

## ***Efficacy of Imazapyr and its Mixtures against Weeds under Rubber***

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*Isopropylamine salt of imazapyr is effective against several weeds in rubber plantations but is relatively more expensive. Lower rates of imazapyr were therefore evaluated in mixtures with other herbicides to determine whether improved weed control can be obtained. Effectiveness of the herbicide using different nozzle types and spraying equipment were also evaluated. Trials were conducted along planting strips of rubber between one to six years' old against weeds comprising mainly of *Ottochloa nodosa*, *Paspalum conjugatum*, *Axonopus compressus*, *Borreria latifolia* and *Asystasia gangetica*. Evaluation on efficacy of imazapyr showed weeds were susceptible at low rates of application and acceptable control could be obtained at 0.2 kg ae/ha. Imazapyr at 0.375 kg ae/ha provided more effective weed control than standard treatments with pre-mixed paraquat + diuron (0.6 kg ai/ha + 0.6 kg ai/ha), pre-mixed glyphosate + dicamba (0.54 kg ae/ha + 0.27 kg ae/ha), glufosinate ammonium (0.5 kg ai/ha) and slashing. Lower rate of imazapyr at 0.15 kg ae/ha in mixture with ametryn (0.5 kg ai/ha or 1.0 kg ai/ha), metsulfuron methyl (0.015 kg ai/ha) or pre-mixed isopropylamine salt of glyphosate + isopropylamine salt of dicamba (0.18 + 0.09, 0.36 + 0.18 or 0.54 + 0.27 kg ae/ha) improved weed control while its mixture with diuron (0.5 kg ai/ha or 1.0 kg ai/ha) provided comparable control. Addition of alachlor (0.48 kg ae/ha or 0.96 kg ae/ha), metolachlor (0.36 kg ae/ha or 0.72 kg ae/ha) or oxyfluorfen (0.12 kg ae/ha or 0.24 kg ae/ha) to imazapyr at 0.25 kg ae/ha provided comparable control to imazapyr alone. Comparison of fan, hollow cone and solid cone nozzles showed comparable weed control with imazapyr at 0.375 kg ae/ha. Application of imazapyr at 0.375 kg ae/ha with the controlled droplet applicator showed improved weed control compared to the knapsack sprayer.*

**Key words:** imazapyr; mixture; herbicides; application; weed control; droplet applicator; knapsack sprayer

Currently, glyphosate mixtures are commonly used for general weed control under young rubber. These mixtures control a broad range of weeds but some weeds are, however, tolerant

or not effectively controlled and alternative herbicides or their mixtures need to be sought. Furthermore, continued use of the same herbicide or herbicide mixtures are not advisable

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as this will encourage dominance of tolerant weed species and possible development of weed resistance. Continued use of glyphosate for example has been reported to result in resistance of *Eleusine indica*<sup>1,2</sup>.

Imazapyr is an imidazolinone herbicide which inhibits acetohydroxyacid synthase and prevents plants from synthesizing the amino acids valine, leucine and isoleucine<sup>3</sup>. It has been reported effective against general weeds in rubber plantations<sup>4,5</sup>. It is also effective against noxious weeds such as *Imperata cylindrica*<sup>6,7,8</sup> and *Pennisetum polystachion*<sup>9,10</sup>. Lowering its rate of application in order to reduce cost and phytotoxicity may reduce its effectiveness on weeds. But its activity could probably be improved by mixing with other potential herbicides. This paper reports on the compatibility of selected herbicides with imazapyr, effectiveness of the mixtures against weeds and performance of imazapyr with different nozzle types and different spraying equipment.

#### MATERIALS AND METHODS

Trials were conducted along planting strips of one to six-year-old rubber infested with mixed weeds comprising *Ottlochloa nodosa*, *Paspalum conjugatum*, *Axonopus compressus*, *Borreria latifolia* and *Asystasia gangetica*. Plots of 30 m<sup>2</sup> were arranged in a randomised design with three replicates. Weed control was assessed visually at specified interval based on a scale of 0 to 100, where 0 = no effect and 100 = complete kill of aerial shoots. Herbicide solution was applied using a knapsack sprayer at a rate of 450 l/ha in Trials 1 to 8. In Trial 8, orifice size of the fan or hollow cone nozzle was 0.2 cm. In Trial 9, herbicide solution was applied at a rate of 450 l/ha with the knapsack sprayer and 40 l/ha with the controlled droplet

applicator (CDA). All herbicide treatments used commercial formulations of the respective herbicides. Details of treatments for evaluation of imazapyr, its mixtures, sprayer nozzles and spraying equipment are provided in Table 1.

