

## REPORT ON THE RESULTS OF CHEMICAL WEED CONTROL EXPERIMENTS THE RUBBER PLANTATIONS IN SOUTH INDIA

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### SUMMARY

*Experiments were conducted by the Rubber Research Institute of India to study the possibility of chemical weed control in the seedling nurseries and immature rubber plantations. While in the seedling nursery, the use of pre-emergence weedicides was found promising, a sequence of pre- and post-emergence weedicides were proved to be advantageous in the planting strips of immature areas. Application of the pre-emergence weedicide Diuron gave good control on the emergence of weeds in seedling nurseries. In the planting strips of immature areas no weedicide, when applied alone, could effectively control all the weeds due to the diversity in the weed population. However a cocktail application of different combinations of weedicides were found to be effective, the ingredients of the cocktail being determined by the dominant type of weed population. Combinations of MSMA and Fernoxone were effective for weed population dominated by monocots and of Paraquant and Fernoxone for populations dominated by dicots, especially Eupatorium odoratum. When the grass weeds Imperata cylindrica and Pennisetum sp. dominate, the chemical 2,2-Dichloro propionic acid and MSMA were found to be more effective.*

### INTRODUCTION

In India, because of the prevalence of a pronounced dry season for about 3–5 months in the rubber growing districts, the problems due to weed growth are comparatively less serious than in other natural rubber producing countries. However, weed problems in rubber nurseries and in immature open plantations are rather serious and their control measures are very expensive. On the other hand, in mature areas where the canopy has closed, the problems is less serious.

For the initial establishment of seedlings in nurseries, it is essential to keep the seed bed completely devoid of weeds. Similarly, in the case of immature plantations it is essential to control weeds very effectively in the planting strips or terraces as well as in inter rows in order to permit good growth of plants and to facilitate establishment of leguminous ground covers. Timely sowing of cover crops and bimonthly weeding of the inter rows for the first two years would facilitate the establishment of a good cover of legumes which thereafter will be able to smother the weeds in the inter rows till the weeds get shaded out by the developing canopy of the rubber plants. Therefore, under Indian conditions, weeding after two years could be limited to planting strips and selective slashing of noxious weeds in inter rows.

Effective control of weeds in rubber plantations by pre-emergence weedicides has been reported by Jeevaratnam & Kanthaswamy (1962), Riepma (1962), Pereira (1966), Sethuraj *et al.* (1966), Smith (1966) and Mathew & Punnoose (1975). Post-emergence weedicides like Gramaxone, MSMA and Dalapon, have also been found to be very effective in the control of weeds in rubber plantations by many workers in different countries.

As the present practice of labour intensive manual weed control may prove to be uneconomic in the years to come, the necessity to intensify research on chemical weed control was felt. Comprehensive trials on the effect of pre-emergence and post-emergence weedicides in rubber nurseries and planting strips in immature plantations were therefore initiated by the Rubber Research Institute of India. Results of these trials are reported in this paper.

#### MATERIALS AND METHODS

Nine field experiments were conducted during the period 1969 to 1976. Of these, three trials were in seedling nurseries using pre-emergence weedicides. Out of the remaining six trials, two each were under open conditions, inter rows in immature rubber areas and in the planting strips, respectively. The experimental details are furnished in Appendix I.

In seedling nurseries, weedicides were applied after final preparation of nursery beds, keeping the spray volume at 750 l/ha. Sprouted Tjir 1 seeds were planted with minimum soil disturbance 6 days after the application of weedicides. In experiment Nos. 4, 5, 6 and 8 the chemicals were sprayed two weeks after slashing the weeds at a height of 15 cm from ground level, whereas, in experiment No. 9, clean weeding with a spade was done just before spraying pre-emergence weedicides. The spray volume used was 650—700 l/ha. Whenever the percentage regeneration was found to be 50 or more, as assessed by visual grading, subsequent sprayings were done in all the experiments except in nurseries.

#### RESULTS AND DISCUSSION

##### *Pre-emergence weedicides (Experiment 1)*

Among the five weedicides tested, Diuron, and Tenoran significantly reduced the weed growth till 3 months after planting, while VCS-438 was found effective only upto 1½ months (Table 1). In this connection, it is important to mention that Diuron and Tenoran were reported to be effective in controlling weeds in rubber and other crops by several workers. Chandapillai *et al.*, 1973 ; Garcia *et al.*, 1976 ; Nanaya *et al.*, 1974).

