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Summaries of Herbicide Trials for Pasture, Range, and Non-Cropland Weed Control—2000

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The tables herein summarize herbicide trials for the control of pasture, range, and non-cropland weeds conducted by the College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa; the Hawaii Department of Agriculture; the Division of Forestry and Wildlife of the Hawaii Department of Land and Natural Resources; and other cooperators. These preliminary data are published to assist applicators experimenting with herbicides for weed control. The herbicide applicator is cautioned to confirm that any herbicide use, rate, or method of application conforms to the product label.

Rating weed response to herbicides

Weed response to treatment is evaluated by different methods. Plant injury may be scored on a 0–100 scale in which the score is a subjective evaluation of the severity of injury:

0	No symptoms
10–30	Insignificant to poor weed control; little or no defoliation
40–60	Inadequate weed control; moderately severe symptoms; less than 70% defoliated
70	Adequate weed control; severe symptoms; all leaves chlorotic or more than 70% defoliated
80	Good weed control; very severe symptoms; 80% defoliated
90	Excellent weed control; very severe symptoms; 90% defoliation
100	Complete control; no sign of life

In addition to the scale described above, efficacy of treatments may be determined by estimation of defoliation or its opposite, remaining weed cover. The method used depends on the growth habit of the weed. Response may also be measured by counting the number of surviving plants or stems, by measuring weed height, or a combination of these.

Methods of herbicide application

Foliar

Several methods of herbicide application were used in the trials described here, including foliar, cut-surface, basal bark, stump bark, and soil applications (See CTAHR publication WC-4, 1999, *Woody plant control for the home, pasture, and forest*. Also, low-volume and very low-volume variants of foliar application (drizzle method) and basal barak and stump bark treatments were evaluated (see Motooka, P., G. Nagai, and L. Ching, 1983, "The 'magic wand' method of herbicide application," Proc. Ninth Asian Pacific Weed Sci Soc. Conf., Suppl. Vol., p. 550–553; and Motooka, P., J. Powley, M. DuPonte, L. Ching, G. Nagai, and G. Kawakami, 1999, "Drizzle herbicide application for weed management in forests," Proc. West. Soc. Weed Sci. 52:136–139).

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Materials tested

Herbicides	Trade name and manufacturer
2,4-D	Amine salt formulation, various brands Ester formulation, various brands
Glyphosate	Rodeo (Monsanto) Roundup (Monsanto)
Hexazinone	Pronone Power Pellets (DuPont) Velpar L (DuPont)
MCPA	MCP Amine (Clean Crop)
Triclopyr	Garlon 4 (Dow AgroSciences) Remedy (Dow AgroSciences)) Redeem (Dow AgroSciences) Pathfinder II (Dow AgroSciences)
Tebuthiuron	Spike 20P (Dow AgroSciences)

Adjuvants	Manufacturer
Activator 90	Loveland Industries
Excell 90 NF	Brewer Environmental Industries
Quicksorb	Monsanto
Forestry Crop Oil	Platte Chemical

Weeds

Bushy beardgrass *Schizachyrium condensatus* (Kunth) Nees
Christmas berry *Schinus terebinthifolius* Raddi
Fayatree *Myrica faya* Aiton
Kahili ginger *Hedychium gardnerianum* Ker-Gawl
Guava *Psidium guajava* L.
Hau *Hibiscus tiliaceus* L.
Hiptage *Hiptage benghalensis* (L.) Kurz
Karakanut *Corynocarpus laevigatus* J.R. Forster & G. Forster
Kiawe *Prosopis pallida* (Humb-Bonpl. ex Willd.) Kunth
Kikuyugrass *Pennisetum clandestinum* Chiov.
Lantana *Lantana camara* L.
Madagascar fireweed *Senecio madagascariensis* Poiret
Mangrove *Rhizophora mangle* L.
Mauritius hemp *Furcraea foetida* (L.) Haw.
Shoebutton ardesia *Ardesia elliptica* Thunb
Shrimp plant *Justicia betonica* L.
Strawberry guava *Psidium cattleianum* Sabine
Thimbleberry *Rubus rosaefolius* Sm.
Yellow Himalayan raspberry *Rubus ellipticus* Sm.
Wild olive *Olea europaeus* L.

Observations

A number of species were treated with soil applications of hexazinone granules and tebuthiuron pellets at 1, 2, and 4 kg/ha (1kg/ha = 0.9 lb/A) in 5 m diameter circular plots. Efficacy was poor on bushy beardgrass (Table 1), kahili ginger (Table 6), karakanut (Table 7), kikuyugrass (Table 9), wild olive (Table 17) and strawberry guava (Table 19). Tebuthiuron was evaluated for selectively in native koa (*Acacia koa* A. Gray) and koa displayed very little injury (Table 10). Further tests are warranted in different ecozones. Christmas berry was very susceptible to soil applications of hexazinone pellets in grid or "hot spot" applications (Table 2). Fayatree was somewhat tolerant of triclopyr applied with water in drizzle applications although an oil carrier increased efficacy somewhat (Table 3). Fayatree has a dense canopy which makes good coverage difficult with low-volume methods. It is expected that repeat applications will gradually strip upper layers of the canopy, reduce biomass, and eventually allow good coverage and control. A third application was made late in year and has yet to be evaluated.