#### RESULTS AND DISCUSSION

##### Imazapyr and its Mixtures

At three weeks after treatment, imazapyr provided low percentage control of weeds dominated by *O. nodosa* with small percentages of *A. gangetica* and *Calopogonium caeruleum* (Table 2). Percentage weed control increased at six weeks after treatment and effective control was obtained at 0.2 kg ae/ha to 0.35 kg ae/ha while moderate weed control at 0.1 and 0.15 kg ae/ha. At 10 weeks after treatment, weed control decreased and effective control was obtained only with 0.3 and 0.35 kg ae/ha while other rates were less effective. The weeds which regenerated were mainly *A. gangetica* and *C. caeruleum*. The effectiveness of imazapyr on general weeds under young rubber has been reported<sup>4,11,5</sup> and it was shown that imazapyr provided longer duration of weed control compared with paraquat mixtures. It has also been reported that this herbicide was effective against noxious weeds such as *I. cylindrica*<sup>6,7,8</sup> and *P. polystachion*<sup>9,10</sup>.

Imazapyr was also found to be more effective than standard treatments with glyphosate + dicamba, glufosinate ammonium, paraquat + diuron or slashing in the trial involving two weeding rounds on weeds comprising of *O. nodosa* (mainly), *A. gangetica*, *Paspalum conjugatum* and *B. latifolia* (Table 3). The initial effect of imazapyr and glyphosate + dicamba was slow. However, weed control was most effective with imazapyr whether after both the first and second round of weeding. Paraquat

TABLE 1. DETAILS OF TREATMENTS FOR TRIALS CONDUCTED

Experiment	Trial	Treatments	Rate/ha
Imazapyr and its mixtures	Trial 1	1. Imazapyr	0.10 kg ae
		2. Imazapyr	0.15 kg ae
		3. Imazapyr	0.20 kg ae
		4. Imazapyr	0.25 kg ae
		5. Imazapyr	0.30 kg ae
		6. Imazapyr	0.35 kg ae
	Trial 2	1. Slashing	—
		2. Paraquat + diuron	0.6 kg ai + 0.6 kg ai
		3. Glufosinate ammonium	0.5 kg ai
		4. Glyphosate + dicamba	0.54 kg ae + 0.27 kg ae
		5. Imazapyr (check)	0.375 kg ae
		Treatments were repeated at 11 weeks.	
	Trial 3	1. Imazapyr + 2,4-D dimethylamine	0.15 kg ae + 1.08 kg ae
		2. Imazapyr + 2,4-D dimethylamine	0.15 kg ae + 2.16 kg ae
		3. Imazapyr + glufosinate ammonium	0.15 kg ae + 0.225 kg ai
		4. Imazapyr + glufosinate ammonium	0.15 kg ae + 0.45 kg ai
		5. Imazapyr + ametryn	0.15 kg ae + 0.5 kg ai
		6. Imazapyr + ametryn	0.15 kg ae + 1.0 kg ai
		7. Imazapyr + diuron	0.15 kg ae + 0.5 kg ai
		8. Imazapyr + diuron	0.15 kg ae + 1.0 kg ai
		9. 2,4-D dimethylamine	2.16 kg ae
		10. Glufosinate ammonium	0.45 kg ai
		11. Ametryn	1.0 kg ai
		12. Diuron	1.0 kg ai
		13. Imazapyr (check)	0.15 kg ae
	Trial 4	1. Imazapyr (check)	0.15 kg ae
		2. Imazapyr + metsulfuron methyl	0.15 kg ae + 0.1 kg ai
3. Imazapyr + metsulfuron methyl		0.15 kg ae + 0.015 kg ai	
4. Metsulfuron methyl		0.1 kg ai	
5. Metsulfuron methyl		0.15 kg ai	
Trial 5	1. Metsulfuron methyl	0.03 kg ai	
	2. Imazapyr + metsulfuron methyl	0.075 kg ae + 0.01 kg ai	
	3. Imazapyr + metsulfuron methyl	0.075 kg ae + 0.015 kg ai	
	4. Imazapyr + metsulfuron methyl	0.075 kg ae + 0.02 kg ai	
	5. Imazapyr + metsulfuron methyl	0.075 kg ae + 0.025 kg ai	
	6. Imazapyr + metsulfuron methyl	0.075 kg ae + 0.03 kg ai	
	7. Imazapyr (check)	0.075 kg ae	