TABLE 1 : MEAN DRY WEIGHT OF WEEDS

Treatment	T1 Diuron 3 kg/ha	T2 Lasso granules 25 kg/h	T3 Tenoran 6 kg/ha	T4 VCS - 438 5 kg/ha	T5 TOK E - 25 10 l/h	T6 No herbicide (control)	SE	CD (5%)
Mean dry weight of weeds cut 1½ month after planting rubber seedlings (g)	73	852	412	823	940	1235	134	400
Mean dry weight of weeds cut 1½ month & at 3 months after planting rubber seedlings (g)	143	964	550	959	1043	1352	138	409

*Optimum dose of Diuron (Experiment 2)*

TABLE 2 : MEAN DAY WEIGHT OF WEEDS CUT 2½ MONTHS AFTER PLANTING RUBBER

Treatment	Levels of Diuron kg/ha						SE	CD (5%)
	T1 1	T2 2	T3 3	T4 4	T5 5	T6 No weedicide (control)		
Mean dry weight of weeds (g)	664	535	420	318	280	1160	653	193

The effect of Diuron was significant at all levels (Table 2). Diuron in increasing doses progressively reduced the weed growth, but the differences between successive levels were not significant. Since levels 3, 4 and 5 kg/ha were on par and 3 kg in turn was superior to 1 kg dose, the 3 kg/ha dose could be considered as optimum.

*Comparative efficiency of Diuron and Cotoran (Experiment 3)*

TABLE 3 : MEAN DRY WEIGHT OF WEEDS CUT 2 MONTHS AFTER PLANTING RUBBER

Treatment	T1 Diuron 2 kg/ha	T2 Diuron 3 kg/ha	T3 Cotoran 2 kg/ha	T4 Cotoran 3 kg/h	T0 No weedicide (control)	SE	CD (5%)
Mean dry weight of weeds (g)	480	100	880	270	2080	150	440

The results (Table 3) indicated that there was no significant differences between the two chemicals tried on an equal dose basis. In the case of Diuron both the levels were on par. But for Cotoran the 3 kg/ha level was significantly better than the lower dose. Thus either 2 kg/ha of Diuron or 3 kg/ha of Cotoran could be considered as optimum.

The results of the three nursery trials reported above, reveal that one round of spraying with Diuron at 2-3 kg/ha, Cotoran at 3 kg/ha or Tenoran at 6 kg/ha, immediately after the final preparation of the seed bed, will give a satisfactory control of weeds for a period of 2-3 months, which would eliminate one round of manual weeding. The relative cost structure of the different chemicals will have to be taken into account in the choice of the weedicide to be used.

*Post-emergence weedicides on Eupatorium odoratum (Experiment 4)*

All the weedicides as well as clean weeding with a spade significantly controlled *Eupatorium*, the effect of TOK E - 25 being significantly lower than other weedicide treatments (Table 4). A combination of 1.5 litres Gramoxone and 0.75 kg Fernoxone was found to have maximum effect. On the other hand only Ansar 529 had a suppressing effect on the other weeds, mainly grasses.

Though mixtures of Ansar 529 with 2, 4-D or Diuron have been reported effective (Dalabarre & Snoeck, 1976; Rouxel *et al.*, 1976), in the present investigation, Ansar 529 alone was found most effective for overall control of grasses and *Eupatorium*. Similar results have also been reported (Johnson, 1975; Rouxel *et al.*, 1976).

TABLE 4 : MEAN DRY WEIGHT OF *Eupatorium* AND OTHER WEEDS

Treatments (dosage/ha)	Dry weight (g/plot)	
	<i>Eupatorium</i>	Other weeds
A. TOK. E - 25 7.5 l	1089.0	1689.5
B. TOK. E - 25 7.5 l + Gramoxone 1.5 l	119.9	2522.8
C. TOK. E - 25 7.5 l + Bladex G 1.0 l	313.6	2624.8
D. RH - 315 1.25 kg + Gramoxone 1.5 l	238.0	2800.0
E. Gramoxone 1.5 l	183.1	2683.3
F. Gramoxone 3.0 l	107.4	2537.5
G. Gramoxone 1.5 l + Fernoxone 0.75 l	97.0	2406.2
H. Ansar 529 3.0 l	279.2	1341.5
I. Ansar 529 6.0 l	162.5	1359.8
J. Ansar 529 3.0 l + Bladex G. 0.5 l	122.4	1429.2
K. Clean weeding with spade	1428.7	1735.4
L. No weeding	3946.7	2695.0
SE	186.5	377.3
CD (5%)	530.1	1072.0

