

**SEASONALITY AND CONTROL OF THE BEAN FLY,
OPHIOMYIA PHASEOLI (TRYON) (DIP; AGROMYZIDAE)
ATTACKING GRAIN LEGUMES**

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ABSTRACT

Seasonality studies have enabled the adjustment of crop planting date to minimize damage by *O. phaseoli*. Hundreds of varieties of cowpeas, green gram and black gram have been screened for resistance/tolerance to *O. phaseoli* and some differences in infestation have been recorded. Despite the undesirable aspects of insecticides the same will continue to be important in pest management programmes till effective alternatives are found. Seed dressings and soil treatment appear to be more effective and practical than spraying especially where the problem of water and equipment shortages exist.

INTRODUCTION

Grain legumes are leguminous plants producing dry edible seeds, although the other parts of the same plants may also be edible. Grain legumes constitutes a group of high-protein food crops for millions of people who could be classified as the poorest of the poor, where nutritional needs are concerned. In subsistence agriculture, especially in the developing countries, the nitrogen fixing ability of grain legumes is of special advantage.

1. The Pest Problem

Insect pest damage is probably the main factor limiting yield of grain legumes in the tropics (Singh and Van Emden 1979). Large numbers of pests attack all parts of the plant at all stages, from seedling to harvest and beyond. In general, the data gathered in several countries suggests that two to tenfold yield increases are easily obtained from grain legumes with effective insect pest control (Singh and Van Emden 1979).

In Sri Lanka, more than forty insect species are known to feed or breed on grain legumes (Subasinghe unpublished). Among them, the bean fly, *Ophiomyia phaseoli* Syn. *Melanagromyza phaseoli*, (Tryon) is the most damaging single pest during the young stages of the crop. In some production areas, seedling mortality as high as 80—100% has been recorded where the pest had not been timely controlled (Subasinghe, unpublished).

The fly oviposits mostly on the upper surface of the leaf and the hatched maggot mines sub-epidermally through the leaves, petioles and stems. On seedling plants, it pupates below the epidermis of the stem just at or immediately above the ground level. In older plants, pupation takes place at the base of the petiole. Infestation begins as soon as the plants appear above ground. Leaves of infected plants become pale and in most cases the stem is swollen, cracked, and rotted. Such plants are either killed or severely stunted. The plants that survive an attack produce few pods, many of which are empty or contain small seeds (Abul-Nasr and Assem 1968; Greathead 1969; Swaine 1969). Partial recovery can be achieved by earthing up the bases of affected plants. This usually induces adventitious rooting above the region of the damaged stem.

O. phaseoli attacks plants belonging to the family Papilionaceae, chiefly the members of the genera *Phaseolus*, *Pisum* and *Vigna*. To a lesser extent it damages lablab (*Dolichos lablab* L.) pigeon pea or toor dhal (*Cajanus cajan* L.) sunhemp (*Crotalaria juncea* L.) etc. (Bindra and Singh 1969). In Sri Lanka, *O. phaseoli* is observed to attack all the commonly cultivated legumes, but the attack is more severe on *V. unguiculata*, *V. radiata* and *V. mungo*.

2. Seasonality of pest

In Sri Lanka, for many pests, diapause is not thought to be very important and survival over the dry season occurs on wild hosts and on small irrigated crop areas (Subasinghe and Fellowes, 1978). Under these circumstances, the well defined bimodal rainfall pattern can be expected to determine pest phenology. Data from light trapping (Robinson type 125 W MV) shows that total insect catch follows a strong bimodal pattern closely related to rainfall. Linear regression analysis of log transformed data gives a correlation co-efficient of 0.83. Keeping this factor in view, population dynamics studies of *O. phaseoli* were initiated.

Materials & Methods: Bimonthly planting of the cowpeas (Variety MI.35) was done at the Agricultural Research Station, Maha Illuppallama. Ovipositor punctures on the first two leaves were counted on 50 randomly selected plants after 5—7 days of emergence. Numbers of plants with stem damage were recorded on a sample of at least 250 plants after 21 days of germination. Daily data on rainfall were kept.

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Results:

O. phaseoli population in terms of geometric mean of leaf punctures and percent stem damage and corresponding rainfall for the same period at Maha Illuppallama is given in Figure 1. Rainfall is the dominant feature of the physical environment in the dry zones of Sri Lanka and the population fluctuation of *O. phaseoli* follows a bimodal pattern closely related to rainfall (Fig. 1). *O. phaseoli* population tends to increase during the dry period after the rain, with a very high peak in May–June.