TABLE 1. DETAILS OF TREATMENTS FOR TRIALS CONDUCTED (Contd.)

Experiment	Trial	Treatments	Rate/ha	
	Trial 6	1. Imazapyr + glyphosate + dicamba	0.15 + 0.18 + 0.09 kg ae	
		2. Imazapyr + glyphosate + dicamba	0.15 + 0.36 + 0.18 kg ae	
		3. Imazapyr + glyphosate + dicamba	0.15 + 0.54 + 0.27 kg ae	
		4. Glyphosate + dicamba	0.27 + 0.135 kg ae	
		5. Glyphosate + dicamba	0.54 + 0.27 kg ae	
		6. Imazapyr (check)	0.15 kg ae	
		Trial 7	1. Imazapyr +alachlor	0.25 + 0.48 kg ae
			2. Imazapyr +alachlor	0.25 + 0.96 kg ae
			3. Imazapyr + metolachlor	0.25 + 0.36 kg ae
			4. Imazapyr + metolachlor	0.25 + 0.72 kg ae
5. Imazapyr + oxyfluorfen			0.25 + 0.12 kg ae	
6. Imazapyr + oxyfluorfen			0.25 + 0.24 kg ae	
7. Alachlor			0.96 kg ae	
8. Metolachlor			0.72 kg ae	
9. Oxyfluorfen			0.24 kg ae	
10. Imazapyr (check)			0.25 kg ae	
Sprayer nozzles and spraying equipment	Trial 8	Imazapyr at 0.375 kg ae/ha was evaluated with :		
		1. Fan nozzle	-	
		2. Hollow cone nozzle	-	
	Trial 9	Imazapyr at 0.375 kg ae/ha was evaluated with:		
		1. Knapsack sprayer	-	
		2. Controlled Droplet Applicator (CDA)	-	

+ diuron provided moderate control after the second round of weeding which could be due to the residual effect of the pre-emergence herbicide diuron.

Mixture of imazapyr at 0.15 kg ae/ha with 2,4-D dimethylamine at 1.08 kg ae/ha or 2.16 kg ae/ha resulted in decreased control of

weeds comprising mainly *O. nodosa* with small percentages of *Croton hirtus*, *B. latifolia* and *A. compressus* (Table 4). At 5 weeks after treatment, imazapyr mixture with the higher rate of 2,4-D dimethylamine showed significant reduction on weed control, and at 11 and 17 weeks after treatment imazapyr mixture with both rates of 2,4-D reduced

TABLE 2. EFFECT OF IMAZAPYR AGAINST WEEDS ALONG PLANTING STRIPS OF RUBBER (TRIAL 1)

Treatment	Rate/ha (kg ae)	Percent weed control		
		3 weeks	6 weeks	10 weeks
Imazapyr	0.10	10 d	63 d	33 e
Imazapyr	0.15	15 d	75 c	50 d
Imazapyr	0.20	18 cd	80 bc	60 c
Imazapyr	0.25	27 c	85 bc	65 bc
Imazapyr	0.30	37 b	94 a	72 b
Imazapyr	0.35	47 a	94 a	85 a

Means followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at 5% level of significance.

