MARDI Res. Bull., (1983) 11, 3: (320—327)

EFFECTIVENESS OF PRE-EMERGENCE HERBICIDES AT THREE LOCALITIES IN PENINSULAR MALAYSIA

S.A. LEE*

Keywords: Pre-emergence herbicides, Weed density, Duration of control, Degree of control.

RINGKASAN

Kajian telah dijalankan di atas kesan alachlor, butralin, atrazine, bromacil, diuron, fluometuron dan K–223 di tiga tempat (Kelang, Simpang Renggam dan Alor Bukit). Kekurangan padat rumpai yang berkesan oleh semua racun herba telah didapati di tiga tempat ini.

INTRODUCTION

Pineapple is sensitive to the common post-emergence herbicides like dalapon, 2, 4–dichlorophenoxyacetic acid, 4–chloro–2–methylphenoxyacetic acid, glyphosate, paraquat and sodium chlorate (LEE, 1972). COLLINS, (1960) reported that 2, 4–dichlorophenoxyacetic acid should not be used to kill weeds in pineapple growing areas in Hawaii because dilute concentrations of this hormone can cause serious damage to pineapple plants. Since 1967, attention has therefore been focused on the use of pre-emergence herbicides. TAN and ABDULLAH (1968), TAN and TAY (1968), TAN (1971) have shown that atrazine and diuron were the more effective pre-emergence herbicides when compared with simazine, prometryne and prometone on peat in Peninsular Malaysia. Diuron has been recommended in Hawaii, South Africa and Australia (GOWING & LANGE, 1962; REYNHARDT, 1967; DANIELSON, 1969; ANON, 1975). Bromacil has been recommended in the United States for weed control in pineapple growing areas while atrazine has been recommended in Thailand (SUWANNAMEK, 1963).

The main objective of this study was to evaluate the effectiveness of alachlor, atrazine, bromacil, diuron and fluometuron in three localities on peat.

MATERIALS AND METHODS

Four experiments were conducted in 1974–1975 at three localities where young pineapple (2–6 months) was grown *(Table 1)*. The herbicides and their rates tested are shown in *Table 2*. Using an 18 litre knapsack sprayer, the herbicides were sprayed on moist soil since there was rain the previous day. The volume of application was 1100 litres of tap water/ha.

Monthly enumeration of the number of weeds (according to species) was performed using a 30 x 45 cm quadret with 8 to 10 points per plot. Counting of weeds followed the method outlined by KLINGMAN (1971). *Commelina*, for instance, was counted by recording the number of rooted nodes. To prevent enchroachment and weeds, the inter-plot and the border areas were hand-weeded regularly.

The effectiveness of the pre-emergence herbicides at a particular locality was evaluated by comparing the weed densities of herbicide-treated plots and untreated (unweeded) plots.

The duration of control was the period taken by the herbicide-treated plots to reach the average weed density attained by the unweeded control after one month.

The control of each weed species was assessed by expressing the number of plants of a particular species as a percentage of the number of plants (of the same species) in the untreated (unweeded) plots after 2 or 3 months. The control of a particular species was rated as 'good' when its weed density was 35% and less, 'satisfactory' between 35 and 70%, and 'poor' above 70%.

*MARDI, Jalan Kebun, Kelang, Selangor.

TABLE 1: LOCALITY, PLOT SIZE, NUMBER OF REPLICATES, DURATION OF EXPERIMENT, NUMBER OF ROUNDS AND RAINFALL AMOUNT FOR EACH EXPERIMENT ON PEAT

Expt. No.	Locality	Plot size (m^2)	No. of replicates	Duration of experiment	No. of spraying round	Rainfall amount (cm)	
						2mt	3mt
1	Jalan Kebun (Selangor)	40	4	Dec 74 – Apr 75	2	33.7+ 40.2++	
2	Jalan Kebun	200	3	May 74 – Aug 75	1	26.3	45.9
3	Pineapple Estate (Simpang Rengam, Central Johore).	150	4	Feb 75 – May 75	1	67.8	85.0
4	Alor Bukit (South-West Johore)	25	4	Feb 74 – June 76	1	46.6	62.4

+ First round
++ Secound round

TABLE 2: DETAILS OF TREATMENT

Experiment No.	Treatments & rates (kg a.i./ha in brackets) of application of herbicides
1.	No weeding, monthly weeding, alachlor (3.40), butralin (4.00), K–223 (3.40), bromacil (1.40), diuron (5.40) and atrazine (2.70)
2.	No weeding, diuron (5.40), alachlor (3.40), bromacil (1.40)
3.	No weeding, alachlor (3.06), diuron (4.48), fluometuron (4.25), bromacil (1.20), atrazine (2.50)
4.	No weeding, monthly weeding, atrazine (2.54), alachlor (2.72), bromacil (1.20), flumeturon (2.70), diuron (3.60), alachlor + atrazine (1.36 + 1.12)

All untreated and herbicide-treated plots had pineapple, which was evaluated for phytotoxic injury.

