Scrub Weeds

PROPERTIES AND ACTIVITY OF TRICLOPYR ON SOME NEW ZEALAND BRUSHWEEDS

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Summary

Triclopyr is a new, highly translocated herbicide which, when applied as a foliar or basal spray, was more active than 2,4 5-T in controlling regrowing brushweeds such as barberry (*Berberis glaucocarpa*) and sweet brier (*Rosa rubiginosa*). Both amine and ester were suitable, used at around 200g/100 litres alone, or at lower rates in mixture with picloram. Triclopyr was also active on a number of other brushweeds as a broadcast treatment at 4 kg/ha. Toxicity and soil residue data indicated triclopyr was well-suited and safe to use for farm brushweed control. Its use for broadleaf weed control appeared limited.

INTRODUCTION

Brush and scrub weeds continue to be the largest group of problem weeds in New Zealand. Their control has relied to a large extent on the development and use of 2,4,5-T. However, 2,4,5-T has provided inconsistent control of many resprouting species such as blackberry, barberry and sweet brier. The addition of picloram greatly improves the control of these species (Upritchard 1969), but its toxicity to clovers (*Trifolium* spp), its long soil residual life and relatively high manufacturing cost has limited the rate which can be applied and the extent of its use.

In the USA triclopyr had shown promising activity against many resprouting trees (e.g. ash (*Fraxinus excelsior*), oaks (*Quercus* spp), and willow (*Salix* spp) and brushweeds including blackberry, hawthorn (*Crataegus laevigata*), multiflora rose (*Rosa multiflora*), and horse nettle (*Solanum carolinense*), yet was less persistent in the soil than picloram (Byrd *et al* 1975; Haagsma 1975). This paper described the chemical and biological properties of triclopyr and reports some of the New Zealand field evaluation results. A separate paper at this conference (Forgie and Saunders 1977) deals specifically with blackberry control.

CHEMICAL AND TOXICOLOGICAL PROPERTIES

Triclopyr is the common name for 3,5,6-trichloro-2-pyridinyloxy acetic acid. It is a white solid with water solubility of 440 ppm, moderate oral toxicity to mammals (LD50 = 713 mg/kg rat) and low toxicity to birds (LC50 = 5000 ppm mallard duck) and fish (LC50 = 117 ppm rainbow trout). It has a low vapour pressure (1.26×10^{-6} mm Hg at 25°C). No teratogenic or mutagenic effects have been

Proc. 30th N.Z. Weed and Pest Control Conf.

Scrub Weeds

observed and bioconcentration has not occurred in pond studies. Most ingested triclopyr is excreted unchanged in the urine although small amounts may be found in the faeces and milk. The amine formulation of triclopyr is very stable but mildly corrosive and may cause eye inflammation and milk skin irritation.

Formulations used in the trials were liquids containing triclopyr either as the triethylamine (A) water soluble salt (360g/litre) or the butoxyethanol ester (EC) (400 or 480 g/litre). Picloram when added to the sprays was as the potassium salt, while the standard in all trials was 2,4,5-T butyl ester.

BIOLOGICAL ACTION

Triclopyr is absorbed by both leaves and roots and readily translocates within sensitive plants, inducing characteristic auxin-type responses. Brushweeds appear to respond at any growth stage provided conditions are adequate for normal growth. Sprayed plants gradually darken or turn red over a period of 2-10 weeks, depending on the growth rate at the time, until the leaves eventually turn brown, or if deciduous fall off. Regrowth, if it occurs, is normal. Broadleaf weeds are most susceptible at a young stage or pre-emergence.

BARBERRY AND SWEET BRIER

In view of the activity of triclopyr against blackberry, field trials were also conducted on a closely related brushweed sweet brier; as well as on barberry. Table 1 summarises five of these trials which were laid down during 1975-76 in Taranaki (barberry) and Canterbury/Otago (sweet brier) on 3-4 single-bush replicates using a brush-gun cover spray. Regular assessments of control (see Upritchard 1969 for details) were made, but only the last is shown.

TABLE 1: Percent control of barberry and sweet brier with triclopyr amine (A) and ester (EC)

Treatment	g/100 litres	<i>Barberry</i>			<i>Sweet Brier</i>		
		MA	Apr	Oct	Mar	Jan	Feb
		ME	21	15	14	13	12
triclopyr A	200		—	—	93	—	—
	400		100	100	—	—	—
triclopyr EC	200		100	100	65	60	72
	400		100	100	—	—	—
triclopyr EC + picloram	100 + 19		—	—	—	100	—
	100 + 25		—	—	97	—	88
	200 + 50		100	100	100	—	—
2,4,5-T	200		—	—	—	10	54
	400		0	30	37	—	—
2,4,5-T + picloram	100 + 25		—	—	57	100	56
	200 + 50		100	90	70	—	—

MA = Month applied. ME = Months elapsed at last assessment.

Scrub Weeds

Triclopyr showed excellent activity on barberry, achieving 100% control from 200g/100 litres of either ester or amine formulations in the first two trials when applied to "run-off". Results in the third trial, which received only a light foliage spray, were not as good, except when picloram was added. 2,4,5-T on its own gave poor results, but in mixture with picloram gave good control. Both spring and autumn applications were successful.

Cut-stump applications of 20g/litre triclopyr EC in diesel also gave complete regrowth control, which compared favourably with the rates required for 2,4,5-T (36g/litre) and 2,4,5-T + picloram (20 + 5g/litre).

A *basal spray* of 12g/litre triclopyr EC in diesel applied in March to 4m high bushes has also been most promising, with 70-100% leaf drop after 12 months. Latest reports from Europe using these methods to apply triclopyr to birch (*Betula pendula*) and oaks suggest comparable results can be achieved by replacing the diesel carrier with water plus 1% surfactant. Further trials have been laid down to confirm this, since it would simplify and reduce the cost of what is a very effective method for controlling both barberry and sweet brier.