TABLE 3. EFFECTS OF IMAZAPYR COMPARED WITH OTHER HERBICIDES AND SLASHING AGAINST WEEDS ALONG PLANTING STRIPS OF RUBBER (TRIAL 2)

Treatment	Rate/ha	Percent weed control					
		1 <sup>st</sup> Spray			2 <sup>nd</sup> Spray		
		4 wks	7 wks	11 wks	3 wks	6 wks	11 wks
Slashing	—	90	85	10	95	75	23
Paraquat + diuron	0.6 kg ai + 0.6 kg ai	70	70	10	85	75	65
Glufosinate ammonium	0.5 kg ai	95	40	5	90	60	40
Glyphosate + dicamba	0.54 kg ae + 0.27 kg ae	35	80	30	50	70	40
Imazapyr (check)	0.375 kg ae	15	95	60	30	95	80
LSD <sub>(p=0.05)</sub>		6.9	16.9	12.3	6.2	7.6	5.7

weed control significantly. Antagonism of 2,4-D dimethylamine when mixed with glyphosate on wheat, barley and wild oats<sup>12</sup> and Johnsongrass<sup>13</sup> has been reported. The antagonism was attributed to physical or chemical incompatibility rather than biological interaction within the plant<sup>12</sup>. Decreased weed control of imazapyr plus 2,4-D dimethylamine probably could be due to chemical interaction between these herbicides.

Significant reduction on control of weeds comprising mainly *O. nodosa* was also obtained when imazapyr at 0.15 kg ae/ha was mixed with glufosinate ammonium at either 0.225 kg ai/ha or 0.45 kg ai/ha. Glufosinate ammonium is a contact herbicide with little systemic activity and its mode of action is inhibition of glutamine-synthase activity which results in ammonia toxicity in affected plants<sup>14</sup>. Decreased weed control could be due to

TABLE 4. EFFECTS OF IMAZAPYR MIXTURES AGAINST WEEDS ALONG PLANTING STRIPS OF RUBBER (TRIAL 3)

Treatment	Rate/ha	Percent weed control		
		5 wks	11 wks	17 wks
Imazapyr + 2,4-D dimethylamine	0.15 kg ae + 1.08 kg ae	75	67	5
Imazapyr + 2,4-D dimethylamine	0.15 kg ae + 2.16 kg ae	60	70	20
Imazapyr + glufosinate ammonium	0.15 kg ae + 0.225 kg ai	67	67	10
Imazapyr + glufosinate ammonium	0.15 kg ae + 0.45 kg ai	65	42	10
Imazapyr + ametryn	0.15 kg ae + 0.5 kg ai	70	87	67
Imazapyr + ametryn	0.15 kg ae + 1.0 kg ai	85	88	72
Imazapyr + diuron	0.15 kg ae + 0.5 kg ai	95	91	43
Imazapyr + diuron	0.15 kg ae + 1.0 kg ai	87	85	47
2,4-D dimethylamine	2.16 kg ae	5	0	0
Glufosinate ammonium	0.45 kg ai	65	20	5
Ametryn	1.0 kg ai	3	5	0
Diuron	1.0 kg ai	1	1	0
Imazapyr (check)	0.15 kg ae	75	87	48
LSD <sub>(p=0.05)</sub>		7.2	11.8	7.6

the contact activity of glufosinate ammonium which reduced uptake of imazapyr and hence reduced weed control. Higher rate of glufosinate ammonium in the mixture provided faster weed regeneration at 11 weeks after treatment.

Mixture of imazapyr at 0.15 kg ae/ha with ametryn at 1.0 kg ai/ha provided slightly better control of weeds (mainly *O. nodosa* with some *B. latifolia*) than its mixture with ametryn at 0.5 kg ai/ha at 5 weeks after treatment. Both mixtures, however, provided comparable weed control as imazapyr at 11 weeks after treatment and were significantly more effective at 17 weeks after treatment. Mixture of imazapyr at 0.15 kg ae/ha with diuron at 0.5 kg ai/ha and 1.0 kg ai/ha improved weed control at 5 weeks after treatment but were comparable to

imazapyr at 11 weeks and 17 weeks after treatment. Ametryn and diuron are soil acting herbicides and improvement in weed control at 17 weeks with ametryn could probably be attributed to the presence of residual effect of the herbicide which inhibited germination and growth of the weeds.

Imazapyr at 0.15 kg ae/ha provided slight improvement of weed control in mixture with metsulfuron methyl at 0.01 kg ai/ha, but showed significant improvement with metsulfuron methyl at 0.015 kg ai/ha (Figure 1). Major weeds present were *O. nodosa* and *B. latifolia* and smaller percentages of *A. gangetica* and *C. caeruleum*. Metsulfuron methyl is mainly a broad-leaved herbicide and improvement on weed control with imazapyr could be due to wider spectrum of weed control.