Guava and shoebutton ardesia were susceptible to very-low volume basal bark applications of triclopyr but the much larger hau stems, still connected to the mother plant, were somewhat tolerant (Table 4). Hiptage was somewhat susceptible to very-low volume basal bark applications of triclopyr and efficacy would probably be increased with coverage completely around the basal stems (Table 5). Young kiawe plants were very susceptible to very-low volume basal bark treatments with triclopyr, and even larger trees were severely damaged, suggesting that higher doses may successfully control the larger trees (Table 8).

Basal bark applications of glyphosate in high concentrations with 10% of surfactants proved very effective on lantana that had coppiced (Table 11) but erratic on lantana with intact stems (Table 12). The latter trial was also in a higher rainfall area which may have influenced response.

Rank Madagascar fireweed was tolerant of 0.5 and 1.0 kg/ha of MCPA and to 0.5 kg/ha of triclopyr amine. MCPA at 2 kg/ha was effective (Table 13). An earlier trial had established that succulent Madagascar fireweed was susceptible to 1 kg/ha of 2,4-D and triclopyr.

Basal bark application with glyphosate was ineffective on mangrove but triclopyr in oil was very effective (Tables 14, 15).

Response of Mauritius hemp, susceptible to triclopyr in oil in foliar treatments in other trials, was confounded by flowering and senescence and by lost tags in dense vegetation (Table 16).

Shoebutton ardesia was moderately susceptible to drizzle foliar applications of 2,4-D and triclopyr in water and oil carriers (Table 18). Repeat applications are expected to increase efficacy since the plants were too tall initially for good coverage. Strawberry guava was also moderately susceptible to drizzle foliar applications of triclopyr in water and somewhat more susceptible to application with the oil carrier (Table 20). Yellow Himalaylan raspberry was susceptible to triclopyr in two drizzle applications 6 months apart. The oil carrier increased efficacy (Table 21).

Table 1. Efficacy of soil applied hexazinone and tebuthiuron on bushy beardgrass (G99-15).
Date installed: 08/16/99. Date rated: 05/03/00. Location: Kokee, Kauai. Investigators: A. Kiyono, G. Nagai, L. Ching, P. Motooka. Notes: Herbicides applied to 5-m diameter circular plots. High defoliation result of drought.

Herbicide	Rate (kg/ha)	Defoliation (%)
Check	0	48
Tebuthiuron	1	38
	2	42
	4	43
Hexazinone	1	27
	2	55
	4	8

Table 2. Control of christmasberry trees by hotspot application of hexazinone pellets to the soil. (V99-6).
Date installed: 10/14/99. Date rated: 08/30/00. Location: Kaupo Ranch. Investigators: J. Powley, A. Franco, P. Motooka. Notes: Large pellets applied in 3-ft intervals along four transects around the base of each tree, 12 pellets per tree. There were 13 trees, 4–14 inches in basal diameter.

Treatment	Defoliation (%)
Check	0
Hexazinone	96

Table 3. Response of fayatree to triclopyr applied by the drizzle method with water or with oil (K99-9).
Date installed: 05/28/99. Location: Keauhou Ranch, Volcano. Investigators: M. du Ponte, P. Motooka. Notes: Retreated 11/09/99, 08/02/00.

Triclopyr rate (kg/ha)	Carrier	Defoliation (%)		
		09/08/99	11/09/99	08/02/00
0.5	Water	38	38	32
0.5	Oil	48	53	42
1.0	Water	55	42	48
1.0	Oil	54	59	60

Table 4. Response of guava, hau and shoebutton ardesia to very-low volume basal bark applications of triclopyr (G 00- 7, 9, 10).
Date installed: 03/09/00. Date rated: 07/18/00. Location: Princeville Ranch. Investigators: L. Ching, G. Nagai, P. Motooka. Notes: Pathfinder II‘ applied with drizzle unit.

Species	Defoliation (%)	Number of plants
Guava	99	21
Hau	52	22
Shoebutton ardesia	89	52

Table 5. Hiptage response to very-low volume basal bark applications of triclopyr (G99-8).
Date installed: 05/19/99. Date rated: 05/03/00. Location: Huleia National Wildlife Reserve, Kauai. Investigators: L. Ching, G. Nagai, P. Motooka. Notes: Pathfinder II applied in four streaks on one or both sides of basal stem.

