CONTROL OF *CLIDEMIA HIRTA* IN MATURE RUBBER AREAS

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Summary. Field trials were conducted under mature rubber trees to control *Clidemia hirta* by slashing and with herbicides. Triclopyr at 0.375 kg a.e./ha was more effective than slashing. Fluroxypyr at 0.4 kg a.e./ha and metsulfuron methyl at 0.02 kg a.i./ha plus a nonionic surfactant were effective. Mixtures of triclopyr with either fluroxypyr or metsulfuron methyl enhanced control of the weed but its mixture with the contact herbicides paraquat or sodium chlorate produced less persistent control. Addition of the adjuvants Ethokem, Polypol Ace, Lissapol and Bivert showed some improvement in control of the weed. Application of triclopyr at 0.25 kg a.e./ha using five different sizes of fan nozzles with their orifices ranging from 0.08 to 0.28 cm resulted with nonsignificant difference in control but triclopyr at 0.075% w/v applied using these nozzles produced decreasing weed control with decreasing nozzle sizes.

INTRODUCTION

Clidemia hirta, a woody shrub under the Melastomaceae family, is an important dicotyledonous weed found under mature rubber especially in the southern part of Peninsular Malaysia. It is usually about one meter high but can grow much taller. Once established, it can spread rapidly especially via seeds. Slashing causes shoots to regenerate from the basal stems. The seeds are small and are embedded in bluish black berries which are relished by birds which help to spread the weed. This weed is susceptible to a number of herbicides and some of these can provide persistent control. The herbicide 2,4,5-T was formerly recommended for controlling this weed (3) but due to its contamination with dioxin which is carcinogenic, alternative herbicides were sought. Subsequent to this, the herbicide triclopyr was found to be a suitable alternative to 2,4,5-T (10).

The objective of the trial was to determine the effectiveness of slashing, herbicides or herbicide mixtures in comparison to triclopyr on the control of *C. hirta*. It was also investigated whether weed control could be improved by adding adjuvants to triclopyr. Trials were also conducted to determine whether weed control is affected by variable orifice sizes of fan nozzles.

METHODS

Established stands of *C. hirta* of moderate to high density under mature rubber trees of about thirty years old in Sungai Buaya, Selangor were used. The height of the weed was mostly about three quarter to one meter high. The herbicides were sprayed using a knapsack sprayer fitted with a fan jet nozzle. The pressure of the pump was about three bars. The size of each plot was 20 m^2 and there were three or four replicates for each treatment. The soil was sandy clay loam.

Weed control was assessed visually based on a 0 to 100 rating system where 0 = 0% kill and 100 = 100% kill of the weed at about monthly intervals. The data were transformed to arcsin $\sqrt{}$percentage for statistical analysis.

The herbicides used were Garlon 250 (triclopyr, butoxy ethyl ester - 32.1% w/w), Tordon 101 (2,4-D triisopropanol amine salt - 39.6% w/w + picloram triisopropanol amine salt - 10.2%

w/w), Starane 200 (fluroxypyr, 1-methyl heptyl ester - 29.64% w/w), Ally 20DF (metsulfuron methyl - 20% w/w), Gramoxone PP910 (paraquat dichloride - 25.3% w/w) and Ancom Sodium chlorate (sodium chlorate - 99% w/w).

Effect of slashing and herbicides. Slashing using a motorised slasher was compared to the herbicides triclopyr (0.375 and 0.75 kg a.e./ha) and picloram + 2,4-D (0.2 + 0.7 and 0.3 + 1.2 kg a.e./ha). Different rates of triclopyr ranging from 0.125 to 0.625 kg a.e./ha was also evaluated. The more recent herbicides, fluroxypyr and metsulfuron methyl, were also evaluated. The rates of fluroxypyr were 0.1 to 0.6 kg a.e./ha while metsulfuron methyl were from 0.02 to 0.1 kg a.i./ha. Du Pont Agricultural surfactant which is a nonionic surfactant was also added to metsulfuron methyl.

Evaluation of triclopyr mixtures. Mixtures of triclopyr with either fluroxypyr, metsulfuron methyl, paraquat or sodium chlorate were evaluated in order to determine whether imrovement in weed control could be obtained.