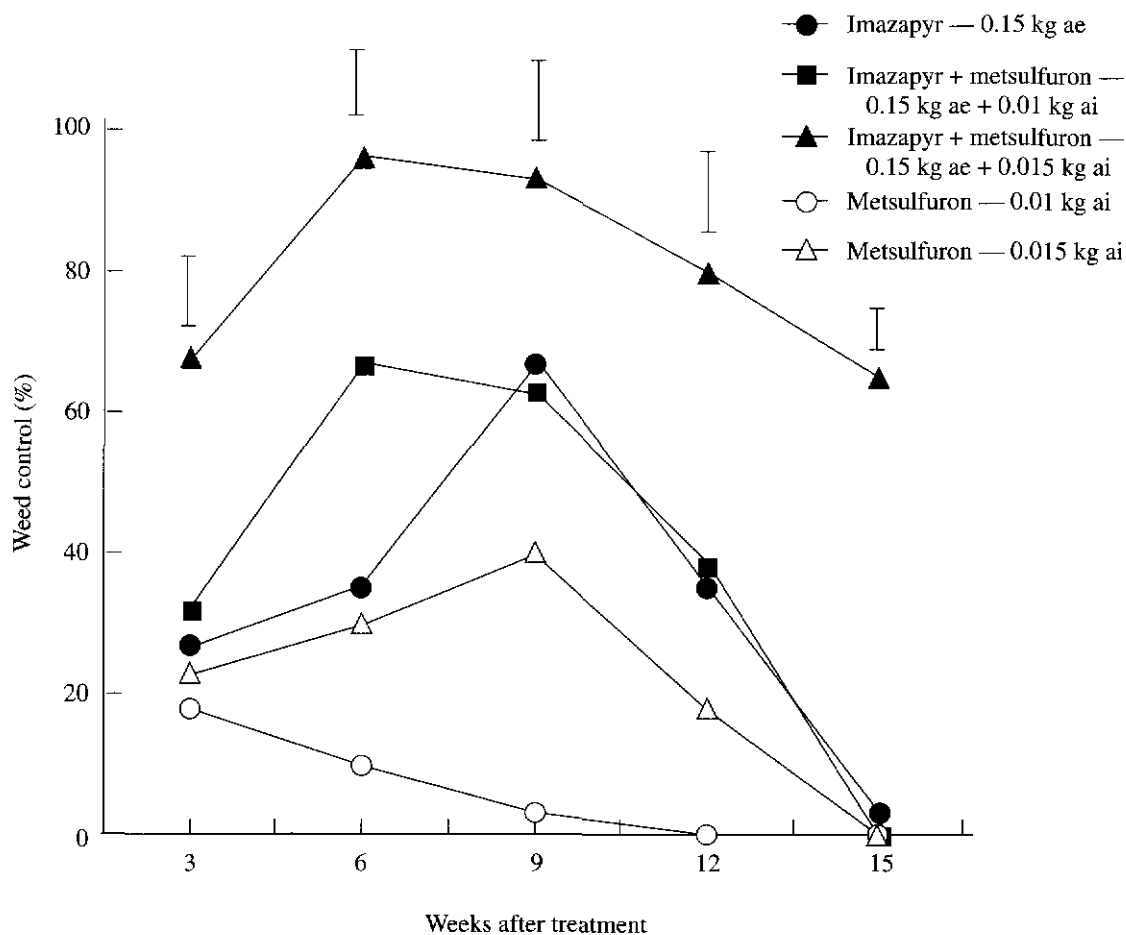


Figure 1. Effectiveness of imazapyr plus metsulfuron methyl against weeds along planting strips of rubber (Trial 4; vertical bars represent  $LSD_{(p=0.05)}$  values).

