

## EVALUATION OF SURFACTANTS FOR INCREASING THE EFFICACY OF TRICLOPYR ON GORSE IN HAWAII

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*Summary.* Field trials were conducted to evaluate different commercial surfactants for their ability to increase the efficacy of triclopyr on gorse (*Ulex europaeus*) in the Humuula district, elevation ca 1800 m, on the island of Hawaii. Silwet L-77® (polyalkyleneoxide modified polydimethylsiloxane, hereafter L-77) increased the efficacy of 1.6 kg a.e./ha triclopyr (butoxyethyl ester) over an unlabelled citrus oil emulsion (hereafter CIT) but not significantly over two other surfactants. L-77 did increase the efficacy of the triethylamine salt of triclopyr at 1.0 kg/ha over the other surfactants used, especially in the mortality rates of treated gorse plants, 80% kill in contrast to 0-10% for other surfactant treatments. These results suggested that triclopyr amine with L-77 would be more effective in controlling gorse than triclopyr ester with any of the surfactants evaluated with it.

### INTRODUCTION

Gorse infests 14,000 ha between 1230 m and 2155 m elevation at two locations in Hawaii, Humuula on the northern slope of Mauna Kea on the island of Hawaii, and Olinda on the western slope of Haleakala on the island of Maui (10). Roughly 25% of the gorse-infested area is densely infested (10). Concern over the gorse problem led to the creation of an interagency Hawaii Steering Committee on Gorse Control to coordinate control efforts and secure funding for research. Part of the control effort centers on chemical control for interim suppression of gorse while research on biocontrol and grazing management are conducted. Until recently picloram had been the herbicide of choice for controlling gorse. However new and stringent regulations make picloram use impractical. For example broadcast spraying is not allowed. In the United States, triclopyr cannot be applied at rates in excess of 1.12 kg a.e./ha in pastures although up to 3.36 kg/ha may be applied in forests and non-cropland. Triclopyr at 1.12 kg/ha only provides marginal efficacy with conventional surfactants (8). Therefore surfactants that can increase the efficacy of triclopyr on gorse are a critical need. Balneaves (2) and others (3, 6, 7, 11) reported that L-77 was very effective in improving the efficacy of metsulfuron and glyphosate on gorse. Motooka *et al.* (8) reported that L-77 increased the efficacy of metsulfuron and of triclopyr (triethylamine salt) more than a commonly used nonionic surfactant Ultramar NI® (nonylphenoxyethoxyethanol, hereafter NI) on gorse in Hawaii. This report covers further evaluations of surfactants for increasing the efficacy of triclopyr on gorse.

### METHODS

Two trials were conducted on pastures at ca 1800 m at Humuula, on the northern slope of Mauna Kea, island of Hawaii. In both trials, plots consisted of individual shrubs 1 m to 1.5 m tall, replicated 10 times and completely randomized. Treatments were applied with a CO<sub>2</sub>-powered sprayer with a four-nozzle boom with SS8003 LP nozzle tips. Pressure was set at 207 kPa. The spray-volume rate was 320 L/ha. Evaluations were made by visual estimation of the percentage of necrotic canopy and on the percentage of plants killed.

Trial 1. The surfactants evaluated with triclopyr ester at 1.8 kg/ha were L-77, NI, Activate 3® (dimethylpolysiloxane, alkyloxypolyethoxy ethanol, and propylene glycol, hereafter A3), and CIT. Evaluations were made at 8 months after treatment (MAT).

Trial 2. The surfactants evaluated with 1 kg/ha of triclopyr amine were L-77, A3, Herbimax (petroleum solvents and esters of omega hydroxypolyoxyethylene, hereafter HBX), LI 700® (phosphatidylcholine and methylacetic acid, hereafter LI), NI, NI plus 5 ppm 2,4-D (dimethylamine salt), and NI plus 0.5% (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> (w/v). The use of 2,4-D as an adjuvant was attempted on the rationale that its ability to elongate cells would disrupt the integrity of the cuticle. The ammonium ion increases uptake, translocation or both of some herbicides (5, 9). Evaluations were made at 6 MAT.

### RESULTS AND DISCUSSION

Trial 1. The L-77 treatment was significantly superior to the CIT treatment but all other differences between means were non-significant. All treatments produced severe necrosis in gorse but by 8 MAT new shoots were emerging on the branches of most plants. Very few of the plants were killed. The highest mortality rate, in the L-77 treatment was only 20%. Some data reported by Burrill *et al.* (4) and Motooka *et al.* (8) suggested improvement in efficacy of triclopyr ester on gorse with L-77. The severe injury induced by treatments suggested that a repeat application similar to the "double kill" method of Balneaves (1) should improve the mortality rate.

Table 1. Response of gorse to triclopyr ester with different surfactants eight months after treatment

Surfactant	Injury rating <sup>a,b</sup> (%)	Kill (%)
0.5% NI	87 <sup>cd</sup>	0
0.2% L-77	93 <sup>c</sup>	20
0.5% A3	80 <sup>cd</sup>	10
0.5% CIT	76 <sup>d</sup>	0

<sup>a</sup> Visual estimate of percentage of canopy killed.

<sup>b</sup> Means followed by the same letters are not significantly different at P = 0.05 by Duncan's Multiple Range Test.

Trial 2. The best amine treatment was that with L-77 in which both the injury rating and the kill rate of 80% were superior to all other treatments. There was no difference in injury ratings and kill rates between the rest of the treatments. The kill rates for those treatments were only 0-10%. Kill by triclopyr ester with L-77 in trial 1 was only 20% in contrast to the 80% kill of the amine formulation with L-77 in trial 2 despite the fact that the triclopyr ester was applied at a higher rate. Burrill *et al.* (4) reported high efficacy ratings in one trial at 12 MAT by several herbicides including triclopyr amine and ester regardless of whether surfactants were used or of what kind of surfactants were used. However, their application procedures suggested that the

rates of herbicide they used, which were not reported, were probably higher than those used in these trials.

Table 2. Response of gorse to triclopyr amine with different surfactants six months after treatment

Surfactant	Injury rating <sup>a,b</sup> %	Kill (%)
0.5% NI	54 <sup>d</sup>	0
0.5% NI + 5ppm 2,4-D	70 <sup>d</sup>	10
0.5% NI + 0.5% (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	74 <sup>d</sup>	10
0.2% L-77	99 <sup>c</sup>	80
0.5% A3	58 <sup>d</sup>	0
0.5% HBX	60 <sup>d</sup>	0
0.5% LI	66 <sup>d</sup>	0

<sup>a</sup> Visual estimate of percentage of canopy killed.

<sup>b</sup> Means followed by the same letters are not significantly different at P = 0.05 by Duncan's Multiple Range Test.

The mortality rate reported here suggests that L-77 is superior to other tested surfactants and especially so with triclopyr amine. Thus triclopyr amine with L-77 should provide greater efficacy than triclopyr ester with L-77 on gorse.

#### ACKNOWLEDGEMENTS

The contributions of chemicals by Dow-Elanco, Union Carbide, United-Agri Products (Hawaii), and Hawaiian Fertilizer Sales, Inc. are gratefully acknowledged.

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