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ATRAZINE AS A PRE-EMERGENCE HERBICIDE FOR PINEAPPLE ON PEAT

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RINGKASAN

Atrazine pada sukatan 1.68 kg a.i./ha (bahan aktif/hactre) dapat mengawal rampai pada jangka masa 10, 10 dan 9 minggu pada pusingan semburan yang pertama, kedua dan ketiga. Kawalan *Cyperus zollingeri* Steud dan *Ageratum conyzoides* L. adalah tidak memuaskan tetapi kawalan rumpai yang lain adalah mencukupi. Tiga pusingan atrazine, tiap-tiap satu dengan sukatan 1.68 kg a.i./ha tidak mengurangkan hasil dan mutu buah nenas jika dibandingkan dengan 12 bulan pusingan merumput dengan tajak.

INTRODUCTION

Weed control is an essential operation in pineapple cultivation. The conventional method of weeding is carried out manually with a tajak (a hoe). In West Malaysia, many pre-emergence herbicides (mainly the substituted ureas and triazines) have been tested for weed control in pineapple on peat, amongst which atrazine and ametryne were found to be promising (TAN, 1971; LEE & TAN, 1971).

Pre-emergence herbicides have also been tested in other countries. In Thailand, SUWANNAMEK (1965) reported that atrazine at 2.25 kg/ha provided good weed control for 2 months in the wet season, while a dosage of 4.5 kg/ha gave satisfactory control for 3 months. In the Philippines, MANUEL (1962) found that simazine gave satisfactory weed control.

The objective of this experiment was to evaluate the effectiveness of atrazine, ametryne, and their mixtures in controlling weeds on peat and to determine their effects on the yield and fruit quality of pineapple.

MATERIALS AND METHODS

The trial was laid down in an old pineapple area which had been cleared and burnt. Large logs were removed. The experiment consisted of six treatments and four replicates arranged in a randomised complete block design. Each plot was 4.3 m x 9.2 m. The distance between the plots was 2.5 m.

One month after clearing, pineapple (cultivar: Masmerah) was planted at a spacing of 90 cm. between double rows, 60 cm. between each of the double rows and 30 cm. between plants along each row. There were 180 plants per plot. One week after planting, a visual assessment of the composition of the weeds was carried out. The plots were than clean-weeded (weeded completely) with a tajak before the treatments were applied.

The six treatments consisted of a control (12 monthly hand weeding rounds with a tajak) and 5 herbicide treatments which consisted of three rounds of herbicides (*Table 1*). In each case, the plots were weeded completely before spraying the herbicide from the knapsack sprayer. The three rounds of herbicides were carried out at intervals of 3 months as TAN (1971) has shown that atrazine and ametryne controlled weeds for this period. In the first round, all the five herbicide treatments

TABLE 1. RATES[1] AND SEQUENCE OF APPLICATION OF ATRAZINE[2] AND AMETRYNE[3]

Treatment	First Round	Second Round (3 months after first round)	Third Round (6 months after first round)
T_0	Control (monthly handweeding)		
T_1	1.68 atrazine	1.68 atrazine	1.68 atrazine
T_2	1.68 atrazine	1.68 ametryne	1.12 atrazine
T_3	1.68 atrazine	0.84 atrazine + 0.84 ametryne	4.48 atrazine
T_4	1.68 atrazine	1.35 atrazine + 0.84 ametryne	5.60 atrazine
T_5	1.68 atrazine	1.35 atrazine + 1.35 ametryne	6.72 atrazine

[1] Indicates rates of application in kg a.i./ha. Herbicides applied in 1100 litres/ha water. + indicates mixtures.
[2] Atrazine: 2 - ethylamino - 4 - isopropylamino - 6 - chloro - 1, 3, 5 - triazine (wettable powder).
[3] Ametryne: 4 - ethylamino - 6 - isopropylamino - 2 methylthio - 1, 3, 5 - triazine (wettable powder).

Figure 1. Manual weeding is carried out by means of a tajak (a modified hoe).

consisted of 1.68 kg/ha atrazine. In the second round, atrazine was compared to ametryne and atrazine-ametryne mixture. In the third round, various dosages of atrazine were used. To prevent enchroachment of weeds, the interplot and the border areas were hand-weeded regularly.

At the end of the ninth month, the herbicide-treated plots were hand-weeded monthly until the twelfth month; thus, three rounds of hand-weeding were carried out.

The period of control by each herbicide treatment was assessed by collecting data on the weed density in each plot after spraying for each round. This was done by using a square quadrat (30.5 cm. x 30.5 cm.) placed at random over ten locations per plot. When the weed density of the herbicide plot at a certain time of sampling has reached the value of the control plot, the herbicide is considered to provide the duration of control from the time of spraying until that time of sampling. In the first round, for instance, the average weed density at the end of each month for the control plot was 2.67 weeds/quadrat. At this density, weeding was considered necessary. A treated plot (T_1), had this density only at the tenth week and the duration of weed control was taken to be 10 weeks.