In another trial, mixture of lower rate of imazapyr with metsulfuron methyl showed inconsistent effect on weeds which comprised mainly of *O. nodosa* and *A. gangetica* and less of *C. caeruleum* and *A. compressus* (Table 5). Increasing the rates of metsulfuron methyl in the mixture with imazapyr (0.075 kg ae/ha) provided increased, decreased or comparable percentage weed control. Reason for less effective weed control with imazapyr +

metsulfuron methyl at 0.075 kg ae/ha + 0.015 kg ai /ha was due to rapid regeneration of *C. caeruleum* while with imazapyr + metsulfuron methyl at 0.075 kg ae/ha + 0.02 kg ai /ha was due to rapid regeneration of *A. gangetica*. Rapid regeneration of *O. nodosa* was the contributing factor to the less effective weed control with imazapyr + metsulfuron methyl at 0.075 kg ae/ha + 0.03 kg ai /ha.

TABLE 5. EFFECTS OF IMAZAPYR AT 0.075 KG AE/HA PLUS METSULFURON METHYL AGAINST WEEDS ALONG PLANTING STRIPS OF RUBBER (TRIAL 5)

Treatment	Rate/ha	Percent weed control		
		3 wks	8 wks	12 wks
Metsulfuron methyl	0.03 kg ai	3	4	0
Imazapyr + metsulfuron methyl	0.075 kg ae + 0.01 kg ai	8	78	45
Imazapyr + metsulfuron methyl	0.075 kg ae + 0.015 kg ai	18	90	27
Imazapyr + metsulfuron methyl	0.075 kg ae + 0.02 kg ai	40	92	38
Imazapyr + metsulfuron methyl	0.075 kg ae + 0.025 kg ai	43	96	67
Imazapyr + metsulfuron methyl	0.075 kg ae + 0.03 kg ai	10	90	37
Imazapyr (check)	0.075 kg ae	20	97	47
LSD <sub>(p=0.05)</sub>		6.0	6.4	15.5

Mixtures of imazapyr at 0.15 kg ae/ha with premixed glyphosate + dicamba at 0.18 + 0.09, 0.36 + 0.18 and 0.54 + 0.27 kg ae/ha improved control of weeds dominated by *O. nodosa* and *A. gangetica* (Table 6). Weeds which regenerated showed dominance of *A. gangetica* over *O. nodosa*. Improved control with imazapyr plus premixed glyphosate + dicamba confirmed effectiveness of the mixture as in Trial 2 (Table 3). Premixed glyphosate + dicamba has been reported effective on general weeds<sup>4,5,11</sup>. This mixture controlled a wide range of grasses and broadleaves and hence probably explain its improvement in activity when mixed with imazapyr.

Mixtures of imazapyr at 0.25 kg ae/ha with alachlor at 0.48 kg ae/ha and 0.96 kg ae/ha, metolachlor at 0.36 kg ae/ha and 0.72 kg ae/ha and oxyfluorfen at 0.12 kg ae/ha and 0.24 kg ae/ha provided comparable control as imazapyr against weeds comprising mainly of *O. nodosa* and *A. gangetica* (Table 7). These pre-emergence herbicides are generally used for controlling weeds during establishment of legume covers in oil palm<sup>15,16</sup> and rubber plantations<sup>17</sup> and did not

have much effect on established weeds as indicated when used alone. The long duration of effective weed control was due to the high rate of imazapyr used. Probably a lower rate of imazapyr would suffice for acceptable control.

### Sprayer nozzles and spraying equipment

Efficacy of imazapyr at 0.375 kg ae/ha using a fan, hollow cone or solid cone nozzle against weeds comprising of *A. gangetica*, *O. nodosa* and *C. caeruleum* did not show significant difference in percentage weed control but slight improvement in weed control was obtained with solid cone nozzle at six and eight weeks after treatment (Figure 2). Slight improvement in weed control with the solid cone was probably due to better coverage of herbicide spray compared with the other two nozzle types.