Some Practical Application: Early Planting. One of the most important features of the rainfed agriculture is ensuring the best use of the incident rainfall. As a normal practice, farmers plant their grain legumes during the end of April or early May, taking their own time in preparing the land. Thus, the crop is usually attacked by the high populations of the beanfly during May/June (Fig. 1) resulting in very poor yields. Whereas, if they planted their crop along with the first showers during late March or early April, the crop could escape damage. In addition, the dry weather prevailing during pod maturity (standard weeks 22–26) favours pod setting and also prevents fungal attacks. Early planting practice has been observed beneficial to the farmers and it appears that large numbers of them are encouraged to adopt this practice with timely land preparations.

3. Varietal Resistance

The use of chemicals, particularly against the pest complex on grain legumes, is too expensive for the subsistence level farmer in Sri Lanka. This fact necessitates the development of non-insecticidal methods of pest control including resistant crop varieties. International Institute of Tropical Agriculture (IITA) is reported to have evolved varieties of cowpeas resistant to some pests (Singh, 1980). But apparently they have not worked on resistance to *O. phaseoli* due to the fact that this pest is not a major problem in West Africa (Singh 1980).

Hundreds of varieties of cowpeas, green gram or mung bean and black gram have been screened for resistance/tolerance to *O. phaseoli* at the Agricultural Research Station, Maha Illuppallama and some differences in infestation have been recorded.

Assessment of Cowpeas (*V. unguiculata*): Materials & Methods: The varieties were planted in the field of Maha Illuppallama in three replicates under conditions of moderate natural infestation and assessment was made of ;

- (i) ovipositor punctures on the cotyledons 5–7 days after germination.
- (ii) stem mining 21 days after germination since infestation was not severe enough to cause plant mortality.

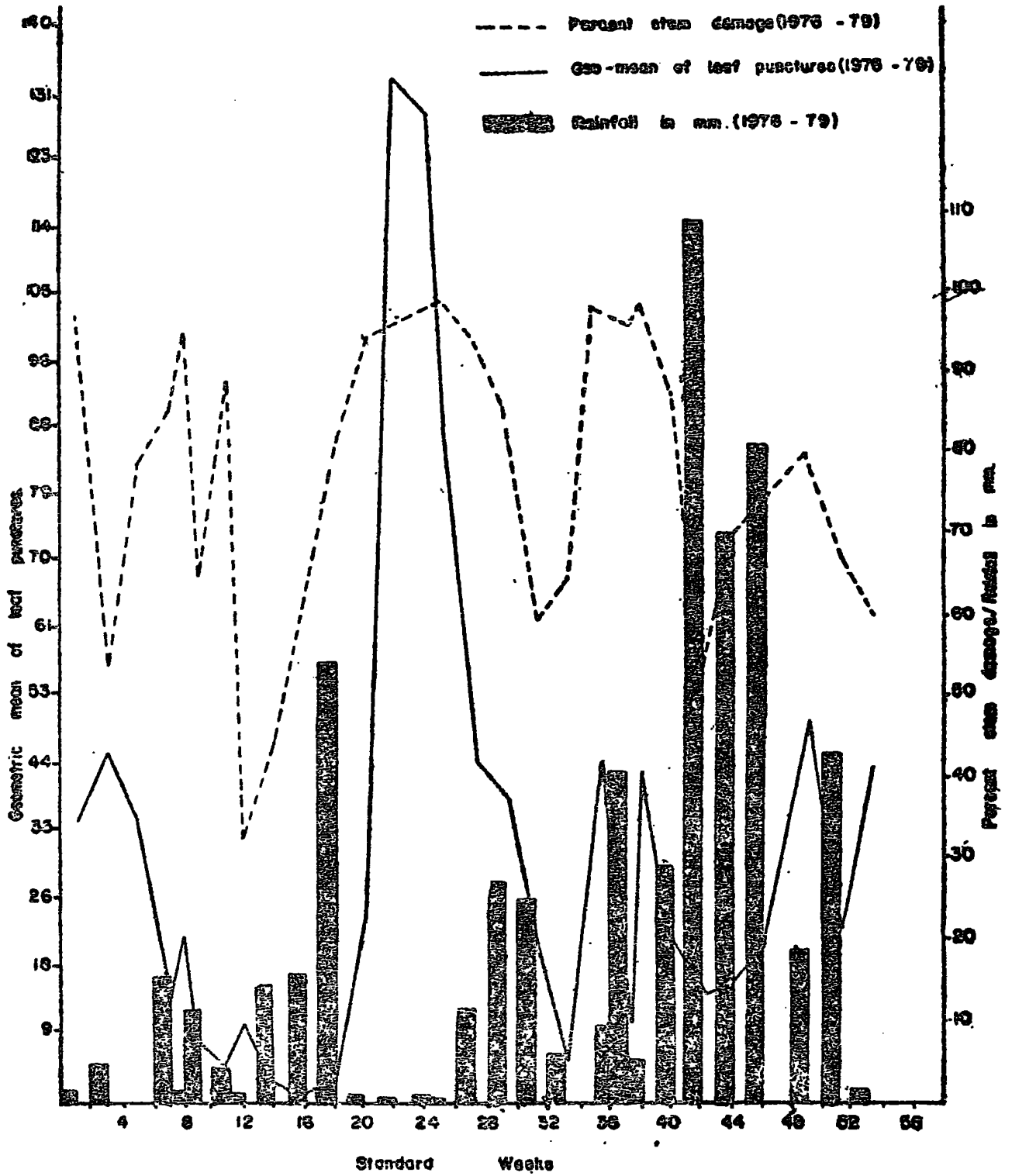


Fig. 1 *O. Phaseoli* Population (1976 - 1979)