RESULTS

Weed density

Significant differences in the weed densities between the control and the herbicide treatments were obtained in all the 4 experiments *(Figs. 1a & b, 2a–d)*.

In experiment 1, at Jalan Kebun, differences in the weed density among the herbicides were non-significant. Plots treated with diuron had the lowest weed density, followed by alachlor, fluometuron, bromacil, butralin, atrazine and K–223 *(Figure 1a)*. In experiment 2 at Jalan Kebun, differences in the weed densities in plots treated with alachlor and bromacil were non-significant after 3 months but their densities were significantly lower than those obtained with diuron *(Figure 1a)*. In experiment 3 at Simpang Renggam, differences in the weed densities in plots treated with bromacil, atrazine and diuron were non-significant but their densities were significantly lower than fluometuron or alachlor *(Figure 1b)*. In experiment 4 at Alor Bukit, the lowest weed density after 4 months was obtained with an application of alachlor + atrazine *(Figure 1b)*; differences in the weed densities obtained with this mixture, fluometuron, atrazine, alachlor and bromacil were however not significant.

Duration of control

Each herbicide provided the following period of control:–

Alachlor	: 2.72–3.40 kg a.i. ha	8–12 weeks
Butralin	: 4.00 kg a.i./ha	10 weeks
Atrazine	: 2.50–2.70 kg a.i. ha	11–14 weeks
Bromacil	: 1.20–1.40 kg a.i. ha	8–14 weeks
Diuron	: 3.50–5.40 kg a.i. ha	6–12 weeks
Fluometuron	: 2.70–4.20 kg a.i. ha	6–14 weeks
K–223	: 3.40 kg a.i. ha	8 weeks
Alachlor + Atrazine	: 1.36 + 1.12 kg a.i. ha	14 weeks

Degree of control of weed species

The degree of control of 14 species for experiment 1 (at 2 months) and experiments 2–4 (at 3 months) is shown in *Table 3*.

Alachlor provided variable control (poor to satisfactory) of *Ageratum conyzoides* but atrazine, bromacil and fluometuron provided good control. Good control of *Borreria latifolia* was obtained with bromacil. *Melastoma malabathricum* was best controlled by alachlor and diuron. All the herbicides provided poor to satisfactory control of *Commelina nudiflora*. Control of *Digitaria longiflora* and *Echinochloa colonum* was inconsistent but atrazine and K–223 controlled the latter weed.

Satisfactory to good control of *Eleusine indica* was obtained by alachlor while all the