Application of imazapyr at 0.375 kg ae/ha against weeds comprising mainly *O. nodosa* and *A. gangetica* showed that CDA provided comparable weed control as the conventional

TABLE 6. EFFECTS OF IMAZAPYR PLUS PREMIXED GLYPHOSATE + DICAMBA AGAINST WEEDS ALONG PLANTING STRIPS OF RUBBER (TRIAL 6)

Treatment	Rate/ha (kg ae)	Percent weed control		
		2 wks	7 wks	12 wks
Imazapyr + glyphosate + dicamba	0.15 + 0.18 + 0.09	43	93	20
Imazapyr + glyphosate + dicamba	0.15 + 0.26 + 0.18	68	96	37
Imazapyr + glyphosate + dicamba	0.15 + 0.54 + 0.27	96	98	72
Glyphosate + dicamba	0.27 + 0.135	65	35	10
Glyphosate + dicamba	0.54 + 0.27	85	80	40
Imazapyr (check)	0.15	30	75	10
LSD <sub>(p=0.05)</sub>		10.1	7.7	11.3

TABLE 7. EFFECTS OF IMAZAPYR PLUS PRE-EMERGENCE HERBICIDES AGAINST WEEDS ALONG PLANTING STRIPS OF RUBBER (TRIAL 7)

Treatment	Rate/ha (kg ae)	Percent weed control			
		3 wks	11 wks	17 wks	29 wks
Imazapyr + alachlor	0.25 + 0.48	75	99	99	97
Imazapyr + alachlor	0.25 + 0.96	75	99	99	97
Imazapyr + metolachlor	0.25 + 0.36	60	99	98	90
Imazapyr + metolachlor	0.25 + 0.72	65	99	99	90
Imazapyr + oxyfluorfen	0.25 + 0.12	85	99	98	90
Imazapyr + oxyfluorfen	0.25 + 0.24	85	99	95	90
Alachlor	0.96	5	20	0	0
Metolachlor	0.72	3	15	0	0
Oxyfluorfen	0.24	40	0	0	0
Imazapyr (check)	0.25	80	99	99	95
LSD <sub>(p=0.05)</sub>		6.2	7.3	0.8	2.3

knapsack sprayer up to 12 weeks after treatment (*Figure 3*). At 15 weeks after treatment, weed control was significantly more effective with the CDA than with the knapsack sprayer. The improvement in weed control was

probably attributed to better spray coverage with the CDA than with the knapsack sprayer. The greater effectiveness of CDA on control of common weeds under rubber has also been reported<sup>18,19</sup>.

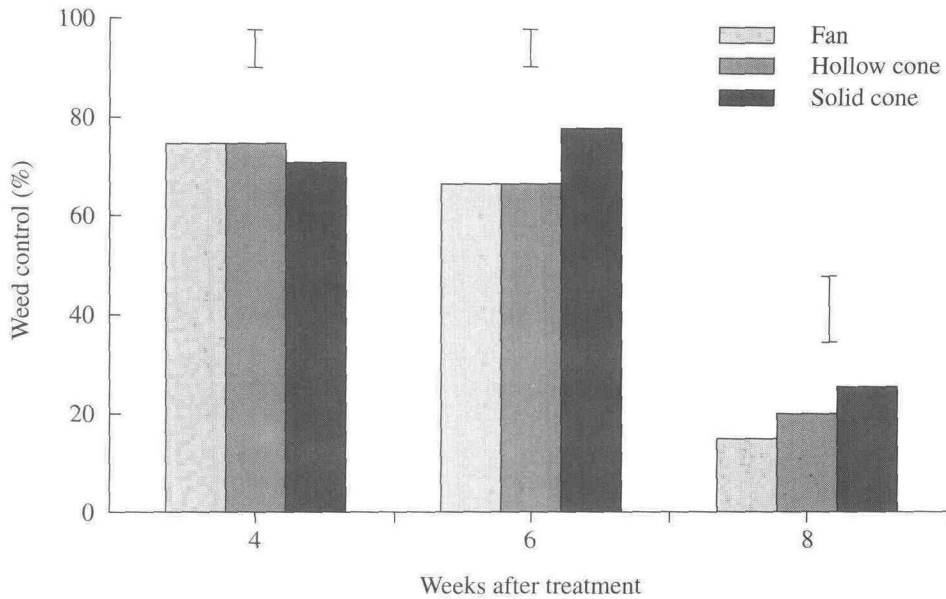


Figure 2. Effect of different nozzle types on efficacy of imazapyr at 0.375 kg ae/ha against weeds under immature rubber (Trial 8; vertical bars represent  $LSD_{(p = 0.05)}$  values).

