SOME OBSERVATIONS ON THE INSECT PESTS OF DHAL *(CAJANUS CAJAN)* AND THEIR CONTROL

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INTRODUCTION

PERENNIAL dhal varieties were introduced into Government farms about three decades ago chiefly for improving soil fertility. These varieties, although they satisfied the need, did not give good yields and their seeds were small and harvesting difficult. Therefore annual varieties, which gave better and quicker yields and which had larger and more attractive seeds were introduced about eight years ago.

During the first few years of introduction the yields obtained at the Dry Zone Research Institute at Maha Illuppallama were very satisfactory, being 1,200-1,500 pounds per acre. In subsequent years there has been a steady decline in yields and at present yields are never over 400-500 pounds per acre. At times the yields have been much lower. Large scale shedding of buds and flowers, and pods without seeds or with damaged seeds have been observed to account for loss in yields. These conditions are mainly due to attack by several insect borers.

INSECT PESTS AND NATURE OF DAMAGE

Gywala (1939) who conducted a varietal trial at the experimental station, Anuradhapura, observed that the dhal crop was damaged only by two insect pests, namely (1) the pod borer belonging to the *Agromyza* species and (2) blister beetles. He however did not consider the damage serious. Ishikura (1957) who conducted a survey at Maha Illuppallama, listed four insects that attacked buds and flowers, six* that attacked pods, and four* that attacked the leaf and stem. From the present studies conducted through three seasons at Maha Illuppallama, it has been possible to list the more prevalent pest species in their order of importance, the nature of the damage and time of appearance. Observations have also been made on their biology.

(* Three of these ten insects had not been named by Ishikura.)

The plant is free from serious damage by pests during its vegetative growth and the few insects that are found during this period are of not much consequence. Pest attack is very serious in the flowering and pod forming stages. The damage can be very heavy and there have been instances where no harvest has been possible due to severe pest attack.

The annual dhal variety yields twice, once in Maha and again in Yala, and the pests of the two seasons differ and are therefore treated separately.

PESTS OF MAHA SEASON

1. **Maruca testulalis* Gever—Bud and pod boring caterpillar.
2. *Lampides boeticus* L.—Bud and pod boring caterpillar.
3. **Heliothes armigera* Hb.—Bud and pod boring caterpillar.
4. *Mylabris pustulata* Thunb.—Flower eating beetle.
5. *Sphenarches caffer* Zell.—Bud and pod boring caterpillar.
6. *Dolichothrips varipes* Bagn.—Thrips that damage flowers.

(* Not listed by Ishikura 1957)

Maha flowering starts by about late January and may go on till early March and green pods may be found on the crop till early April. Bud and pod attacking insects therefore have food available for about three months and some of them could complete three reproductive cycles during this period. Population densities of the three major caterpillar pests for Maha season is given in Fig. 1.

1. *Maruca testulalis.*—The caterpillar of this moth is the most serious pest of early Maha, sometimes attacking as much as 50 per cent of the flowers and pods. The egg is laid on the bud and the young caterpillar on hatching bores into the unopened bud and attacks it from inside. After a few days of growth it moves out and bores into a fresh bud and so on attacking as many as 20-25 buds during its life which may take about 2-3 weeks. The bud that is eaten partly fades and drops off. The caterpillar also bores in to young pods and eats up the seeds. After finishing one seed it usually comes out and bores again to get to the next seed. One caterpillar may damage several pods during its life.

Pupation usually takes place in a cluster of dried up flowers held together by a silky secretion. Pupal stage lasts about one week.

2. *Lampides boeticus.*—The caterpillar of this blue copper butterfly damages the buds and pods in the same way as *M. testacealis.* The butterflies, which are found very commonly fritting about in and

around the crop right through the season, lay their eggs on the bud and the young greenish slug like caterpillar bores into the unopened bud and moves from bud to bud as it grows. The life cycle takes about 4-6 weeks.

The caterpillar which is fairly common on the crop during the early stages of flowering shows a sharp decline as the season progresses as shown in Fig. 1. The damage due to this pest is about 10-15 per cent. Pupation is similar to that of *M. testacealis* and the pupal stage takes about 5-7 days.

3. *Heliothes armigera.*—This is a common pest of leguminous crops in general and the caterpillar attacks buds and pods in the same way as *M. testacealis.* The greenish caterpillar is about 1½ inches long. During its life one caterpillar may damage 30-40 flower buds. Young pods are also attacked by this pest and while eating the immature seeds the posterior end of the caterpillar is seen protruding outside. The caterpillar is not common in the early part of the season but builds up, especially at the tail end of Maha season. During this period damage by *H. armigera* may be as much as 15-20 per cent.