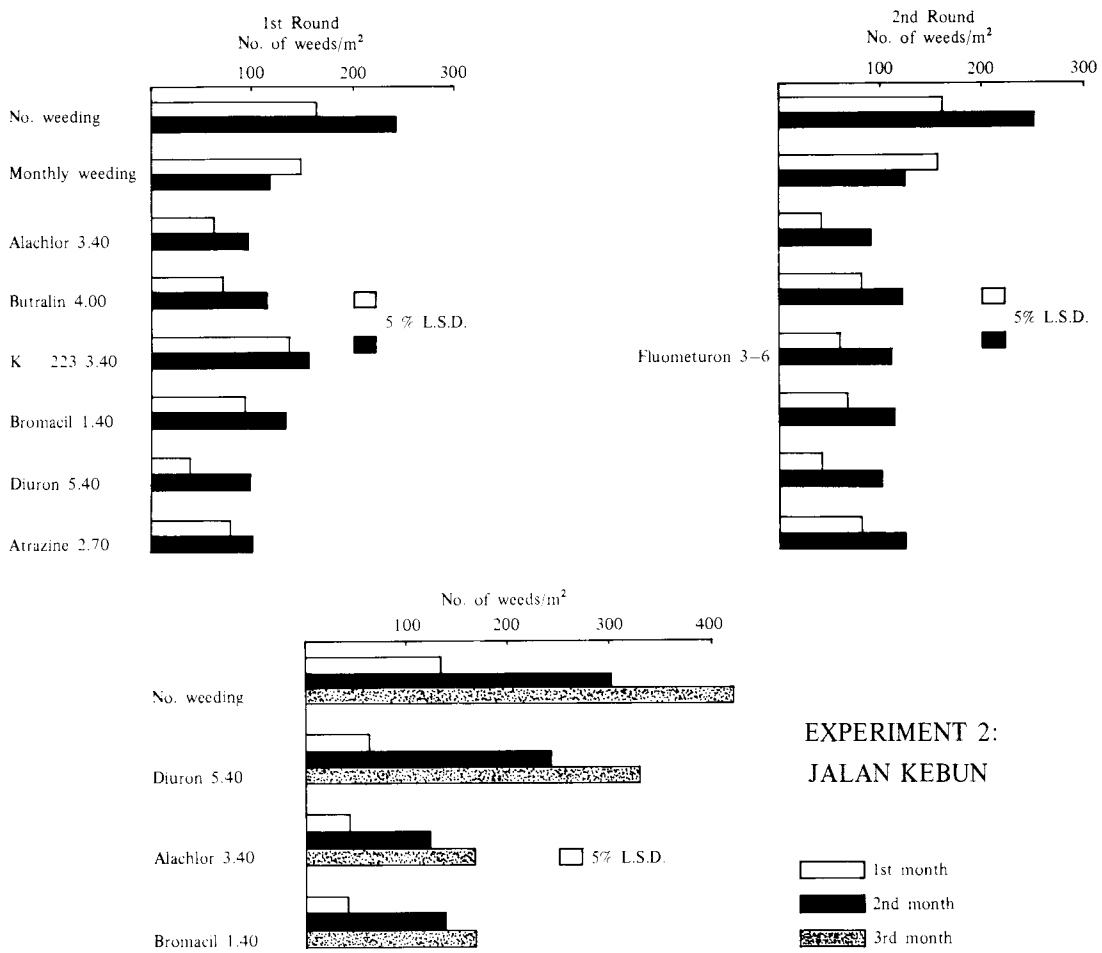

Figure 1a: Effect of pre-emergence herbicides on the weed density at various months at Jalan Kebun. (All dosages in kg a.i./ha).

other herbicides exhibited poor to satisfactory control. Alachlor again provided the best control for *Paspalum conjugatum* even at the third month. *Cyperus zollingeri* was well controlled by alachlor.

Effects of herbicide on pineapple

No phytotoxic injury on the young pineapple was observed.

DISCUSSION

The effectiveness of pre-emergence herbicides at different localities is influenced by soil factors (e.g. organic matter content and soil moisture content), climatic factors (e.g. rainfall), dosage, etc.

It is generally known that the adsorption of a pre-emergence herbicide, e.g. atrazine, increases as the organic matter content of the soil is increased (SEUHISA, 1967). In the early 1960s, it was not clear if pre-emergence herbicides could provide about two to three months of weed control on peat. The present results showed that despite the high organic matter content (85–90%) of peat (PARBERY & VENKATACHALAM, 1964), a reasonable period of control could be obtained. For instance, atrazine at 2.50–2.70 kg a.i./ha controlled weeds for 11–14 weeks. In a previous study, it provided 9–10 weeks of control at a dosage of 1.68 kg a.i./ha (LEE,