### CONCLUSIONS

Amount of imazapyr required for acceptable control of general weeds was at least 0.2 kg ae/ha. Imazapyr at 0.375 kg ae/ha provided more effective weed control than standard treatments with pre-mixed paraquat + diuron, pre-mixed glyphosate + dicamba, glufosinate ammonium and slashing. Improved weed control was obtained when imazapyr at 0.15 kg ae/ha was mixed with either ametryn (0.5 kg ai/ha or 1.0 kg ai/ha), metsulfuron methyl (0.015 kg ai/ha) or pre-mixed isopropylamine salt of glyphosate + isopropylamine salt of dicamba (0.18 + 0.09, 0.36 + 0.18 or 0.54 + 0.27 kg ae/ha). Imazapyr at 0.15 kg ae/ha mixed with diuron (0.5 kg ai/ha or 1.0 kg ai/ha) or imazapyr at 0.25 kg ae/ha mixed with alachlor (0.48 kg ae/ha or 0.96 kg ae/ha), metolachlor (0.36 kg ae/ha or 0.72 kg ae/ha) or oxyfluorfen (0.12 kg ae/ha or 0.24 kg

ae/ha) provided comparable weed control to imazapyr alone. Efficacy of imazapyr at 0.375 kg ae/ha against general weeds was comparable when sprayed using either the fan, hollow cone or solid cone nozzle. More effective weed control was obtained when imazapyr at 0.375 kg ae/ha was applied with the CDA compared to the knapsack sprayer. Symptoms of phytotoxicity to the rubber trees were not observed in all trials.

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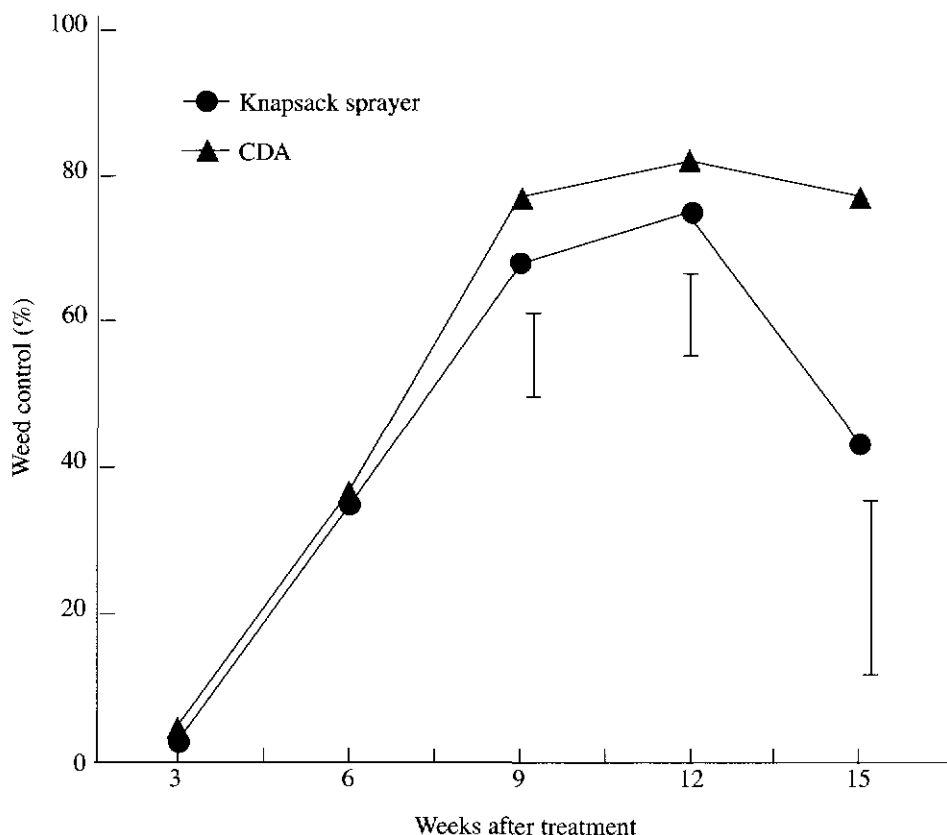


Figure 3. Comparative effects of two spray applicators on efficacy of imazapyr at 0.375 kg ae/ha against weeds under immature rubber (Trial 9; vertical bars represent  $LSD_{(p=0.05)}$  values).

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