very dry conditions prior to spraying may have influenced the results.

Rosa rubiginosa (Table 4) Though control of this weed with 2, 4, 5-T is generally regarded as erratic it is still sprayed with this material as it often occurs in association with blackberry and furze. The results obtained with CDA applications of 2, 4, 5-T indicate that very poor control of this species must be expected. Higher volume treatments provided significantly better defoliation than either CDA treatment.

Control of this weed with DPX 1108 was excellent with the spot spray conventional application and very effective with the two CDA treatments.

Herbaceous species

Silybum marianum (Table 5) Results clearly show that both 2, 4-D amine and ester have provided excellent control of this weed, irrespective of mode of application.

Carduus tenuiflorus and C. pycnocephalus (Table 6) At two of the sites excellent control was obtained with all treatments whereas at the other site, control was poor. Variable results on this weed have been previously reported (Parsons 1963).

Echium plantagineum (Table 7) All treatments gave over 85% reduction in flowering heads - the amine formulations of 2, 4-D applied by CDA being comparable to the conventional whereas the ester formulation was not as effective.

Senecio jacobaea (Table 7) Both formulation and application method had little effect, the overall level of control being good.

DISCUSSION

The results on woody weeds clearly undicate that whilst the CDA technique tested by us can be used now for the control of Rubus fruticosus it is not yet practical against Ulex europaeus or Rosa rubiginosa. The immediate value of this technique for R. fruticosus control is in areas where there are small infestations, in inaccessible situations and in areas where control over spray drift is essential, i.e. in close proximity to enviromentally sensitive areas or susceptible crops.

Results on herbaceous weeds were also very encouraging particularly as the control of Silybum marianam, Senecio jacobaea and Carduus spp was equally as good with CDA as with conventional spot spraying. The results show that a 5% a. i. formulation of either 2, 4-D iso octyl ester or dimethylamine salt is adequate for the control of small plants of the more susceptible species e.g. Silybum marianum, and Carduus spp.. Control of more resistent weeds, e.g. Senecio jacobaea, and larger plants of the other weeds tested, probably requires a 15% a. i. formulation of these products.

The encouraging results on herbaceous weeds with the CDA equipment tested suggests that it could be used by growers and contractors for the control of a range of plants in particular where they occur in small isolated patches, or as single plants, or where they occur close to susceptible non-target species.

Further tests are under way to determine the effectiveness of the CDA technique using 2, 4-D and 2, 4, 5-T and other herbicides on a range of other plant species.

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Table 3. The response of Rubus fruticosus to DPX 1108 and 2,4,5-T after spot treatment with Micron "Herbi".

Application details:	Stage of growth	Date	Method	Herbicide	% concn of a.i.	Assessment (0=no effect, 9=100% effect)		
						cane dieback		
						Site	1	2	3
						Date	17.10.77	12.10.77	11.10.77
Site 1	1.5-2m high	29.2.77	Herbi	DPX 1108	20		0.5	1.0	4.5
Site 2	1.5-2m high	15.2.77			31		2.0	3.0	3.5
Site 3	1.5-2m high	16.2.77	Conv.		0.4		1.5	2.0	3.0
			Herbi	2,4,5-T iso octyl ester	5		7.0	9.0	7.5
					10		7.5	8.5	6.5
			Conv.	2,4,5-T butyl ester	0.07		8.0	8.5	6.5
			Unsprayed control				0	0	0
						Foliage reduction			
			Herbi	DPX 1108	20		2.0	0.0	6.5
					31		2.5	2.0	6.5
			Conv.		0.4		2.0	8.0	6.0
			Herbi	2,4,5-T iso octyl ester	5		7.5	9.0	8.5
					10		7.8	8.5	9.0
			Conv.	2,4,5-T butyl ester	0.07		8.0	9.0	8.0
			Unsprayed control				0	0	0

Table 4. The response of Ulex europaeus and Rosa rubiginosa to DPX 1108 and 2,4,5-T after spot treatment with the Micron "Herbi"