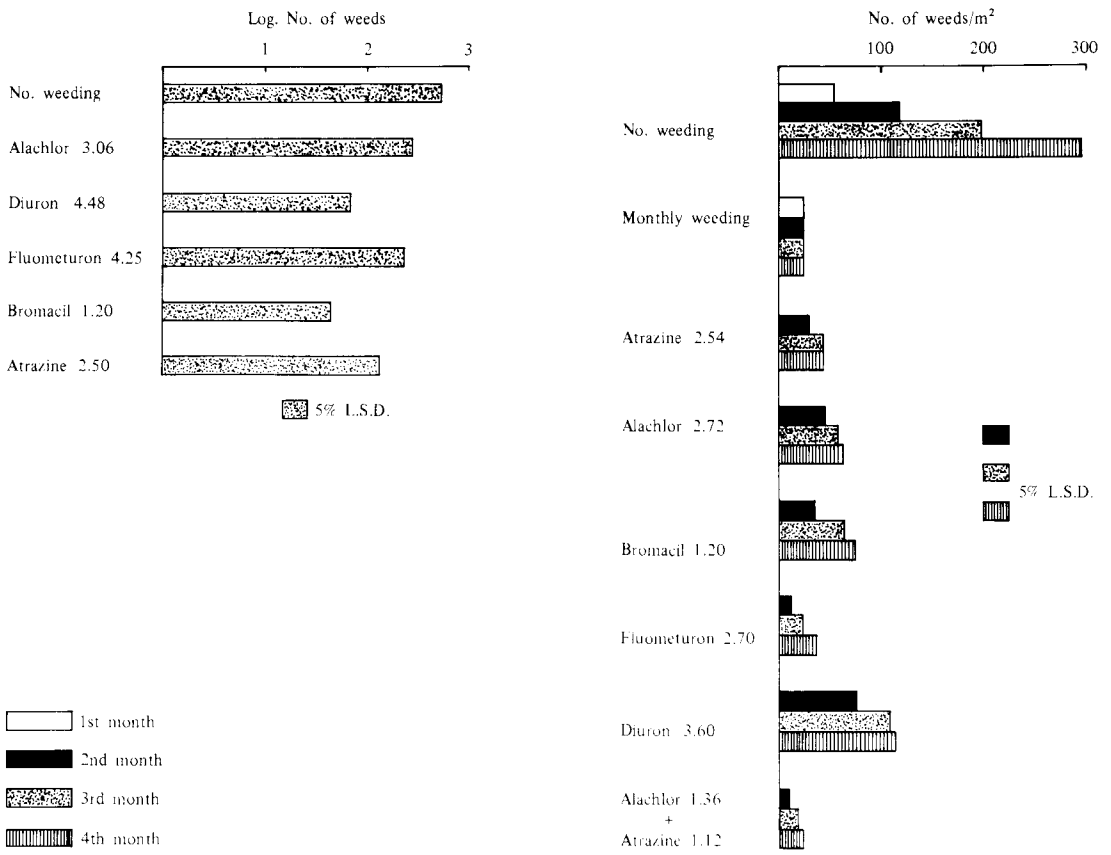

Figure 1b: Effect of pre-emergence herbicides on the weed density at various months at Simpang Rengam and Alor Bukit. (All dosages in kg a.i/ha).

1975). On sedimentary soils, RIEPMA (1962) reported that several pre-emergence herbicides including atrazine at 1.0–2.0 kg a.i./ha provided 13–16 weeks of weed control.

Previous reports (LEE, 1974 & 1975) have shown that atrazine at 1.68 kg a.i./ha provided poor control of *A. conyzoides* but the present studies showed that a dosage of 2.50 kg a.i./ha provided good control. The effectiveness of bromacil against *Borreria latifolia* has been similarly reported by PUSHPARAJAH & WOO (1971). Alachlor was found to be effective against *E. indica* and *C. zollingeri* (ANON, 1966).

The finding that no single herbicide was effective against all the weed species *(Table 3)* suggest that spot weeding was necessary to remove the resistant weeds that emerge after the first application of a particular herbicide. Alternatively it is suggested that a sequential application of another pre-emergence herbicide which will control the resistant weeds be performed. Further studies on the use of herbicide mixtures is suggested because pre-emergence herbicides might combine synergistically to provide a duration of control that is greater than that achieved by a single herbicide. The mixtures are likely to broaden the range of weeds that would be controlled. Recent results from other field trials showed that diuron + bromacil (2 + 2 kg) provided a longer duration of control than either herbicide at 4 kg.

Based on the results of the above multi-location trials, several macro-plots with

2a: Unweeded

2b: Sprayed with alachlor

2c: Sprayed with bromacil

2d: Sprayed with diuron

Figure 2a – d: Effect of 4 treatments on the weed density after 1 month in Experiment 1 at Jalan Kebun, Klang.

TABLE 3: DEGREE OF CONTROL OF WEED SPECIES BY VARIOUS HERBICIDES IN THE THREE LOCALITIES

Herbicide \ Weed Species	Ageratum conyzoides	Borreria latifolia	Cleome sp.	Hedyotis corymbosa	Jussiaea linifolia	Lindernia crustacea	Melastoma malabathricum	Commelina nudiflora	Digitaria longiflora	Echinochloa colonum	Eluesine indica	Paspalum conjugatum	Cyperus zollingeri	Fimbristylis pauciflora
Alachlor	PS	PG	S	PG	G	S	G	P	PS	PG	SG	G	G	SG
Butralin	PS	S		G				P	PS	PS	P			SG
Atrazine	G	PG	G	G			G	P	P	G	PS	S	S	P
Bromacil	G	G	S	G	P	S	S	PS	PG	SG	PS	S	PS	PG
Diuron	SG	PG	S	G	S	P	G	P	PG	PG	PS	G	PS	PG
Fluometuron	G	S	—	S			G		P	SG	P	S	SG	SG
K – 223	G	G		S			G			SG	P	SG	SG	SG
Alachlor + Atrazine	G													G

P = Poor S = Satisfactory G = Good control PS = Poor to satisfactory PG = Poor to good
SG = Satisfactory to good Underlined letters indicate inference based on 2 or 3 localities.
Letters not underlined indicate inference based on 1 locality. Blanks indicate absence of the weeds.

pineapple plants were sprayed with atrazine, diuron and bromacil and diuron + bromacil. The period of weed control was 10–16 weeks (ANON, 1981).