4. *Mylabris pustulata.*—This flower eating beetle shows up in late February and persists till the flowering is over. This is not a serious pest during Maha and could easily be handpicked and destroyed, when present.

5. *Sphenarches caffer.*—The caterpillar of this plume moth is also a bud and pod borer and is found in very small numbers right through the season. When other pests are found in large numbers this is very rare.

6. *Dolichothrips varipes.*—Thrips are found in almost all buds and sometimes as many as ten or twelve may be found in each bud. Severe attack by thrips results in the drying and falling off of buds.

PESTS OF YALA SEASON

1. *Melanagromyza obtusa* Malloch—Pod borer.
2. *Mylabris pustulata* Thunb.—Flower eating beetle.
3. *Maruca testulalis* Gever—Bud and pod borer.
4. *Lampides boeticus* L.—Bud and pod borer.

1. *Melanagromyza obtusa.*—This pod boring maggot is by far the most serious pest of Yala. The fly lays its eggs through a puncture, inside the seed chamber of a young pod. The maggot that hatches out lives on the seed and eventually pupates in the seed chamber but outside the seed. During its life one maggot eats only one seed

or part of it. Often a maggot may be found in each seed chamber of the pod.

No external damage is visible on the attacked pod when green but subsequently minute holes through which adult flies had emerged may be seen. The damage due to the fly is very serious and may be even 50-75 per cent at times. Partly damaged seeds are usually subject to bacterial and fungal attacks and become entirely useless.

2. *Mylabris pustulata.*—The flower eating beetle may become a serious pest in Yala.

3 & 4. *Maruca testacealis* and *Lampides boeticus.*—These two pests which do great damage during Maha, although present never reach significant proportions. Yala flowering is normally confined to period of 3-4 weeks only, and the very warm dry climate during Yala seem to have a limiting influence on these insects.

TRIAL ON THE CONTROL OF PESTS BY INSECTICIDES

Material and Methods

A preliminary trial with six insecticides was conducted during Yala 1959 and on the results of this, a full scale trial was conducted through Maha 1959/60 and Yala 1960.

Annual dhal variety T85 was used in plots 30 ft. × 20 ft. at spacing of 3 ft. × 2 ft. The following were the insecticides tried and the doses :—

Dieldrin 20 per cent *E. C. Low—1 fl. oz. in 2 gal. water.
High—1 fl. oz. in 1 gal. water.

Dipterex 80 per cent @W. S. P. Low—0.1 oz. by wt. in 1 gal. water.
High—0.2 oz. by wt. in 1 gal. water.

Endrin 20 per cent E. C. Low—1 fl. oz. in 4 gal. water.
High—1 fl. oz. in 2 gal. water.

Gusathion 20 per cent E. C. Low—1 fl. oz. in 4 gal. water.
High—1 fl. oz. in 2 gal. water.

Malathion 50 per cent E. C. Low—1 fl. oz. in 4 gal. water.
High—1 fl. oz. in 2 gal. water.

Parathion (Folidol) 46.7 per cent E. C. Low—1 fl. oz. in 8 gal. water.
High—1 fl. oz. in 4 gal. water.

Phosdrin 24 per cent E. C. Low—1 fl. oz. in 4 gal. water.
High—1 fl. oz. in 2 gal. water.

(* E. C.—Emulsion Concentrate, @ W. S. P.—Water soluble Powder.)

There were three replications with 15 plots in each replicate. The total trial area was about 3/5 acre.

Flowering started about 11 weeks after planting when the plants were about 3½-4 ft. tall. Pest incidence was significant enough to give the first spraying when the crop was about 12 weeks old. Spraying was done by senior knapsack sprayers using a cone shaped nozzle. All insecticides used were emulsion concentrates except for water soluble dipterex.

Quantitative counts of all pests were taken weekly. For this purpose, five plants were selected at random from each plot and labelled. Attacked flowers from each of these plants were plucked and counted. The number of unattacked flowers on the plant was also counted. The caterpillars from the attacked flowers were counted by species. Similarly for pods, five other plants were fixed and similar counts taken.

The crop was sprayed five times during the Maha season according to pest incidence. Plants were sprayed in such a way that the flowers were nearly drenched. About 60-80 gallons of spray fluid was required for good coverage. Five sprayings were necessary due to unusual rains in February resulting in a second spate of flowering and a second peak in pest incidence. In normal years two to three sprayings should give adequate protection for the entire season. Two picks were taken during the season.

