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Clopyralid in Short Rotation Tree Plantation at Hamakua, Hawaii

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SUMMARY

Clopyralid (Transline) was found to be effective for the control of *Desmodium intortum*, an important noxious weed in eucalyptus, while being selective to eucalyptus at all growth stages in the field. Clopyralid at 0.5 lb a.e. per acre provided control of *Desmodium intortum*, *Crotalaria* sp. (rattlepod), *Crassocephalum crepidioides* (thickhead), *Erechtites hieracifolia* (fireweed), *Erigeron bonariensis* (horseweed), and *Ageratum conyzoides* (ageratum). One-day transplanted, eight-week-old seedling and seven-month-old established *Eucalyptus grandis* trees were unaffected by directed or over-the-top broadcast application.

INTRODUCTION

Tree plantations are being established in high rainfall areas on former sugarcane fields on the Hamakua Coast on the Island of Hawaii. With ample rainfall, weeds are a major limitation to high yield. None of the herbicides currently labeled for use in tree plantations provides selective postemergence control of broadleaf weeds in eucalyptus. As a result, field sites are often overgrown with broadleaf weeds within three months of transplanting. The weeds intercept solar radiation, water and nutrients resulting in reduced tree growth and increased production costs.

The broadleaf weeds of primary importance in terms of difficulty to control and population were *Desmodium intortum*, horseweed, rattlepod, ageratum, thickhead, and fireweed in fields at Hamakua, Hawaii. Two preemergence herbicides (oxyfluorfen and pendimethalin) provide preplant and early post-plant control of seedlings of the above species, but little control of established weeds. The use of directed application of paraquat and glyphosate by knapsack is required at a high cost. Our objective was to find a herbicide providing postemergence control of these established broadleaf weeds without adversely affecting eucalyptus, thus allowing broadcast applications.

MATERIALS AND METHODS

The field sites were located in the Paahau and Paauilo Hamakua Coast area on the Island of Hawaii. This area receives 60 to 150 inches of rainfall annually, which is fairly well distributed throughout the year, with occasional dry summer months. The rainfall is higher and the soil is more weathered and infertile with increasing elevation. These soils are formed from volcanic ash and are classified as Andisols. Temperature distribution along the Hamakua Coast varies by elevation with average temperature in the mid 60's at 2,000 ft elevation and in the mid 70's at the 400 ft elevation. Experimental sites were located across this range.

At the experimental sites, the temperatures range from 60° to 85°F, with the coolest temperatures and highest rainfall occurring in January and February.

Five field trials were installed to evaluate clopyralid at 0.125 to 2.85 lb acid equivalent (a.e.) per acre on important broadleaf weeds and to eucalyptus (Table 1).

Table 1. Five trials installed in *Eucalyptus grandis* on the Hamakua Coast.

Trial No.	Installation Date	Tree Age at Treatment*	Field Location	Clopyralid Rates (lb a.e./acre)	Spray Volume (gal./acre)
1	5/11/97	1 day	C23	0.375	35
2	5/10/97	2 months	C24b	0.281	35
3	10/17/97	7 months	C1	2.850	85
4	10/17/97	3 months	C5	0.125, 0.250, 0.500, 1.000	30
5	11/14/97	7 months	C1 and C2	0.125, 0.250, 0.500, 1.000	30 and 60

* Relative to transplanting date.

A CO₂ plot sprayer with flatfan nozzles was used to apply clopyralid with 0.25 percent nonionic surfactant and water as the carrier. Trials 1 and 2 consisted of screening a number of herbicides, including clopyralid, in unreplicated plots of 8 ft x 75 ft (8 ft wide x 10 trees). The trees were 1 and 2 ft tall for Trials 1 and 2, respectively. The broadcast application was made over the trees. The soil and air temperatures were 80° to 84°F, wind speed of 0 to 3 mph, relative humidity of 95 percent, and cloud cover of 80 percent at the time of treatment. Both trials were evaluated for efficacy on weeds and crop effect on 29 May 1997 and 20 June 1997.

The Trial 3 application was made to 7-month-old trees at a high rate of 2.85 lb a.e. per acre or 5.7 times the maximum current label rate of 0.5 lb a.e. per acre. The trees in the 30 ft x 36 ft area were about 15-ft tall. The lower branches to a height of 7-ft were sprayed. The only weed present was *Desmodium intortum*, and its vines were crawling on the tree branches. The weed was mature and formed a mat about 4-ft thick. The

weather conditions at application were air temperature of 77°F, wind speed of 0 to 3 mph, relative humidity of 77 percent, and cloud cover of 50 percent. This trial was evaluated for efficacy and crop effect on 14 November 1997 and 11 December 1997.