Treatment	Killed plants (%)
Check	0
2-sided treatment	40 (another 40% had cracked bark)
1-side treatment	46 (another 11 % with cracked bark)

Table 6. Efficacy of soil applied hexazinone and tebuthiuron on kahili ginger (G99-18).
Date installed: 08/18/99. Date rated: 05/02/00. Location: Kokee, Kauai. Investigators: C. Koga, L. Ching, G. Nagai, P. Motooka. Notes: Herbicide applied to 5-m diameter circular plots.

Herbicide	Rate (kg/ha)	Defoliation (%)
Check	0	10
Hexazinone	1	3
	2	8
	4	30
Tebuthiuron	1	17
	2	42
	4	10

Table 7. Efficacy of hexazinone and tebuthiuron on karakanut trees (G99-21).
Date installed: 09/14/99. Date rated: 05/02/00. Location: Kokee, Kauai. Investigators: G. Kawakami, G. Nagai, L. Ching, P. Motooka. Notes: Herbicide applied to 5-m circle around base of tree. Basal diameter of trees 5–10 inches.

Herbicide	Rate (kg/ha)	Defoliation (%)
Check	0	0
Hexazinone	1	0
	2	28
	4	0
Tebuthiruon	1	0
	2	3
	4	8

Table 8. Kiawe tree control with very-low volume basal bark application of triclopyr (K99-23).
Date installed: 11/05/99. Date rated: 01/21/00. Location: Kohanaiki, Kona. Investigators: G. Fukumoto, P. Motooka. Notes: Pathfinder II‘ applied.

Basal diameter (inches)	Defoliation (%)
≤2	100
2 ≤ 4	99
4.1 ≤ 6	94
> 6	93

Table 9. Efficacy of soil applied hexazinone and tebuthiuron on kikuyugrass (G99-20).
Date installed: 09/14/99. Date rated: 05/02/00. Location: Kokee, Kauai. Investigators: A. Kiyono, L. Ching, G. Nagai, P. Motooka. Notes: Herbicides applied to 5-m diameter circular plots.

Herbicide	Rate (kg/ha)	Defoliation (%)
Check	0	3
Hexazinone	1	8
	2	27
	4	40
Tebuthiuron	1	17
	2	7
	4	18

Table 10. Tolerance of koa trees to soil applied tebuthiuron (G99-16).
Date installed: 08/16/99. Date rated: 05/02/00. Location: Kokee, Kauai. Investigators: A. Kiyono, G. Kawakami, G. Nagai, L. Ching, P. Motooka. Notes: Tebuthiuron pellets applied in 5-m circle around base of tree.

Herbicide rate (kg/ha)	Defoliation (%)
Check	13
1	22
2	10
4	17

Table 12. Response of lantana to basal bark application of glyphosate (K00-2).
Date installed: 06/02/00. Date rated: 09/06/00. Location: Keaukaha, Hawaii. Investigators: M. DuPonte, P. Motooka. Notes: High-rainfall area.

Treatment	Defoliation (%)
Check	0
Spray, 50% glyphosate/10% Excell 90	50
Spray, 50% glyphosate/10% Quiksorb	69
VLV, 50% glyphosate/10 Quiksorb	57
Spray, Triclopyr (Pathfinder II)	24

Table 11. Lantana control by basal bark applications of glyphosate (G00-10).
Dated installed: 06/10/00. Date rated: 0718/00. Location: Kapaa. Investigators: L. Ching, P. Motooka. Notes: Lantana plants were mowed and had coppiced.

Treatment	Method of application	Volume/plant (ml)	Defoliation (%)
Check		0	0
Glyphosate 50% + 10% Activator 90	Conventional spray	124	96
Glyphosate 25% + 10% Quiksorb	Conventional spray	125	100
Glyphosate 50% + 10% Quiksorb	Conventional spray	148	100
Glyphosate 50% + 10% Quiksorb	Very low volume	9	97
Triclopyr ester 20% with crop oil	Low volume spray	74	76

Table 13. Madagascar fireweed control with MCPA foliar sprays (V00-1).
Date Installed: 08/29/00. Date rated: 12/04/00. Location: Makawao, Maui. Investigators: J. Powley, P. Motooka

Herbicide	Rate (kg/ha)	Fireweed cover (%)	Control (%)
0	0	84	0
MCPA	0.5	83	2
MCPA	1.0	57	32
MCPA	2.0	10	88
Triclopyr amine	0.5	84	11

Table 14. Mangove response to very-low volume basal bark applications of triclopyr or glyphosate (K00-1a)
Date installed: 01/21/00. Date rated: 02/28/00. Location: Kohanaiki, Kona. Investigators: G. Fukumoto, P. Motooka.