During Yala the crop was sprayed twice and this was sufficient for the entire season. Two picks were taken during Yala also.

Results

Maha Season.—Of the seven insecticides tried dieldrin and endrin gave the best results. The percentage flowers attacked on the fifteen selected plants from each treatment is given in Table 1 and the same for pods is given in Table 2. The percentage of flowers and pods attacked in dieldrin and endrin treated plots was always less than in the untreated plots as shown in Fig. 2.

Dieldrin at the dose of 1 fl. oz. per gallon and endrin at the dose of 1 fl. oz. in 2 gallons gave the best yields, of the insecticides tried. The yield from three 30 ft. × 20 ft. plots with dieldrin was 60 lb. and with endrin was 58.3 lb. compared with 43.8 lb. in the control. In one dieldrin treated plot the yield was 23.3 lb. which works out to about 1,691 lb. per acre compared with 1,060 lb. per acre from the untreated plots.

The total yield from the trial area was 745.2 lb. of dhal which works out to 1,200 lb. per acre. The details of the yields are given in Table 4.

Yala Season.—The major pest of the Yala season being *M. obtusa*, insecticide effectiveness differred from the Maha season. The results given in Table 3, are not very significant although malathion, phosdrin and gusathion gave better yields than the others. Yield figures are given in Table 4. The total yield from the trial area was 576.4 lb. for Yala the equivalent of 930 lb. per acre Malathion at a concentration of 1 fl. oz. in 4 gallons water gave the best yield of 42.9 lb. compared to 39.2 lb. from the untreated control.

The total yield for the two seasons from the entire area was 1321.6 lb. which works out to about 2,132 lb. per acre.

Discussion

The total yield of 2,132 lb. per acre from the entire trial area shows that treatment with insecticide significantly increases yields. This compares very favourably with yields at Maha Illuppallama which have been in the neighbourhood of 300—500 pounds per acre in the past few years. The seed weight in all the treatments has been about 65—75 per cent of the bulk pod weight and in one case it was as high as 87 per cent of bulk weight. Normally the seed weight is about 50 per cent or less of the bulk weight. This is due to heavy damage to seed by pests.

Dieldrin at a dilution of 1 fl. oz. per gallon water gave the best yield. At this dose and at the rate of about 75 gallons of spray fluid per acre the cost of insecticide application works out to about Rs. 22.50 per application. With endrin at 1 fl. oz. in two gallons water, the cost per application is about Rs. 15.75. These figures include about Rs. 5 for cost of labour. Although the plots were treated five times in the present trial during Maha due to unusual weather conditions, it would seem that in normal years three applications should suffice, with two more applications for Yala.

Pest damage on dhal is very severe during Maha as conditions seem more favourable during this period. Although heavy rains have an immediate depressing effect on pest populations, there is a quick build up soon after. Prolonged flowering, sometimes for as long as 6—8 weeks also is very conducive to pest build up. The warm dry weather of Yala months seem to exert a limiting influence on the caterpillar pests but *M. obtusa* thrives during this period.

A cultural practice that promises to be of value is one of growing dhal in association with either sorghum or maize on the same piece of land. Both crops in the association are sown together at the

appropriate time in the Maha season, the grain component being harvested in January/February and the dhal component in August. In this connection the following facts are worthy of mention:—(1) The growth of the dhal, which is suppressed during the Maha season by competition with the grain crop, is rapid during the Yala season, the main flush of flowering occurring during the dry season in July—August when insect control is easiest, (2) The yield from the grain component is not influenced by competition from the dhal, and (3) Dhal cannot be successfully established in the Yala season only. A crop association of this type can make maximum use of a piece of land. The economics of the control of insects of dhal in a sorghum/dhal association is under study at present and will form the subject of a further report.

From the present studies it is evident that pests could be controlled economically by insecticides.

Summary

Yields from annual dhal varieties, introduced into the Dry Zone about eight years ago, which had been about 1,200—1,500 lb. per acre during the first two years have dwindled to less than 500 lb. per acre in recent years. Pest damage appears to be the major cause for this condition.

From observations made at Maha Illuppallama the following major pests are listed:—

Maha Season

(1) *Maruca testulalis* Gever	Bud and pod borer.
(2) *Lampides boeticus* L. ..	Bud and pod borer.
(3) *Heliothes armigera* Hb. ..	Bud and pod borer.
(4) *Sphenarches caffer* Zell.	Bud and pod borer.
(5) *Mylabris pustulata* Thunb.	Flower eating beetle.
(6) *Dolichothrips varipes* Bagn. ..	Thrips that damage flowers.