Trial 4 was installed on the same day as Trial 3 and under the same weather conditions. The purpose of this trial was to evaluate control of individual weed species and determine the effect of over-the-top application to 3 to 4 ft tall trees in 10 ft x 35 ft plots. Each treatment was replicated three times. This trial was evaluated for efficacy and crop effect on 14 November 1997, 11 December 1997, and 16 January 1998.

Trial 5 was installed to determine the optimum rate of clopyralid to control mature *Desmodium intortum*. The population of *Desmodium intortum* in Trial 4 was insufficient and too young to determine the rates needed for control of mature plants. The *Desmodium intortum* in Trial 5 had vines longer than 5-ft and was flowering. The air temperature was 75°F, wind speed of 0 to 3 mph, relative humidity of 80 percent, and cloud cover of 30 percent at the time of application. This trial was evaluated for the control of *Desmodium intortum* and crop phytotoxicity on 11 December 1997 and 16 January 1998.

Crop phytotoxicity and weed control effects were visually graded using the system described in Table 2.

Table 2. Grading system of 1 to 9 for crop phytotoxicity and weed control.

Grade	Crop Phytotoxicity	Weed Control
1	Normal, no crop effect.	No effect on weeds.
3	About 30% of foliage showing damage symptoms.	About 30% control. Unacceptable results.
5	About 50% of foliage damaged. Usually not commercially acceptable.	About 50% control. Unacceptable results.
7	About 70% of foliage damaged. Not commercially acceptable.	About 70% control. May be commercially acceptable.
9	Crop dead.	Complete control.

RESULTS AND DISCUSSION

Crop Phytotoxicity

No phytotoxicity to *Eucalyptus grandis* was observed in any of the five trials with rates of clopyralid from 0.125 to 2.85 lb a.e per acre. The tree height of one-day transplants to seven-month-old trees ranged from 1 to 15 ft tall at the time of application. The treated plants were healthier than the untreated trees after more than 30 days after treatment (DAT) due to weed competition in the untreated plots. New tree growth was observed in all trials suggesting that clopyralid had no phytotoxic effect on *Eucalyptus grandis*.

Weed Control

Trial 1

Adequate postemergence control of all broadleaf weeds was achieved in Trial 1 after 40 DAT with 0.375 lb a.e per acre of clopyralid (Table 3). The broadleaf weeds were about 12 inches tall at the time of treatment. The weeds present in the untreated areas were thickhead, ageratum, *Desmodium intortum*, *Tritonia crocosmiflora* (Portuguese lily), *Panicum maximum* (guineagrass), and *Panicum repens* (torpedograss). Portuguese lily, guineagrass, and torpedograss were not controlled. The preemergence grade was low, but the emerging weeds were small and appeared stunted even after 40 days after treatment. Clopyralid appears to have preemergence activity on the broadleaf weeds.

Table 3. Grading for crop phytotoxicity and broadleaf weeds for Trials 1 and 2 with one replicate per treatment. Preemergence (PRE) grade is based on number of emerging seedlings and postemergence (POST) grade based on controlling emerged weeds at the time of treatment. Tree height at application was about 1 ft and 2 ft for Trial 1 and 2, respectively.

Trial No.	Clopyralid (lb a.e./acre)	Days After Treatment	Crop Phytotoxicity	Weed Control	
				PRE	POST
1	0.375	18	1	-*	4
	0.375	40	1	4	9
2	0.281	19	1	-	4
	0.281	41	1	3	6

*No data

Trial 2

In Trial 2, the weeds were at the early two- to three-leaf seedling stages at the time of application. The weeds present in the untreated plots were rattlepod, *Cassia leschenaultiana* (Japanese tea), *Desmodium intortum*, guineagrass, and torpedograss. The PRE to early-POST application with the lower rate of 0.281 lb a.e. per acre did not provide commercially acceptable control of broadleaf weeds at 41 DAT (Table 3). Rattlepod and Japanese tea were only partially controlled, while *Desmodium intortum* was completely controlled. Weeds probably germinated after the treatment resulting in the less than acceptable results. The lower rate of clopyralid was insufficient to give adequate soil activity for acceptable preemergence control.