Treatment	Defoliation (%)
Check	10
Glyphosate 50% / Quicksorb 10%	28
Triclopyr 20% / Oil	95

Table 15. Very-low volume basal bark application of glyphosate or triclopyr to control mangrove (G00-3).
Date installed: 01/25/00. Date rated: 03/09/00. Location: Nawiliwili. Investigators: L. Ching, G. Nagai, P. Motooka

Treatment	Defoliation (%)
Check	0
50% Glyphosate + 10% Quiksorb	20
Triclopyr (Pathfinder II)	100

Table 16. Response of flowering and non-flowering Mauritius hemp to drizzle applications of triclopyr ester in oil (K00-1).
Date installed: 02/10/00. Date rated: 08/10/00. Location: Kaupulehu, Kona. Investigators: L. Hadway, P. Motooka. Notes: Plants treated with triclopyr ester, 15% in crop oil. There were 10 replicates but many plants collapsed and tags could not be found.

Plant growth stage / treatment	Defoliation (%)	No. plants
Nonflowering/ check	17	6
Nonflowering/ triclopyr	74	8
Flowering/check	100	2
Flowering/triclopyr	93	6

Table 17. Efficacy of soil applied hexazinone and tebuthiuron on wild olive (G99-17).
Date installed: 08/16/99. Date rated: 05/02/00. Location: Kokee, Kauai. Investigators: A. Kiyono, G. Nagai, L. Ching, P. Motooka. Notes: Herbicide applied to 5-m diameter circle at base of trees.

Herbicide	Rate (kg/ha)	Defoliation (%)
Check	0	20
Hexazinone	1	13
	2	13
	4	20
Tebuthiuron	1	3
	2	13
	4	13

Table 18. Response of shoebutton ardesia to drizzle applications of herbicides (G00-8)
Date installed: 03/09/00. Date Rated: 07/18/00. Location: Princeville Ranch. Investigators: L. Ching, G. Nagai, P. Motooka.

Treatment	Defoliation (%)
Check	0
2,4-D ester	65
Triclopyr ester/water	72
Triclopyr ester/oil	60

Table 19. Efficacy of soil applications of hexazinone and tebuthiuron on strawberry guava.
Date installed: 09/13/99. Date rated: 05/03/00. Location: Wailua, Kauai. Investigators: L. Ching, G. Nagai, P. Motooka. Notes: Granular hexazinone and pelleted tebuthiuron were applied in a 5-m circle around the base of the target tree.

Herbicide	Rate (kg/ha)	Defoliation (%)
Check	0	0
Hexazinone	1	28
	2	17
	4	43
Tebuthiuron	1	23
	2	53
	4	27

Table 20. Response of strawberry guava to drizzle applications of triclopyr in water and in oil (K99-8).
Date installed: 05/14/99. Location: Kurtistown. Investigators: M. DuPonte, P. Motooka. Notes: Triclopyr applied at 1 kg/ha, retreated 11/18/00.

Carrier	Defoliation (%)	
	11/18/99	06/02/00
Water	40	46
Oil	61	62

Table 21. Response of yellow Himalayan raspberry to drizzle applications of triclopyr in water and in oil (K99-10).
Date installed: 05/28/99. Location: Volcano. Iinvestigators: M. DuPonte, A. Kawabata, P. Motooka. Notes: Reapplication on 11/09/99, 08/02/00.

Triclopyr rate (kg/ha)	Carrier	Defoliation (%)		
		09/08/99	11/09/99	06/01/00
0.5	Water	70	48	74
0.5	Oil	73	70	87
1.0	Water	78	63	78
1.0	Oil	99	88	94

Table 22. Results of demonstration trials.

Weed	Herbicide	Rate/ Conc.	Method	Control (%)	Reps	Duration(mo)	Site
Fayatree 4 inch basal diameter	Glyphosate	50%/10% Quiksorb	VLV basal bark	49	12	7	Keauhou Ranch
Fayatree 7 inch basal diameter	Glyphosate	50%/10% Quiksorb	VLV Basal bark	31	7	7	Keauhou Ranch
Kiawe	Glyphosate	1 lb/A	Drizzle	72	8	2.5	Kohanaiki
Kiawe	Glyphosate	Conc.	Notch	88	4	2.5	Kohanaiki
Kiawe	Triclopyr	0.5 lb/A	Drizzle	58	5	2.5	Kohanaiki
Madagascar fireweed	Tebuthiuron	2 kg active/ha	Soil	95	1 large plot	3	Makawao
Madagascar fireweed	Triclopyr amine	1 kg active/ha	Drizzle	0	1 large plot	3	Makawao
Shrimp plant	MCPA	1 kg active/ha	Foliar	90	1 small plot	3	Makawao
Thimbleberry	Triclopyr ester/water	1 lb/A	Drizzle	80	1	7	Kurtistown
Thimbleberry	Triclopyr ester/oil	1 lb/A	Drizzle	95	1	7	Kurtistown