Yala Season

(1) *Melanagromyza obtusa* Malloch ..	Pod borer.
(2) *Mylabris pustulata* Thunb.	Flower eating beetle.
(3) *Maruca testulalis* Gever	Bud and pod borer.
(4) *Lampides boeticus* L.	Bud and pod borer.

Studies have been made on the nature of damage by the pests, their seasonal prevalence and relative importance.

Trials on the control of the pests have been carried out through three seasons at Maha Illuppallama. Of the seven insecticides tried, dieldrin and endrin gave very good control of all the pests during Maha season and significantly higher yields than the untreated checks. A yield of nearly 2,132 lb. per acre have been obtained from a 3/5 acre trial area. Trials have shown that pests could be economically controlled with the use of insecticide applications with adequate increase in yields.

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TABLE I

Percentage buds and flowers attacked, in fifteen selected plants from each treatment, during Maha season

Treatment		*Percentage buds and flowers attacked*					
		Before treatment	*One week after each treatment*				
			1	*2*	*3*	*4*	*5*
Dieldrin	Low	27	10	10	12	5	3
	High	15	4	4	8	0	3
Dipterex	Low	13	15	8	5	2	2
	High	9	16	7	12	2	1
Endrin	Low	19	3·5	6	10	0	1
	High	9	4	5	6	2	3
Gusathion	Low	29	17	10	7	0	2
	High	26	10	7	5	0	0
Malathion	Low	19	10	5	7	0	1
	High	15	14	6	9	3	2
Parathion	Low	15	7	9	10	1	2
	High	15	9	3·5	4	1	2
Phosdrin	Low	17	11	13	7	0	2
	High	10	12	12	9	0	2
Control		21	15	24	10	5	1

TABLE 2

Percentage pods attacked by caterpillars, in fifteen selected plants from each treatment, during Maha season

Treatment		*Percentage pods attacked*						
		Weeks after each treatment						
		1	*1*	*2*	*1*	*1*	*1*	*2*
Dieldrin	Low	0	4	9	9	2	2	14
	High	0	5	7	6	3	1	5
Dipterex	Low	2	2	12	4	4	2	9
	High	0	3	8	9	4	1	5
Endrin	Low	2	4	5	5	4	0	9
	High	0	2	6	5	3	0·5	5
Gusathion	Low	6	6	8	12	5	3	6
	High	3	8	8	5	3	1	10
Malathion	Low	3	6	14	12	5	0·5	2
	High	0	7	13	10	2	0	3
Parathion	Low	1	7	10	9	6	1	4
	High	0	3	8	13	3	1	8
Phosdrin	Low	0	8	13	8	3	0	8
	High	3	15	11	6	4	1	7
Control		6	8	12	15	8	8	15

TABLE 3

Percentage pods attacked by Melanagromyza obtusa in fifteen selected plants from each treatment during Yala season

Treatment		*Percentage pods attacked*			
		Weeks after first treatment		*Weeks after second treatment*	
		1	*2*	*1*	*2*
Dieldrin	Low	8	2	8	7
	High	10	7	9	3
Dipterex	Low	5	0	7	10
	High	3	2	6	6
Endrin	Low	5	2	5	5
	High	7	7	8	3
Gusathion	Low	21	2	9	4
	High	6	4	7	6
Malathion	Low	7	1	5	6
	High	6	1	7	4
Parathion	Low	6	4	8	5
	High	12	7	5	3
Phosdrin	Low	8	5	4	8
	High	1	1	6	7
Control		20	23	14	7

TABLE 4

Dhal yields in pounds of seed obtained from 30 ft. × 20 ft. plots in three replications during Maha and Yala seasons