*Optimum dose of Ansar (Experiment 5).*

The three levels of Ansar as well as clean weeding was effective in controlling weeds as measured by the number of clumps and tillers (Table 5).

TABLE 5 : MEAN NUMBER OF CLUMPS AND TILLERS (NUMBER/50 CM<sup>2</sup>)

Treatments	Number of clumps as on				Number of tillers as on			
	8-10-69	11-11-69	23-12-69	10-2-70	8-10-69	11-11-69	23-12-69	10-2-70
T0 Ansar 529 4.7 l/ha	26.3	13.2	9.3	2.4	270.5	59.9	43.8	8.3
T1 Ansar 529 9.4 l/ha	28.2	12.0	6.7	1.1	290.2	80.2	26.3	2.6
T2 Ansar 529 14.1 l/ha	21.8	11.3	5.9	0.7	245.8	57.1	16.7	1.8
T3 Clean weeding	23.3	2.7	9.0	3.3	213.9	6.0	36.4	18.3
T4 No weeding	23.8	24.6	45.1	10.1	265.0	276.7	240.0	80.3
S. W.		1.8	6.7	0.7		24.3	7.1	7.3
C. D.		5.2	19.8	2.1		71.9	20.8	21.7

Since there was no significant difference between the three levels of Ansar, the lower dose of 4.7 l/ha could be considered sufficient to give satisfactory control of this type of weed. Effectiveness of Ansar on the control of *Pennisetum* sp. was reported earlier (Abdul Kalam *et al.*, 1975). Efficient control of grasses by Ansar has also been reported (Milihollan, 1970).

*Tafapon on Lalang (Experiment 6)*

All three levels of Tafapon significantly decreased the growth of Lalang, the difference between various levels being non-significant (Table 6). This indicated the sufficiency of the lowest dose of 10 kg/ha.

TABLE 6 : MEAN FRESH WEIGHT OF GRASS WEEDS 75 DAYS AFTER SPRAYING

Treatments	Fresh weight g/50 cm <sup>2</sup>
D1 — Tafapon 10 kg/ha	36.0
D2 — Tafapon 15 kg/ha	12.2
D3 — Tafapon 20 kg/ha	0.6
D4 — Weeding with spade	252.4
D5 — No weeding	456.8
S.E.	29.2
C.D.	87.6

The active ingredient in Dalapon and Tafapon are the same.

Good control of Lalang with Dalapon either alone or with Gramoxone, was also reported from Malaysia (Basnayaka, 1966 ; Watson *et al.*, 1967) and Thailand (Samose *et al.*, 1971). Weeding with the spade also resulted in significant reduction of growth but it was found to be less effective than chemical weed control.

*Gramoxone on Passiflora sp. (Experiment 7)*

Spraying of Gramoxone at 2.8, 4.2 and 5.6 l/ha and clean weeding with the spade resulted in a significant reduction of *Passiflora* growth (Table 7). It was also noted that the two higher doses *viz.* 4.2 and 5.6 l/ha were on par and superior to lower dose and clean weeding. This indicates that 4.2 l/ha is the optimum dose of Gramoxone for the control of *Passiflora* sp.

Since Gramoxone, a contact weedicide has been reported to be effective against a wide spectrum of weeds (Reipma, 1962 ; Watson, 1963 ; Seth, 1971 ; Holy, 1965 ; Khubutiya *et al.*, 1967), the control of *Passiflora* sp. obtained in the present investigation stands substantiated.