The pineapple plants were fertilized at 3, 6 and 9 months with 10:1:8 NPK mixtures which contained 280 kg/ha N (sulphate of ammonia), 28 kg/ha P_2O_5 (double superphosphate) and 224 kg/ha K_2O (muriate of potash). Twelve months after planting, the pineapple plants were treated with calcium carbide solution to induce flowering. The fruits were decrowned and three slips were retained

per fruit. About 18 months after planting, 25 fruits per plot at three-eye ripe stage were randomly sampled for determinations of weight, length, diameter, sugar and acid content and incidence of broken core, infected core, infected flesh and black eye.

For determination of sugar and acid, one longitudinal quarter of the fruit was used. Sugar content (°brix) was measured using a hand-refractometer and acid content (in terms of % acid) was determined by titrating the juice with 0.1562 M sodium hydroxide solution.

RESULTS

Weed Control

In the first round, atrazine at 1.68 kg/ha controlled weeds for a period of 10 weeks (*Table 2*). Good control was obtained for *Borreria setidens* and *Erechthites valerianifolia* while poor control was obtained for *Cyperus zollingeri* and *Ageratum conyzoides* (*Table 3*).

In the second round, atrazine at 1.12 kg/ha controlled weeds for 10 weeks again. Ametryne alone controlled weeds for only 8 weeks and was not as effective as atrazine. However, mixtures of atrazine and ametryne performed as well as atrazine alone (*Table 2*).

In the third round, atrazine at 1.12 kg/ha controlled weeds for 5 weeks only. Atrazine at 1.68 kg/ha controlled weeds for 9 weeks, instead of 10 weeks which was obtained in the first as well as the second rounds. This was attributed mainly to the difficulty in covering the soil with a blanket spray of the herbicide because the pineapple plants had increased in size considerably. Higher rates of atrazine (4.48 -6.72 kg/ha) controlled weeds for 12- 14 weeks.

Effect of Yield and Fruit Quality

Differences in the fruit weight, length and diameter of pineapple between control and the herbicide-treated plots were non-significant (*Table 4*) . However, fruit weight values of herbicide treated plots ranged from 1.19 1.35 kg compared to 1.16 kg for control. Sugar and acid contents were again unaffected by the herbicide treatments.

Reduction in the incidence of infected core was obtained by treatments T_2 (1.68 kg/ha atrazine followed by 1.68 kg/ha ametryne followed by 1.12 kg/ha atrazine) and T_3 (1.68 kg/ha atrazine followed by 0.84 kg/ha atrazine + 0.84 kg/ha ametryne followed by 4.48 kg/ha atrazine).

The fact that higher concentrations of herbicides (T_4 and T_5) did not reduce the incidence of infected core could not be readily explained. However, this might be related to the type of weeds present rather than to the number of weeds. As little data were collected on the weed species present, explanations cannot be forwarded here. Investigations on this aspect, however, are in progress and it is hoped that future data would provide some explanation. It must be added that the C. V. was rather high.

The incidence of broken core, infected flesh and black eye was unaffected by the use of atrazine and ametryne.

DISCUSSION

The results of this experiment showed that atrazine could be used in peat areas where common weeds like *Borreria setidens, Erechtites valerianifolia, Digitaria ciliaris, Cleome rutidosperma, Hedyotis dichotoma, Melastoma malabathricum, Phyllanthus niruri* and *Physalis minima* are present.

TABLE 2. DURATION OF WEED CONTROL FOR EACH ROUND OF HERBICIDE

Treatment	Duration of weed control (weeks)			
	First[1] Round	Second[2] Round	Third[3] Round	Total
T_1	10	10	9	29
T_2	10	8	5	23
T_3	10	10	12	32
T_4	10	10	13	33
T_5	10	10	14	34

1) Average weed density requiring weeding = 2.67 weeds/quadrat. Rainfall = 52.1 cm. (3 months).

2) Average weed density requiring weeding = 3.34 weeds/quadrat. Rainfall = 64.0 cm. (3 months).

3) Average weed density requiring weeding = 4.00 weeds/quadrat. Rainfall = 125.5 cm. (3 months).

TABLE 3. DEGREE OF CONTROL OF VARIOUS WEED SPECIES BY 1.68 KG/HA ATRAZINE FOR THE FIRST ROUND

Weed Type	Species	Control Rating
Sedge	*Cyperus zollingeri* Steud.	Poor
Grass	*Digitaria ciliaris* (Retz.) Keol.	Satisfactory
Broadleafed	*Ageratum conyzoides* Linn.	Poor
	Borreria setidens (Miq.) Bold	Good
	Cleome rutidosperma D.C.	Satisfactory
	Erechthites valerianifolia (Wolf) D. C.	Good
	Hedyotis dichotoma Koenig ex–Roth	Satisfactory
	Melastoma malabathricum Linn.	Satisfactory
	Phyllanthus niruri Linn.	Satisfactory
	Physalis minima Linn.	Satisfactory