Evaluation of adjuvants. The ability of selected adjuvants to improve the effectiveness of triclopyr was evaluated. The effectiveness of triclopyr at 0.25 kg a.e./ha mixed with either the cationic surfactants Ethokem (fatty amine ethoxylate) or Hyspray 52 (polyethoxylated amine), a nonionic surfactant Polypol Ace (nonylphenol polyethylene glycol ether) or Lissapol (sodium oleyl ceyl sulphate) or with an adjuvant Bivert (amine salts of organic acids, aromatic acid, aromatic and aliphatic petroleum distillate) was also evaluated.

Evaluation of fan nozzles. Triclopyr at 0.25 kg a.e./ha was sprayed using fan nozzles with nozzle orifices of 0.08, 0.12, 0.16, 0.2 and 0.28 cm which delivered about 100, 130, 300, 500 and 600 L/ha of water respectively.

In another trial, triclopyr at a fixed concentration of 0.075 % w/v of the active ingredient per unit area was evaluated with similar sizes of fan nozzles.

RESULTS AND DISCUSSION

Effect of slashing and herbicides. Slashing was only effective initially as shoot regeneration from the living stems was relatively rapid (Fig. 1). Picloram + 2,4-D at 0.2 + 0.7 or 0.3 + 1.2 kg a.e./ha did not give good control of the weed but was more effective than slashing. Triclopyr at 0.375 and 0.75 kg a.e./ha were significantly more effective than picloram + 2,4-D and slashing. Teoh *et al.* reported that triclopyr was effective on *C. hirta* at 0.7 and 1.4 kg a.e./ha (7). The present trial, however, showed that a lower rate of triclopyr was sufficient to give good control of the weed. Yeoh and Faiz also reported on the efficacy of triclopyr but the rates used were slightly higher (10).

Increasing the rates of triclopyr increased control. Good control was achieved with triclopyr at 0.375, 0.5 and 0.625 kg a.e./ha. Regeneration of the weed was slow and at 36 weeks after treatment, triclopyr at 0.375 kg a.e./ha produced about 70% control while at 0.5 kg a.e./ha and at 0.625 kg a.e./ha, about 90% control was achieved. At least 0.375 kg a.e./ha of triclopyr was necessary to obtain effective control of the weed. Abu Bakar and Abu Bakar reported that triclopyr at rates of 0.45 to 0.75 kg a.e./ha were effective (1).

Fluroxypyr at 0.3 kg a.e./ha or more produced more than 90% control. At 30 weeks after treatment, fluroxypyr at 0.3, 0.4, 0.5 and 0.6 kg a.e./ha still showed more than 90% control. The efficacy of fluroxypyr on perennial broad-leaved weeds had been reported by Lee and Liao and they suggested rates of 0.25-0.5 kg a.e./ha for effective control (5).

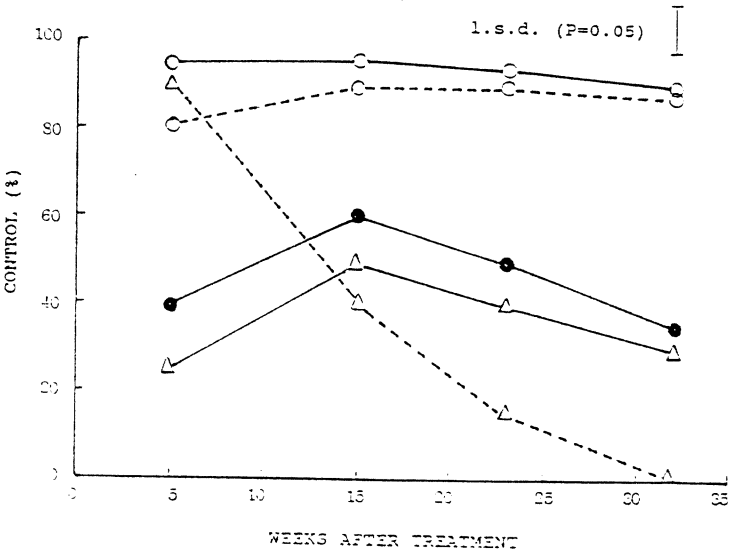

Figure 1. Effect of slashing (△---△) versus triclopyr at 0.375 kg a.e./ha (○---○) or 0.75 kg a.e./ha (○—○) and picloram + 2,4-D at 0.2 + 0.7 kg a.e./ha (△—△) or 0.3 + 1.2 kg a.e./ha (●—●) on control of *C. hirta*.