TABLE 7 : MEAN FRESH WEIGHT OF (*Passiflora*) WEEDS 90 DAYS AFTER SPRAYING

Treatments	Fresh weight g/50 cm <sup>2</sup>
G1 — Gramoxone 1.4 l/ha	290.5
G2 — Gramoxone 2.8 l/ha	228.3
G3 — Gramoxone 4.2 l/ha	83.0
G4 — Gramoxone 5.6 l/ha	70.3
G5 — Clean weeding	246.3
G6 — No weeding	364.3
S.E.	26.0
C.D.	78.4

*Control of weeds in planting strips (Experiment 8)*

*Weed Growth* : There was significant reduction in wet weight of weeds over the control and clean weeding due to the various weedicide combinations tried (Table 8). Treatment C (Ansar + Gramoxone + Diuron) was significantly superior to Ansar or Gramoxone applied alone. Since treatments C, D, E, F and G were on par and E and G consists of only two weedicides (Gramoxone or Ansar in combination with Fernoxone) the latter combinations may be used for satisfactory control of weeds in planting strips. Similar results have been reported by earlier workers (Johnson, 1975 ; Rahman *et al.*, 1973 ; Rouxel *et al.*, 1976 ; Rubber Research Institute of Malaysia, 1971).

TABLE 8 : MEAN FRESH WEIGHT OF WEEDS

Treatments	Fresh wt. g/50 cm <sup>2</sup>
A. Gramoxone 2.5 l/ha	126.0
B. Ansar 4 l/ha	83.8
C. Ansar 4 l + Gramoxone 0.6 l + Diuron 0.5 kg/ha	23.6
D. Ansar 4 l + Gramoxone 0.6 l + Fernoxone 1 kg/ha	63.3
E. Gramoxone 2 l + Fernoxone 1 kg/ha	51.4
F. Dalapon 2.5 kg + Ansar 4 l + Fernoxone 1 kg/ha	55.4
G. Ansar 4 l + Fernoxone 1 kg/ha	55.0
H. Control (Two slashing)	254.0
I. Mammtty weeding (clean weeding)	213.5
	S.E.
	18.8
	C.D.
	54.6

*Girth of trees* : Initially there was no significant difference in girth between various treatments. In subsequent years control plots recorded significantly lower girth than the weedicide treated plots (Table 8a). Since only two rounds of slashing were given in control plots the competition from the weeds might have been so severe that it resulted in a reduction in growth. Among the weedicides there was no appreciable difference in girthing of trees. The difference in girthing between control and scraping the planting strips was evident only in 1973, while in the next year it just missed the level of significance. The slight growth retardation observed in clean weeded plots might be attributed to the damage of feeding roots by scraping.

TABLE 8(a) : MEAN GIRTH OF PLANTS IN CM

Treatments (dosage/ha)	Year		
	1972	1973	1974
A. Gramoxone 2.5 l	17.59	31.11	34.32
B. Ansar 529 4 l	18.62	30.96	34.71
C. Ansar 4 l + Gramoxone 0.6 l + Diuron 0.5 kg	18.63	30.20	34.35
D. Ansar 4 l + Gramoxone 0.6 l + Fernoxone 1 kg	18.52	30.24	34.17
E. Gramoxone 2 l + Fernoxone 1 kg	19.30	31.84	35.40
F. Dalapon 2.5 kg + Ansar 4 l + Fernoxone 1 kg	19.05	31.71	35.21
G. Ansar 4 l + Fernoxone 1 kg	19.30	31.38	35.39
H. Control (slashing)	18.23	28.60	31.95
I. Clean weeding	18.46	30.47	33.51
C.D. for comparison of H with A to G (1973)	1.493	to	1.559
C.D. for comparison of H with A to G (1974)	1.851	to	1.927
C.D. for comparison of H with I (1973)			1.493
C.D. for comparison of H with I (1974)			1.851

*Pre-emergence weedicides followed by post-emergence weedicides (Experiment 9).*

Diuron and VCS 438 significantly reduced the weed emergence over control as well as plots treated with Lasso, the effect of Diuron being superior to that of VCS 838 (Table 9). The present finding suggests the superiority of Diuron as a pre-emergence weedicide. This is in agreement with the results obtained in seedling nurseries and earlier reports (Dawson *et al.*, 1976 ; Pereira, 1966).