TABLE 4. EFFECT OF THREE ROUNDS OF ATRAZINE AND AMETRYNE ON THE FRUIT CHARACTERS OF PINEAPPLE ON PEAT

Treatment	Weight (kg)	Length (cm)	Diameter (cm)	Sugar (°brix)	Acid (% citric)	Broken core[1] (%)	Infected core[2] (%)	Infected flesh[3] (%)	Black eye[4] (%)
T_0	1.16	16.17	11.65	11.92	0.60	40.14	23.29	36.14	19.43
T_1	1.35	17.11	11.83	12.36	0.63	43.14	16.57	31.43	18.00
T_2	1.25	16.19	11.81	12.21	0.56	39.67	10.33	38.67	35.34
T_3	1.19	16.15	11.73	11.95	0.60	20.33	11.67	33.33	19.00
T_4	1.24	16.04	11.79	12.56	0.56	27.14	21.86	39.29	23.14
T_5	1.25	16.99	11.75	11.71	0.57	44.43	20.57	32.57	19.72
L.S.D. (5%)	NS	NS	NS	NS	NS	NS	9.78	NS	NS
C.V. (%)	7.2	4.8	1.5	5.3	9.5	37.0	39.3	34.3	45.0

NS = non significant at P = 0.05
[1] Fissures across the core
[2] Core shows brown colouration
[3] Flesh shows brown colouration
[4] At least one eye shows black colouration

TABLE 5. COSTINGS ON CHEMICAL[1] AND TRADITIONAL[2] METHODS OF WEED CONTROL FOR 7 MONTHS ($/HA)

Method of weed control	No. of rounds	Cost level	Herbicide cost	Spraying cost	Clean-weeding cost	Total cost
Chemical	3	Low	144.50	37.00	74.00	255.50
Traditional	7	Low	–	–	173.00	173.00
Chemical	3	High	144.50	56.00	111.00	311.50
Traditional	7	High	–	–	259.50	259.50

[1] 3 rounds of atrazine, each at 1.68 kg/ha.
[2] Monthly weeding with a ***tajak***.

Atrazine and ametryne belong to the class of herbicides triazines which act as soil-residual herbicides; susceptible weed seedlings absorb the herbicide and are killed. The triazines arrest the hill reaction of the chloroplasts (MORELAND *et al.*, 1959).

The performance of a pre-emergence herbicide in the field is affected by climatic factors, soil and herbicidal factors and their interactions (VAN der ZWEEP, 1960). The persistence of the herbicide would be affected by leaching, decomposition and volatization (AUDUS, 1951). As nearly all the pineapple in West Malaysia are planted on peat, adsorption of atrazine herbicides would be a significant factor. South Malayan peat soil has an average organic matter content of 86% (PARBERY and VENKATACHALAM, 1964). Several investigators have reported the close relationship between the organic matter content and atrazine adsorption (SUEHISSA, 1967; MCGLAMMERY, 1965). The dosages required on peat soils are higher than that on mineral soils in order to provide the same period of weed control.

Pre-emergence herbicides like atrazine are important because pineapple is extremely sensitive to post-emergence herbicides like paraquat, 2, 4–D, MSMA, MCPA, Dalapon and Sodium Chlorate (LEE, 1972).

The final evaluation of the use of atrazine would depend on the costs involved. The best treatment in this experiment was T_5 but herbicide costs would be extremely high. Treatment T_2 provided the shortest duration of weed control and would not be considered. The choice would be three rounds of atrazine, each at 1.68 kg/ha and it controlled weeds for about 7 months. Atrazine costs $28.65/kg. a.i. The cost of manual clean-weeding with a tajak varies from $24.70/ha/round to $37.00/ha/round. At the lower cost of clean-weeding, the total costs for the chemical method is $255.50/ha compared to $173.00/ha for the traditional method (*Table 5*). At the higher cost of clean-weeding, the total cost for the chemical method is $311.50/ha which is $52.00 more than the traditional method. Therefore, the difference in the total cost of the chemical and the traditional method of weeding is reduced in situations where the cost of clean-weeding is high. Increase in the labour cost of clean weeding would favour the introduction of the chemical method.

Experiments are already in progress with the objective of testing other pre-emergence herbicides that are capable of controlling *Cyperus zollingeri* and *Ageratum conyzoides*. The final choice of a pre-emergence herbicide would depend mainly on the weed flora and the rainfall pattern of the particular pineapple area.

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SUMMARY

Atrazine at 1.68 kg. a.i./ha controlled weeds for periods of 10, 10 and 9 weeks for the first, second and third rounds of spraying respectively. *Cyperus zollingeri* Steud and *Ageratum conyzoides* L. were poorly controlled but the other weeds were adequately controlled, Three rounds of atrazine, each at 1.68 kg. a.i./ha did not reduce the yield and fruit quality of pineapple when compared with twelve monthly rounds of handweeding with a tajak.

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