Metsulfuron methyl was also effective and more than 90% control was still obtained at 29 weeks after treatment with the herbicide at 0.04 to 0.1 kg a.i./ha. The results thus agree with Ackerson and Davis who reported on the efficacy of this herbicide on brush species in plantation crops (2). Earlier, Christie and Cornwell also reported on the effectiveness of this herbicide on broad-leaved weeds in cereals (4).

Efficacy of triclopyr mixtures. Triclopyr mixed with fluroxypyr produced enhanced and significantly more persistent control of the weed compared to the individual herbicide alone. More than 90% control was still obtained at 32 weeks after treatment with these mixtures.

Mixing triclopyr with metsulfuron methyl also improved weed control. Increasing control was obtained with increasing rates of metsulfuron methyl in the mixtures. Control was also more persistent with the herbicide mixtures compared to the individual herbicide treatment.

Mixtures of triclopyr at 0.25 kg a.e./ha with the contact herbicide paraquat at either 0.2 or 0.3 kg a.i./ha or with $NaClO_3$ at either 10 or 15 kg a.i./ha showed significantly less persistent control compared to triclopyr alone. Reduction in control could be attributed to the death of the weed tissues caused by the contact herbicides which prevented further translocation of triclopyr which

is a systemic herbicide. Increasing rates of paraquat or $NaClO_3$ in the respective mixtures, however, showed slight enhancement in weed control.

Evaluation of adjuvants. The effectiveness of triclopyr at 0.25 kg a.e./ha was reduced when mixed with Hyspray 52, slightly improved with Ethokem, and was significantly better when mixed with Polypol Ace at 1.0 L/ha respectively. However, these treatments were significantly less effective than triclopyr at 0.375 kg a.e./ha. Improvement of triclopyr activity by Ethokem had also been reported by Prasad on forest weed species (6).

Addition of the nonionic surfactant Lissapol to triclopyr (0.25 kg a.e./ha) enhanced control of the weed significantly and increasing the rate of Lissapol also increased weed control. Wongwattana and Suwanketnikom had also reported on improved activity of triclopyr when added with a nonionic surfactant. They also found that the nonionic surfactant was also more effective than the anionic surfactant which they tested (9). The addition of the adjuvant Bivert at 0.5 L/ha did not improve triclopyr activity. However, control was slightly improved by the higher rate of Bivert at 1.0 L/ha. Mixture of triclopyr at 0.25 kg a.e./ha with Lissapol plus Bivert each at 0.5 L/ha respectively showed significant improvement in weed control.

Evaluation of fan nozzles. The different sizes of fan nozzles used to spray triclopyr at 0.25 kg a.e./ha did not produce significant differences in control. This indicated that the different volume rate of water applied did not affect the performance of triclopyr. Thomas *et al.* (1988), however, reported that a high carrier volume application generally was more effective and they attributed the improvement in control to better penetration of the dense weed in their trials.

On the contrary, a fixed concentration of triclopyr at 0.075% w/v applied using these fan nozzles produced decreasing weed control with decreasing nozzle sizes (Table 1). This is due to the lower active ingredient per unit area being delivered with the decreasing volume of water.

Table 1. Effect of triclopyr at 0.75% w/v on *C. hirta* using different sizes of fan nozzles

Nozzle size (cm)	Mean % control		
	8 weeks	12 weeks	25 weeks
0.08	70	63	30
0.12	75	70	38
0.16	80	75	55
0.20	98	88	85
0.28	98	95	80
l.s.d. (P=0.05)	5.4	7.7	4.8

CONCLUSIONS

Slashing was less effective than triclopyr at 0.375 kg a.e./ha and picloram + 2,4-D at 0.2 + 0.7 or 0.3 + 1.2 kg a.e./ha. Fluroxypyr at 0.4 kg a.e./ha and metsulfuron methyl at 0.02 kg a.i./ha plus a nonionic surfactant were effective. Mixtures of triclopyr with either fluroxypyr or metsulfuron methyl improved weed control but mixtures of triclopyr with the contact herbicides

paraquat or sodium chlorate resulted in less persistent control. Addition of the adjuvants Ethokem, Polypol Ace, Lissapol and Bivert showed some improvement in control. Application of triclopyr at 0.25 kg a.e./ha using fan nozzles with their orifices ranging from 0.08 to 0.28 cm resulted in almost comparable control. Application of triclopyr at 0.075 % w/v with these nozzles, however, produced decreasing weed control with decreasing nozzle orifices.

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