Treatment		*Seed weight in pounds obtained during Maha 1959-60*					*Seed weight in pounds obtained during Yala 1960*					*Total yield for Maha & Yala*	*Total yield per acre*
		Rep. 1	*Rep. 2*	*Rep. 3*	*Total*	*Yield per acre*	*Rep. 1*	*Rep. 2*	*Rep. 3*	*Total*	*Yield per acre*		
Dieldrin	Low	21·3	12·9	17·1	51·3	1,240	12·5	10·5	8·8	31·8	768	83·1	2,008
	High	23·3	19·4	17·3	60·0	1,450	13·5	9·5	13·9	36·9	892	96·9	2,342
Dipterex	Low	14·4	9·2	15·2	38·8	938	9·5	14·8	10·9	35·2	851	74·0	1,788
	High	16·2	17·3	17·1	50·6	1,223	13·1	11·6	11·6	36·3	877	86·9	2,078
Endrin	Low	17·7	17·4	17·4	52·5	1,269	16·1	7·9	9·4	33·4	807	85·9	2,076
	High	20·1	22·8	15·4	58·3	1,409	12·8	16·3	12·7	41·8	1,010	100·1	2,419
Gusathion	Low	14·1	17·7	18·9	51·0	1,232	16·0	11·7	12·4	40·1	969	91·1	2,202
	High	11·9	17·7	20·3	49·9	1,206	11·1	15·8	14·0	40·9	988	90·8	2,194
Malathion	Low	14·7	14·2	19·3	48·2	1,165	18·8	15·3	8·8	42·9	1,037	91·1	2,202
	High	13·7	17·2	17·4	48·3	1,167	12·8	17·0	11·3	41·1	993	89·4	2,160
Parathion	Low	12·6	17·4	17·3	47·3	1,143	14·1	14·1	10·5	38·7	935	86·0	2,078
	High	18·1	13·3	15·5	46·9	1,133	14·1	11·6	10·5	36·2	875	83·2	2,011
Phosdrin	Low	14·7	14·5	17·5	46·7	1,129	11·6	12·0	16·3	39·9	964	86·6	2,093
	High	17·5	13·7	20·4	51·6	1,247	16·5	14·7	10·8	42·0	1,015	93·6	2,262
Control		11·8	14·9	17·1	43·8	1,059	11·2	13·2	14·8	39·2	947	83·0	2,006
	Total	242·4	239·6	263·2	745·2	1,200	203·7	196·0	176·7	576·4	930	1,321·6	2,132

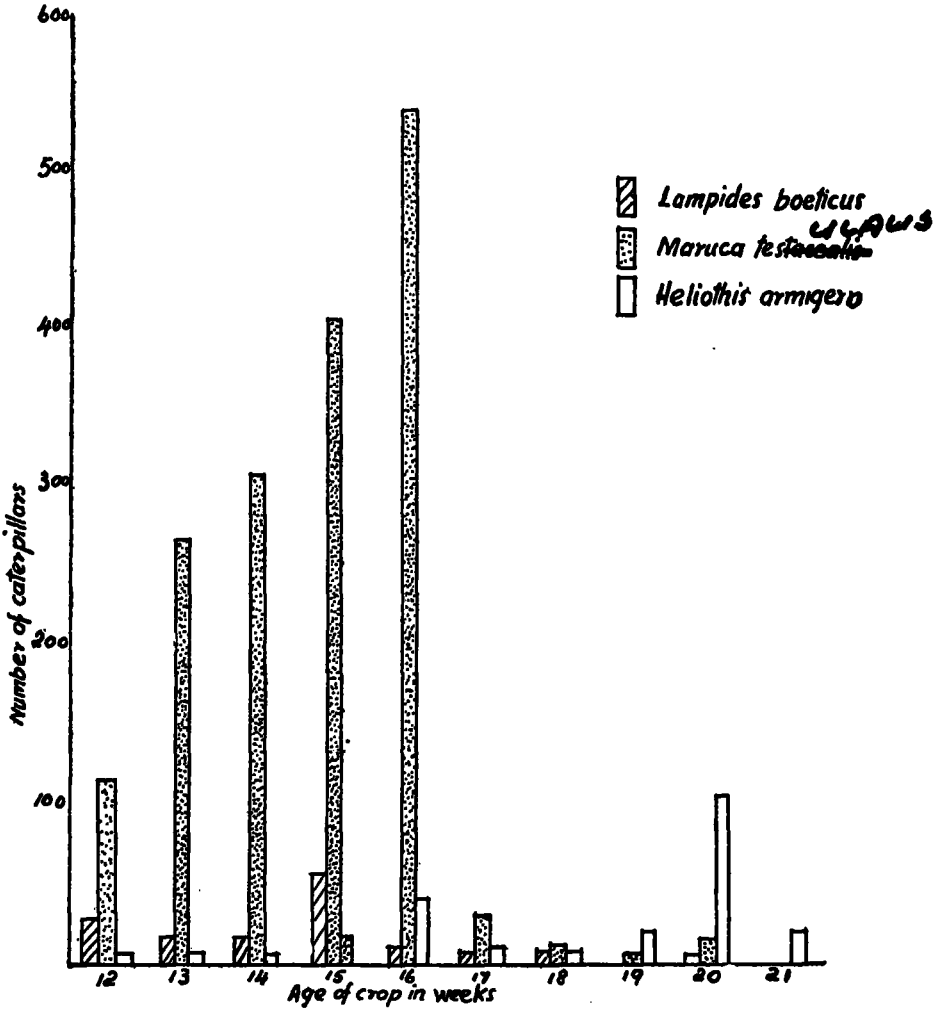

Fig. 1.—Population densitier of three major caterpillar pests on the crop during Maha season.