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Results: All interpretations are made relative to the standard variety MI.35. On the basis of ovipositor punctures, several varieties have shown substantially lower infestation, but the differences are not statistically significant (Table 1) nor are the puncture counts consistently correlated with stem damage. On the basis of stem damage, the varieties fall into three groups.

Group A Can be classified as moderately resistant, having comparatively less stem mining than MI.35.

Group B Can be classified as less susceptible but not significantly different from MI.35.

Group C More susceptible but not significantly different from MI.35.

Table 1: Resistance/Tolerance of Cowpea varieties to *O. phaseoli*

<i>Variety</i>	<i>Mean Puncture Count</i>	<i>Mean % stem mined</i>
(A)		
Arl. × Siagon L1	14.9	5.5
Red cowpea 6—1	11.0	6.5
A × B Sel. 16	13.4	7.0
Red Cowpea 6—12	16.6	7.5
6—12 W	23.4	7.5
Sudu mung	6.5	8.5
A × B Sel. 18	15.5	9.0
No. 5269	6.4	9.2
(B)		
C—152	24.7	15.5
Pusa Brasati	12.7	17.0
Flo. × Arl. Sel. 75	17.5	17.5
Flo. × Arl. Sel. 60—1	11.1	19.0
BG. No. 2	7.5	20.0
TV 1502—10	13.8	21.5
TVU 1930	20.7	23.0
TV × 876—01A	17.2	24.0
TVU 3629	12.6	26.0
Rajangana 7	12.2	27.0
TV × 1836—66E	12.4	28.0
Bombay	13.7	31.5
M1—35	22.4	34.0
(C)		
EG No. 3	17.9	38.5
Flo. × Arl. Sel. 49	31.9	43.0
Arlington	8.9	44.2
Avrdc 6347	23.9	47.0

From these trials and those conducted in the previous seasons, varieties in group A can be recommended as least susceptible to beanfly. Some of these varieties have proven successful in some previous trails for survival under heavy infestation. Varieties from group B could be re-examined if they possess desirable agronomic features.

4. Chemical Control

The chemical control of *O. phaseoli* falls into three categories, viz. insecticide application to the seeds, the soil and the plant. Foliar sprays have been reported to give good control of the beanfly (Calwell, 1975; Walker, 1960; Wickramasinghe and Fernando, 1962; Ho, 1967), Walker (1962) has discussed the use of insecticidal seed dressings in Tanganyika for the control of *O. phaseoli*. Singh *et al.* (1974) reported some findings on granular insecticides for this pest. Jones (1965) reported the use of liquid seed dressings. Wickramasinghe and Fernando (1962) worked on seed, soil and foliar sprays involving both chlorinated hydrocarbons and organophosphates as well as systemic and non-systemic insecticides. They found that foliar spraying with DDT 18% E.C. at one fl. oz. per gal. or Parathion 46% E.C. at 2 ml. per gal. at weekly intervals was very effective in controlling *O. phaseoli*.

Most of the chemicals reported effective against *O. phaseoli* are rather outdated and scarcely available in the present day market. Despite the many undesirable aspects of insecticide, and especially the problems of shortage of equipment and high cost to the subsistence level farmer, insecticides occupy a significant place in pest control on grain legumes until effective alternatives can be developed. In certain dry farming areas of Sri Lanka, shortage of equipment and also shortage of water limit the wider application of insecticides. Therefore, low cost methods of insecticidal application such as seed dressings and soil treatments were evaluated along with the spray applications.

MATERIALS & METHODS

All the trials were conducted at the Agricultural Research Station, Mahailuppallama during Maha 1977/78. Cowpeas (Variety MI.35) were planted in the field using distances of 8 cm. in the row and 30 cm. between the rows. A replicated randomized block design with 10m × 10m plots was adopted for the trials. Seed treatment was done in plastic bags using 20 g insecticide/980 g

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of seed in case of 2% and 10 g of insecticide/990 g of seed in case of 1% treatment. Soil treatment was done by mixing the insecticides well with soil. In both the cases, planting was done manually after 27 hours of the insecticidal treatment. Rubber gloves were used while dealing with insecticides and during the planting of treated seeds. Assessment was made by uprooting the plants after 21 days of planting to record the number of plants with stem damage.