Pre-emergence herbicides are now being used by pineapple plantation owners and larger smallholdings (above 3 ha). They confer the obvious advantages of reduction of labour costs and more optimum mobilization of labour resources. Pineapple plants are relatively unaffected by the dosages used *(Table 1)* while pineapple yield and quality are unaffected by four application of atrazine (WEE, 1972).

ACKNOWLEDGEMENTS

The author is grateful to Dr. Tee Thean Soo, former Head of Horticultural Crops Branch, for his support and comments on this manuscript.

Mr. W.A. Razak, S. Shaharon and S. Salleh are thanked for their field assistance. Grateful acknowledgement is also made to Mr. C.H. Ng, Head of Research at Simpang Renggam Pineapple Estate for the conduct of one of the experiments, and to Mdm. S. Rokiah and Mdm. Anita Abbas for typing the manuscript.

SUMMARY

Investigations were conducted on the effectiveness of alachlor, bromacil, diuron and flumeturon over 3 localities (Kelang, Simpang Renggam and Alor Bukit). Application of all these herbicides resulted in a significant reduction in the weed densities over untreated plots.

REFERENCES

ANON (1966). *Tech. Pap. on Alachlor.* Monsanto Co., U.S.A. 4pp.

ANON. (1975). *The pineapple.* Hortic. Branch Report, Department of Primary Industries, Queensland. 34 pp.

ANON, (1981). *Notes of pineapple culture in Malaysia.* Kursus Nenas, 100–116.

DANIELSON, L.L. (1969). *U.S.D.A. Agric. Handbook*, p. 400.

GOWING, D.P. & LANGE, A.H. (1962). The impact of herbicide research on field practice in pineapple culture. *Weeds, 10,* 118–120.

KLINGMAN, D.L. (1971). Measuring weed density in crops. *Crop loss assessment methods, F.A.O. Manual, Commonwealth Agric. Bur.*, p. 200.

LEE, S.A. (1972). Effects of six post-emergence herbicides on young pineapple. *Malays. pineapple* 2, p. 47–52.

LEE, S.A. (1974). Herbicides for pineapple on peat in Malaysia. *Proc. XIXth Internat. Hortic. Congr.*, p. 12.

LEE, S.A. (1975). Atrazine as a pre-emergence herbicide for pineapple on peat in West Malaysia. *MARDI Res. Bull.* 3(1) : 24–31.

PARBERY, D.B. & VENKATACHALAM, R.E. (1964). Chemical analysis of South Malayan peat soil. *J. trop. Geogr., 18* : 1–9.

PUSHPARAJAH, E. & WOO, Y.K. (1970). Weed control in Rubber Plantations. *Proc. 3rd Asian – Pac. Weed Sc. Soc. Conf.*, 93–100.

REYNHARDT, J.P.K. (1967). Weed control in pineapple in pineapple lands. *Fmg. S. Agr. 43* (6), 52, From *Weed Abstr., 17* : 1713 (1967).

RIEPMA, P. (1962). A comparison between the effectiveness of some pre-emergence herbicides applied in planting strips of *Hevea brasiliensis* on a sandy soil. *J. Rubb. Res. Inst. Malays, 17* (2) : 191–5.

SUEHISA, R.H. (1967). Atrazine adsorption by several Hawaiian soils in relation to organic matter content. *Proc. 1st Asian–Pac. Interchange*, p. 120–121.

SUWANNMEK, U. (1965). Pre-emergence weed control in pineapple. *Kasetsart J.*, 5(1) : 52–59.

TAN, K.M. and ABDULLAH, M.Y. (1968). Evaluation of pre-emergence herbicides. II. *Tech. Pap.* No. 50, *Malay. Pineapple Ind. Bd.* p. 10.

TAN, K.M. and TAY, B.T. (1968). Evaluation of pre-emergence herbicides III. *Tech. Pap.* No. 58, *Malay. Pineapple Ind. Bd.* p. 7.

TAN, K.M. (1971). Preliminary evaluation of pre-emergence herbicides for weed control in pineapple. *Malays. pineapple* 1, p. 29–34.

WEE, Y.C. (1972). Weed infestation of peat areas under pineapple cultivation in West Malaysia. *Proc. 4th Internat. Peat Congr.* I–IV, 165–74.

Accepted for publication on 5th August, 1983.