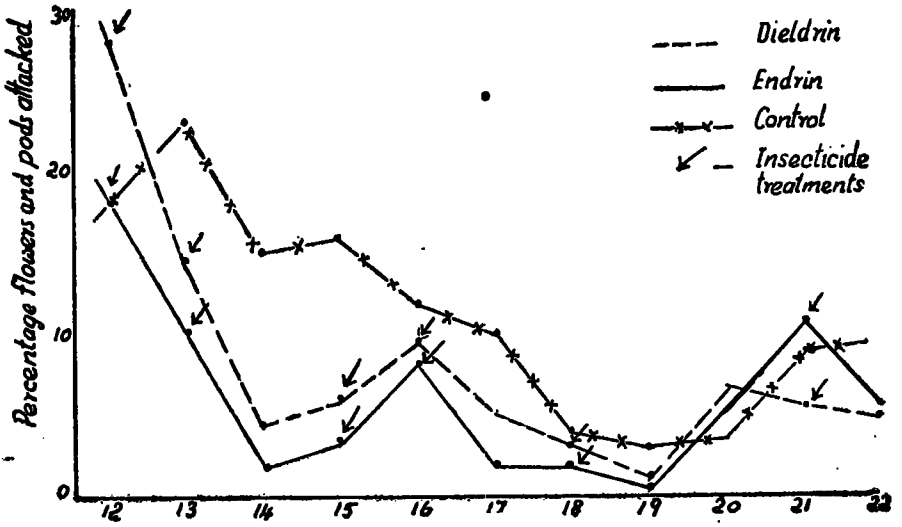

Fig. 2.—Percentage flowers and pods attacked by caterpillar pests during Maha season in the dieldrin and endrin treated plots and the untreated control.

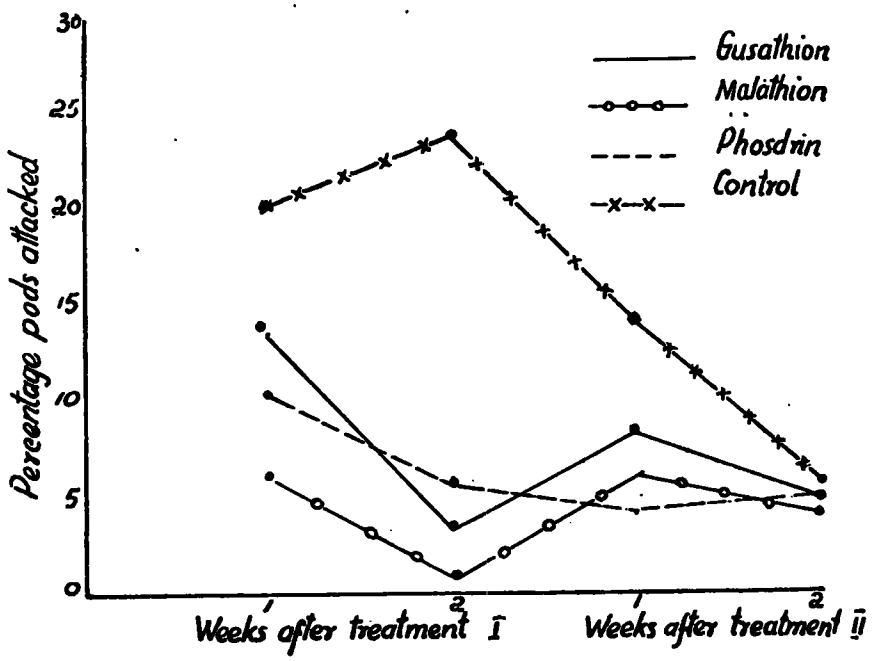

Fig. 3.—Percentage pods attacked by *Melanagromyza obtusa* during Yala season in the Gusathion, Malathion and Phosdrin treated plots and the untreated control.