Foliar sprays were conducted using Knapsack high volume manual sprayer at 5 days after emergence of the crop when plenty of puncture marks were noticed on the leaves. In order to avoid spray-drifts in treating plots, a chip-board screen was used. Assessment was made by uprooting and counting the plants with stem damage after 14 days of the treatment.

RESULTS

The results of seed and soil treatment trial are given in Table 2 while the results of foliage spray trial are presented in Table 3. Table 2 reveals that only Orthene SP 2% had adverse effect on germination to some considerable degree while other treatments improved germination. All the treatments were found to be significantly better than control; there was no significant difference among the various treatments tested. There was no leaf damage by defoliating flea-beetles in all the treatments even at the time of uprooting (21 days after crop emergence) while plants in the control plots had been damaged badly.

Table 2. Mean number of infested plants per replicate in cowpea after application of seed and soil insecticides

<i>Treatment</i>	<i>Rate</i>	<i>%Germination control</i>	<i>%Damage</i>
Control	—	100	57.1 a
Orthene S.P. (Seed treat.)	2%	66	3.8 b
Carbofuran G. (Soil treat)	5 kg./ha	122	3.3 b
Orthene S.P. (Seed treat)	1% w/w	107	3.1 b
Premicid (Soil treat)	5 kg./ha	121	3.0 b
Carbofuran W.P. (Seed treat)	1% w/w	118	2.8 b
Carbofuran G. (Soil treat)	10 kg/ha	118	2.4 b
Carbofuran W.P. (Seed treat)	2%	118	2.2 b
			CV 27%

Values having a letter in common are not significantly different at $P=0.05$

Table 3. Mean number of infested plants per replicate on cowpea after application of foliar sprays of insecticides

<i>Treatment</i>	<i>%Active Ingredient</i>	<i>%Damage</i>
Control	—	99.2 a
Tamaron 60 EC	0.075	94.0 a
Thiodan 35 EC	0.05	93.7 a
Actellic 50 EC	0.075	83.8 a
Lannate 90 SP	0.075	81.9 a
Lebaycid 50 EC	0.075	79.8 a
Rogor 30 EC	0.075	77.2 a
Morfotox 68	0.075	74.3 a
Folimat 50 EC	0.075	16.6 b
Azodrin 60 EC	0.075	10.0 b

Values having a letter in common are not significantly different at $P=0.05$

Table 3 reveals that among the insecticides tested as sprays Azodrin was found to be the best followed by Folimat. None of the other treatments was significantly different from the control. Seed treatment and soil treatment are far more suitable where spraying equipment is a limiting factor. In both soil and seed treatment, the crop is protected beyond 25 days of emergence.

DISCUSSION AND CONCLUSION

Modern integrated pest management demands extensive knowledge of pest biology and ecology and it is in these areas that current research programmes at the Agricultural Research Station, Maha Illuppallama have been concentrated. Population dynamics studies have enabled the adjustment of crop planting date to minimize damage by *O. phaseoli*. There is no difficulty in adopting this practice provided that the lands are prepared in time with first Yala rains. This can avoid the use of insecticides against this pest which is a great benefit since use of chemicals is too expensive for the average farmer in Sri Lanka.

Research on host plant resistance is also of utmost importance and some local selections for resistant/tolerant crop varieties will continue with assistance from International Institutes. Green gram and Black gram varieties have also been screened for resistance to *O. phaseoli* and some differences in infestation have been recorded.

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A wide range of native parasites and predatory insects in Sri Lanka reviewed by de Silva (1961) includes some references to grain legume pests. Surveys conducted on parasites of major pests of grain legumes including *O. phaseoli* and attempts made in introducing parasites have been reported by Fellowes and Amarasena (1977). Grain legume production in Sri Lanka is still mainly under subsistence conditions, on small holdings and in mixed cropping patterns. These factors together with economic constraints in using insecticides could be considered to favour the development of methods to conserve and promote biological control mechanisms. Therefore, it is worthwhile in making further attempts.

In the present study with systemic insecticides, seed dressings as well as soil treatment before sowing have also proved to be effective. These can be practised particularly under situations where application equipments for sprayings and also water are the limiting factors. The damage resulting from the oviposition injury of adult females to leaf tissue is highly localized and is of little economic importance. Maggot damage, on the other hand, is usually very extensive. Since the larvae feed on the internal tissues of the stems of young seedlings, control measures should be applied at a very early stage of growth. If seed or soil treatment is not done, a single spraying with Azodrin or Folimat is most desirable at about 6—8 days after emergence of the crop. This could be especially recommended for the late planted crop during Yala. Despite the undesirable aspects of insecticides the same will continue to play to be important in pest management programmes till effective alternatives are found.

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