TABLE 9 : EFFECT OF PRE-EMERGENCE WEEDICIDES ON FRESH WEIGHT OF WEEDS 12 WEEKS AFTER APPLICATION

Treatments (dosage/ha)	Fresh weight g/0.25 m <sup>2</sup>
Diuron 2.5 kg	34.1
Lasso 3.75 l	88.3
VCS 438 — 3.3 kg	60.2
Control	120.9
C.D. among weedicides	24.0
C.D. between weedicide and control	34.0

When a combination of Gramoxone and Fernoxone followed the pre-emergence application of Diuron, there was significant reduction in weeds. Similarly the combination of Ansar 529 and Fernoxone following all the three pre-emergence weedicides also resulted in a significant reduction in fresh weight of weeds (Table 9a).

TABLE 9(a) : EFFECT OF POST EMERGENCE WEEDICIDES WHEN APPLIED AFTER A PRE-EMERGENCE SPRAY

Post-emergence spray	Fresh weight of weeds g/plot			No spray
	Pre-emergence spray			
	Diuron	Lasso	VCS 438	
Weedazol TL 3.75 l	215.2(4)	251.5 (5)	256.5 (3)	
Gramoxone 2.5 l + Fernoxone 1.25 kg	111.1 (2)	150.7 (3)	145.0 (2)	
Ansar 5 l Fernoxone 1.25 kg	119.8 (2)	80.0 (2)	95.3 (3)	
Slashing				234.2
C.D. 5%				113.6

Figures in brackets show the number of round of post emergence spraying required.

Since Diuron was superior to other pre-emergence weedicides, a programme involving pre-emergence spraying with Diuron followed by two rounds of post-emergence application of Gramoxone or Ansar 529 with Fernoxone appears to be sufficient to get year round control.

#### CONCLUSIONS

From the result of the experiments discussed above the following broad conclusions regarding the use of herbicides can be drawn.

- One round of pre emergence spray with Diuron at 2 - 3 kg per ha, Cotoran at 3 kg/ha or Tenoran at 6 kg/ha will give satisfactory control of weeds for a period of 2 — 3 months in seedling nurseries.
- In areas pre-dominantly infested with *Eupatorium*, cocktail spraying with Gramoxone 1.5 l + 0.75 kg Fernoxone was found to be ideal.
- For control of grasses such as *Pennisetum* sp., Ansar 529 at 4.7 l/ha would give sufficient control.

- Tafapon at 10 kg per ha was found to be effective against k.lang.
- *Passiflora* sp. was effectively controlled by Gramoxone when sprayed at 4.2 l/ha.
- For the year round control of weeds in planting strips 6 rounds of spraying with Gramoxone or Ansar 529 in combination with Fernoxone are necessary.
- When these post emergence sprays followed a pre-emergence spray with Diuron, the number of rounds could be reduced to two for an year round control.

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APPENDIX I  
EXPERIMENTAL DETAILS

Sl No.	Experiment	Duration	Treatments (dosage per ha)	Rounds of spray	Design and plot size	Observations
<i>Seedling Nursery</i>						
1.	Screening of pre-emergence weedicides.	1973 - 74	T1 Diuron 3 kg T2 Lasso granules 25 kg T3 Tenoran 6 kg T4 VCS 438 5 kg T5 TOK E - 25 10 litre T6 No weedicide.	1	RBD with 4 replications Gross plot size 3.6 m <sup>2</sup> Net plot size 1.8 m <sup>2</sup>	Dry weight of weeds at 6 and 8 weeks after planting.
2.	Optimum dose of Diuron.	1974 - 75	D1 Diuron 1 kg D2 Diuron 2 kg D3 Diuron 3 kg D4 Diuron 4 kg D5 Diuron 5 kg D6 No weedicide	1	RBD with 5 replications Gross plot size 3.6 m <sup>2</sup> Net plot size 1.8 m <sup>2</sup>	Dry weight of weeds at 10 weeks after planting.
3.	Comparative efficiency of Diuron and Cotoran.	1975 - 76	T1 Diuron 2 kg T2 Diuron 3 kg T3 Cotoran 2 kg T4 Cotoran 3 kg T0 Control	1	- do -	Dry weight of weeds at 8 weeks after planting.
<i>Open conditions</i>						
4.	Screening of few post-emergence weedicides in areas predominantly infested by <i>Eupatorium odoratum</i> .	1970 - 71	A TOK E - 25 7.5 l B TOK E - 25 7.5 l + Gramoxone 1.5 l C TOK E - 25 7.5 l + Bladex G 1 l D RH 315 1.5 kg + Gramoxone 1.5 l E Gramoxone 1.5 l F Gramoxone 3.0 l G Gramoxone 1.5 l + Fernoxone 0.75 kg H Ansar 529 3 l I Ansar 529 6 l	3 4 4 4 4 4 4 4 4	RBD with 6 replications Plot size 30 m <sup>2</sup> .	Dry weight of <i>Eupatorium</i> and other weeds separately.