Application details;	Stage of growth	Date	Method	Herbicide	% concn of a.i.	Defoliation (0=no effect, 9=100% effect)	
						Site 4A	4B
Ulex europaeus						Date 7.12.77	11.10.77
Site 4A	1-2m high	25.2.77	Herbi	2,4,5-T iso octyl ester	5	6.8	2.0
4B	1-2m high	24.3.77			10	5.3	2.0
			Conv.	2,4,5-T butyl ester	0.1	9.0	1.3
				Unsprayed control		0	0
						Site 5	
Rosa rubiginosa						Date 17.10.77	
Site 5	>2m high	1.3.77	Herbi	DPX 1108	20	7.0	
					36	8.3	
			Conv.		0.4	9.0	
			Herbi	2,4,5-T iso octyl ester	5	3.0	
					10	3.0	
			Conv.	2,4,5-T butyl ester	0.1	7.0	
				Unsprayed control		0	

Table 5. The response of Silybum marianum to 2,4-D amine and ester after spot treatment by the Turbair Forester

Application details;	Stage of growth	Date	Method	Herbicide	% concn of a.i.	Assessment		
						Foliage reduction (0=no effect, 9=100% effect)		Plants/15m^2
Silybum marianum						Site		
Site 1A	20-30cm diameter	25.5.77				Date 28.6.77	20.9.77	20.10.77
1B	20-30cm diameter	7.7.77						
2	2-8 cm diameter	7.7.77						
			Forester	2,4-D amine	4	9.0	-	-
					5	8.5	6.25	0.5
					20	-	7.75	0.3
			Conv.		0.1	7.5	-	-
					0.2	-	7.25	1.0
			Forester	2,4-D iso octyl ester	4	8.5	-	-
					5	8.5	7.25	1.0
					20	-	9.0	0.3
			Conv.		0.16	-	8.0	0.3
					0.32	8.5	-	-
			Unsprayed control			0	0	0

Table 6. The response of two Carduus spps to 2,4-D amine and ester after spot treatment by the Turbair Forester

Application details;	Stage of growth	Date	Method	Herbicide	% concn of a.i.	Assessment		
						Plants/3m^2	/3m^2	/2m^2
Carduus tenuiflorus and C. pyonocephalus						Site 3A	3B	4
						Date 20.10.77	20.10.77	25.10.77
Site 3A	2-6 cm high	12.5.77						
3B	2-6 cm high	12.5.77						
4	2-6 cm high	11.5.77						
			Forester	2,4-D amine	4	0	1.0	106.50
					5	-	0.4	-
			Conv.		0.1	0	-	108.25
					0.2	-	5.0	-
			Forester	2,4-D iso octyl ester	4	0	1.0	90.75
					5	-	1.8	-
			Conv.		0.1	0	0.2	-
					0.32	-	-	50.00
			Unsprayed control			39.4	40.4	144.25

Table 7. The response of Echium plantagineum and Senecio jacobaea to 2,4-D amine and ester after spot treatment by the Turbair Forester

Application details;	Stage of growth	Date	Method	Herbicide	% concn of a.i.	Plants/2m^2	
Echium plantagineum						Site	5	6
Both sites	2.5-10 cm diameter	21.6.77				Date	17.10.77	17.10.77
			Forester	2,4-D amine	4		6.90	26.19
					5		3.24	21.54
			Conv.		0.2		1.34	29.60
			Forester	2,4-D iso octyl ester	4		23.48	31.03
					5		9.22	18.50
			Conv.		0.16		0.41	3.31
				Unsprayed control			148.45	297.03
Senecio jacobaea								
	20-30 cm diameter	6.6.77				Date	8.11.77	
			Forester	2,4-D amine	15		6.30	
					20		7.85	
			Conv.		0.2		12.54	
			Forester	2,4-D iso octyl ester	15		9.01	
					20		14.27	
			Conv.		0.16		22.06	
				Unsprayed control			102.42	