Trial 3

A very high rate (2.85 lb a.e. per acre) was applied to overgrown and flowering *Desmodium intortum* in a 30 ft x 36 ft plot with 15-ft tall trees. The vines were crawling up to 6-ft high and on the lower branches of the eucalyptus trees. The mat of vines was about 3 to 4 ft thick under the trees which suppressed all other weeds. Clopyralid was broadcast at 85 gallons per acre (GPA) with a single nozzle boom to the vine and tree branches as high as 7-ft high. *Desmodium intortum* was completely controlled with no

regrowth nor damage to the branches sprayed with clopyralid. The control achieved with clopyralid was superior to that of past trials with dicamba, glyphosate, or 2,4-D in sugarcane. The treated trees had new shoot growth when first observed at 28 DAT. At 55 DAT, the treated trees appeared to be taller than the untreated trees.

Trial 4

The weeds in this trial consisted of horseweed, ageratum, thickhead, fireweed, *Desmodium intortum*, Portuguese lily, taro, and *Commelina diffusa* (wandering jew or honohono). Thickhead, *Desmodium intortum*, and fireweed were controlled with the lowest rate of

0.125 lb a.e. per acre, though the population of *Desmodium intortum* and fireweed were sparse (Table 4). Lower rates did not kill ageratum and horseweed at 55 DAT, but resulted in stem deformity and severe stunting. At 91 DAT, the ageratum and most of the horseweed were killed. The rate of 0.5 lb a.e. per acre was sufficient to give near complete control of most broadleaf weeds. Portuguese lily, taro, and honohono were tolerant to clopyralid.

Table 4. Four rates of clopyralid on broadleaf weeds in Trial 4. Weed control was graded by broadleaf weed species at 55 and 91 DAT. The average of three replicates are presented, except for *Desmodium intortum*. The trees were about 3-ft tall at the time of application.

Horseweed (1 to 4 ft tall weeds at application):

Clopyralid (lb a.e./acre)	Weed Control	
	55 DAT	91 DAT
0.125	5.3	7.3
0.250	6.7	8.3
0.500	9.0	9.0
1.000	9.0	9.0

Ageratum (1 to 2 ft tall weeds at application):

Clopyralid (lb a.e./acre)	Weed Control	
	55 DAT	91 DAT
0.125	6.0	9.0
0.250	7.7	9.0
0.500	8.3	9.0
1.000	9.0	9.0

Thickhead (1 to 2 ft tall weeds at application):

Clopyralid (lb a.e./acre)	Weed Control	
	55 DAT	91 DAT
0.125	8.7	9.0
0.250	9.0	9.0
0.500	9.0	9.0
1.000	9.0	9.0

Desmodium intortum (1 to 4 ft long vines at application; some plots had no vines):

Clopyralid (lb a.e./acre)	Weed Control		
	Rep 1	Rep 2	Rep 3
0.125	-	-	-
0.250	-	9	-
0.500	9	-	-
1.000	9	-	9

Trial 5

The rate of 0.25 lb a.e. per acre of clopyralid was sufficient to give commercially acceptable control of *Desmodium intortum* (Table 5) at 27 DAT. The grades did not improve at 63 DAT. For near complete kill, rates of 0.5 lb a.e. per acre or higher are required for flowering *Desmodium intortum*. This weed is most difficult to control at the flowering stage as compared to earlier vegetative stages.

Table 5. Weed control grades with four rates of clopyralid and two spray volumes on mature *Desmodium intortum* at 27 DAT.

Clopyralid (lb a.e./acre)	GPA	Weed Control		
		Rep 1	Rep 2	Mean
0.125	30	5.0	3.0	4.0
0.125	60	6.0	3.0	4.5
0.250	30	6.0	6.0	6.0
0.250	60	8.0	6.0	7.0
0.500	30	8.5	8.5	8.5
0.500	60	9.0	8.0	8.5
1.000	30	9.0	9.0	9.0
1.000	60	9.0	9.0	9.0

The higher spray volume of 60 GPA did not significantly improve control, though trends suggest that the higher volume may give better results at the lower rates of 0.125 and 0.250 lb a.e. per acre. This weed has a hairy, leaf surface and the vines can form thick mats where high spray volumes could improve coverage and uptake.

CONCLUSIONS

Clopyralid can provide selective control of difficult-to-control weeds, such as *Desmodium intortum*, in *Eucalyptus grandis*. *Eucalyptus grandis* was very tolerant at all commercial application rates of clopyralid and at all growth stages. No other herbicide registered for eucalyptus can provide as effective and selective postemergence control of broadleaf weeds in *Eucalyptus grandis* on the Hamakua Coast.

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