Sl No.	Experiment	Duration	Treatments (dosage per ha)	Rounds of spray	Design and plot size	Observations
5.	Optimum dose of Ansar 529 in areas predominantly infested with <i>Pennisetum</i> sp.	1969 - 70	T0 Ansar 529 4.7 l T1 Ansar 529 9.4 l T2 Ansar 529 14.1 l T3 Clean weeding T4 No weeding	3	RBD with 6 replications plot size 30 m <sup>2</sup>	Number of tillers and clumps at 4 stages of growth.
<i>Inter-rows of immature plantations</i>						
6.	Effect of Tafapon on the control of Lalang.	1969 - 70	D1 Tafapon 10 kg (5 + 5) D2 Tafapon 15 kg (10 + 5) D3 Tafapon 20 kg (15 + 5) D4 Clean weeding with spade D5 No weeding	2	RBD with 5 replications plot size 40 m <sup>2</sup>	Fresh weight of weeds 75 days after spraying.
7.	Effect of Gramoxone on the control of <i>Passiflora</i> sp.	1969 - 70	G1 Gramoxone 1.4 l G2 Gramoxone 2.8 l G3 Gramoxone 4.2 l G4 Gramoxone 5.6 l G5 Clean weeding with spade G6 No weeding	2	- do -	Fresh weight of weeds 90 days after spraying.
<i>Planting strips</i>						
8.	Effect of few post emergence weedicides	1971 - 74	A Gramoxone 2.5 l B Ansar 4.0 l C Ansar 4.0 l + Gramoxone 0.6 l + Diuron 0.5 kg D Ansar 4.0 l + Gramoxone 0.6 l + Fernoxone 1.0 kg E Gramoxone 2.0 l + Fernoxone 1.0 kg F Dalapon 2.5 kg + Ansar 4.0 l + Fernoxone 1.0 kg G Ansar 4.0 l + Fernoxone 1.0 kg H Slash weeding I Clean weeding with spade	7 7 6 6 6 7 6 4 4	RBD with 4 replications plot size 45 m <sup>2</sup>	1. Pre and post treatment girth at annual intervals. 2. Fresh weight of weeds at the end of three years.
9.	Weed control with pre and post emergence weedicides.	1972 - 74	T1 Diuron 2.5 kg followed by Weedazol TL 3.75 l T2 ,, Gramoxone 2.5 l + Fernoxone 1.25 kg T3 ,, Ansar 5 l + Fernoxone 1.25 kg T4 Lasso 3.75 l followed by Weedazol TL 3.75 l T5 ,, Gramoxone 2.5 l + Fernoxone 1.25 kg T6 ,, Ansar 5 l + Fernoxone 1.25 kg T7 VCS 438 3.3 kg followed by Weedazol TL 3.75 l T8 ,, Gramoxone 2.5 l + Fernoxone 1.25 kg T9 ,, Ansar 5 l + Fernoxone 1.25 kg T10 Clean weeding with spade	* 4 2 2 5 3 2 3 2 3 4	RBD with 3 replications 45 m <sup>2</sup>	1. Fresh weight of weeds 11 weeks after pre emergence spraying. 2. Fresh weight of weeds 2 years after commencement

\* (Number of post emergence sprayings only.)