The results of sweet brier control are not as clear-cut as with barberry. Triclopyr definitely shows more activity than 2,4,5-T, but rates higher than 200g/100 litres or mixtures of picloram/triclopyr may be needed for a high level of control. The results in these trials might also have been improved if application had been made in the spring.

OTHER SPECIES

Triclopyr has also shown promising activity on other brush weeds at the following rates: broom (4 kg/ha); tree lupin (1); woolly nightshade (4); gorse (4); blackberry (4); wineberry (*Aristotelia serrata*) (8); wild thyme (*Thymus vulgaris*) (8).

Species on which triclopyr has shown little activity at the highest rates tried include: manuka (*Leptospermum scoparium*) (8 kg/ha); tauhinu (*Cassinia* spp) (10); buddleia (*Buddleia* spp) (4); bracken (*Pteridium aquilinum* var *esculentum*) (8).

CLOVER TOLERANCE AND BROADLEAF WEED ACTIVITY

One aspect of particular importance in our farming system is the toxicity of foliar applications of a brushweed herbicide to white clover (*Trifolium repens*) and pasture grasses. To evaluate this aspect of triclopyr, two small-scale 3-replicate trials (as described by Naish 1975) were laid down during 1973-74 on a close-grazed white clover-dominant pasture in North Taranaki. The results of these trials are shown in Table 2, together with the control of Californian thistle (*Cirsium arvense*) which occurred in one trial and ragwort (*Senecio jacobaea*) control from a third trial.

Triclopyr caused more damage to white clover than 2,4-D amine, particularly from the February application, but considerably less than picloram. It appears unlikely that more than 0.5-1 kg/ha triclopyr can be used as a pasture spray without seriously affecting the white clover component. Although not evident in these trials, grass burn has been

Scrub Weeds

TABLE 2: Percent clover content, Californian thistle and ragwort control in pastures sprayed with triclopyr.

Treatment	kg/ha	MA	% clover content			Californian thistle	Ragwort
						Dec	Jun
			ME	1	10	2	10
triclopyr A	0.5		26	33	10	57	—
	1.0		20	20	7	57	15
	2.0		7	12	3	70	5
2,4-D amine	2.0		36	45	35	77	45
2,4-D amine + picloram	1 + 0.25		2	3	0	88	90
untreated			40	53	50	0	0

MA = Month applied

ME = Months elapsed when assessed.

noticed at high rates (6-8 kg/ha) under certain conditions, but the effect is short-lived.

In these trials, Californian thistle control with triclopyr was only comparable to 2,4-D at a rate which was too damaging to white clover. Its activity against ragwort was poor. Broadleaf weeds which triclopyr has shown specific activity against include chickweed (*Stellaria media*), docks (*Rumex* spp), fennel (*Foeniculum vulgare*), geranium (*Geranium* spp), nettle (*Urtica urens*), nodding (*Carduus nutans*) and variegated thistle (*Silybum marianum*). Some annual grasses are also controlled. However, apart from showing promise for pre- and post-emergence weed control in rice and wheat, triclopyr appears most suited to brushweed control as an adjunct to 2,4,5-T and picloram.

SOIL RESIDUES

Soil residual life is also an important feature of a brushweed herbicide in New Zealand (MacDiarmid 1975). Results from field trials in six states in USA showed the average half life (by chemical analysis) in soil of 10 kg/ha triclopyr was 46 days. This is more than 2,4,5-T (14 days) but considerably less than picloram (200 days). To examine the residue status of triclopyr in New Zealand soils, samples from pasture and brushweed field trials were collected for bioassay using the method described by MacDiarmid (1975). As the summary in Table 3 shows, virtually no residues could be detected in any of the seven trials 3-4 months after applications of triclopyr at rates as high as 12 kg/ha. For all practical purposes, triclopyr appears no more residual than 2,4,5-T and should cause none of the residue problems encountered with picloram.

Laboratory studies conducted in the USA to try and explain the fate of triclopyr in the environment show that triclopyr leaches in soil at a similar rate to 2,4-D. It is degraded by microbial action into the pyridinol and eventually into CO₂ and soil organic matter; and photodecomposes rapidly in water, with a half-life of 24 hours. It does not hydrolyse in water.

Scrub Weeds

TABLE 3: Clover bioassay rating (0-10) for triclopyr and picloram in soil samples from seven field trials (0 = no effect on clover, 10 = severe damage)

Location	(No. reps)	triclopyr			picloram		
		kg/ha	1	3-4 Mth	kg/ha	1	3-4 Mth
Taieri	(4)	4	0	—	0.5	1.3	—
Mosgiel	(2)	8	0	—	—	—	—
New Plymouth	(2)	2	0	—	0.25	4.6	—
New Plymouth	(2)	4	—	0	0.5	—	5.5
New Plymouth	(2)	6	—	0	1.0	—	6.5
Hikurangi	(2)	8	—	0.2	1.0	—	2.3
Dargaville	(2)	12	—	1.2	1.0	—	4.2

* Bioassay rating less than 4 permits white clover establishment.

CONCLUSION

Triclopyr offers an excellent alternative to 2,4,5-T for controlling many New Zealand brushweeds, particularly deciduous resprouting species such as barberry and sweet brier. Its ready uptake and translocation within the plant makes it suitable either as a foliar or basal spray. It has a short residual life, low toxicity to pasture grasses, moderate toxicity to clover and low oral and dermal toxicity which should make it acceptable to farmers for brushweed control.

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