REFERENCES

- ABDUL KALAM, M. AND PUNNOOSE, K. I. (1975). Effect of some contact weedicides on the control of grasses. *Rubb. Bd. Bull.* **12**, 143.
- BASNAYAKA, V. S (1966). Eradication of sporadic Lalang. *Plrs' Bull. Rubb. Res. Inst. Malaya. No. 87.*
- CHANDAPILLAI, M. M. AND BARNES, D. E. (1973). Integrated weed control technique in oil palms. *Advances in oil palm cultivation, 1973*, 199.
- DAWSON, J. H., CLORE, W. J. AND BRUNS, V. F. (1967). Response of concord grapes and weeds to six annual applications of Monourin Diuron and Simazine. *Weed Abst.* **17**, 2714.
- DALABARRE, M., AND SNOECK, J. (1976). Results of two herbicide selectivity trials on Roubsta coffee in the Ivory Cost. *Weed Abst.* **25**, 1277.
- GRACIA, J. G. L. AND URIARTE, J. R. (1976). Weed control in citrus fruits by means of pre and post-emergence weedicides. *Weed Abst.* **25**, 1267.
- HOLY, J. C. (1965). Chemical weed control under coconut. *J. Agric. Soc. Trin.* **68**, (3), cited in *Weed Abst.* **18**, 1172.
- JEEVARATNAM, A. J. AND KANTHASWAMY, T. (1962). Use of herbicides for weed control in seedling nurseries. *Q. Jl. Rubb. Res. Inst. Ceylon* **38**, 11 — 12.
- JOHNSON, B. J. (1975). Post-emergence control of large crab grass and goose grass in turf. *Weed Sci.* **23**, 404.
- KHUBUTIYA, R. A. AND GOGOBERIDGE, G. S. (1967). Testing of herbicides in citrus plantation. *Weed Abst.* **17**, 2729.
- MILIHOLLAN (W. REX) (1970), M. S. M. A. for Johnson grass control in sugar cane. *Weed Sci.* **18**, 333.
- MATHEW, M. AND PUNNOOSE, K. I. (1975). A study on the comparative effect of some pre-emergence weedicides on the control of weeds in rubber plantation. *Rubb. Board. Bull.* **12**, 136.
- NANAYA, K. A., SRIVASTAVA, K. C. AND LEELA, D. (1974). Chemical control of weeds in citrus. *Abstracts of contributed papers. Proc. of the 19th International Hort. Cong. Warsaw, 1974*, 247.
- PEREIRA, R. J. C. (1976). Use of herbicides in rubber. *Weed Abst.* **18**, 1710.
- RAHMAN, F., DUTTA, A. K. AND SAIKIA, M. C. (1973). Biology and control of *Oxalis acetosella*. *Abst. Trop. Agric.* **1**, n. 7500634.
- ROUXEL, R., GENER, P. AND CORNIER, A. (1976). Herbicide applications in the upkeep of young *Hevea* plantations. *Weed Abst.* **25**, 1014.
- REIPMA KZN, P. (1962). The effect of paraquat on some grasses and other weeds commonly found in rubber plantations. *J. Rubb. Res. Inst. Malaya.* **17**, 141.

- REIPMA KZN, P. (1962). Weed control with Simazine in planting stripe *Hevea brasiliensis* and in legume cover plants. *J. Rubb. Res. Inst. Malaya* 17, 204.
- RUBBER RESEARCH INSTITUTE OF MALAYA (1971). Towards better usage of herbicide mixtures. *Plrs' Bull. Rubb. Res. Inst. Malaya No. 117*, 320.
- SAMOSE, J. AND SEKLI LAGI (1971). Once again chemical Lalang control. *Menara Perkebunan* 35, *Abst. Biblio. of Hevea rubber. RRCT, Thailand* 2, 119.
- SETH, A. K. (1971). Control of *Mikania cordata* in plantation crops using paraquat. *Weed Res.* 11, 17.
- SMITH, D. (1966). Role of Gramoxone in rubber cultivation. *Plrs' Bull. Rubb. Res. Inst. Malaya No. 87*, 184.
- SETHURAJ, M. R., ANANTH, K. C. AND JACOB, K. T. (1966). Preliminary studies on the use of pre-emergence weedicides in rubber plantations. *Rubb. Bd. Bull.* 8, 218.
- WATSON, G. A. (1963). Cover plants, weeds and weed killer. *Plrs' Bull. Rubb. Res. Inst. Malaya, No. 68*, 191.
- WATSON, G. A. AND SETH, A. K. (1967). Gramoxone from planting to replanting. *Planter*. 111.
- YOGARATNAM, N. (1971). Weed control under *Hevea* in Ceylon with herbicide mixtures based on MSMA. *Q. Jl. Rubb. Res. Inst. Ceylon* 48, 1-8.
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