TEMPORAL DISTRIBUTION AND CHEMICAL CONTROL OF THE MAIZE STEM-BORER, *CHILO PARTELLUS* SWINHOE (LEP. ; PYRALIDAE)

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ABSTRACT

The results of temporal distribution studies have been based on nearly four years continuous captures in a light-trap operated nightly at the Regional Agricultural Research Centre, Maha Illuppallama, and systematic crop sampling data for the corresponding period at the same location. The data reveal that *Chilo partellus* population has two distinct peaks during both yala and maha. Moreover, it is found that there is a definite relationship between light-trap catch and the field infestation of *C. partellus*. Population dynamics studies also indicate that it is possible to adjust maize planting date to escape / minimize damage during maha but not during yala. It appears that use of light-trap data in pest population prediction is possible and thus potential involvement of light-traps in integrated pest management system is suggested. Chemical control experiments revealed that single application of carbofuran or diazinon granules or two applications of sprays all gave satisfactory control of *C. partellus*. The application of granules into the central whorl of the plant appears to be more effective and residual than sprays.

KEY WORDS: Chemical control, *Chilo partellus*, Integrated Pest management, Light traps, Population dynamics

INTRODUCTION

Maize or corn (*Zea mays* L.) is one of the most important cereal crops in Sri Lanka. Yellow maize contains even a higher amount of vitamin A than rice (Anonymous, 1976). Maize is used not only for human consumption but also in livestock feeds. The area under maize in Sri Lanka is about 23,300 ha (Hindagala, 1980); but this figure appears to vary considerably. The greater proportion of this extent is cultivated on a shifting system of farming (chena) where maize is grown in a mixed cropping pattern. Monocultures of maize can be seen in some government and private farms.

Maize borer, *Chilo partellus* Swinhoe, is the most damaging single pest of maize. Occurrence of this pest is one of the major constraints in maize production during yala. Besides maize, it also attacks sorghum, millets, sugar cane and rice. Neupane *et al.* (1985) reported 60% yield reduction and 98 %stem infestations in some maize cultivars due to *C. partellus.*

C. partellus starts to infest the crop 3 to 4 weeks after planting and up to maturity of ears. It usually enters near the node of the stalks. This attack is characterized by the presence of granular excreta collected at the opening of the tunnel. Attacked plants show poor growth, leaves bear 'shot-holes' and such plants produce dead hearts and also lodge easily. Larvae can bore into the cobs and destroy grains too.

Modern insect control methods, including systems analysis approach in insect problems, rely on a sound knowledge of insect seasonality. In controlling harmful insects, the need for rapid and accurate methods of monitoring their populations has been widely recognized. Light traps have been widely used for the detection, analysis, and forecasting of outbreaks of insect pests (Brown *et al.*, 1969; Blair and Catling, 1974; Betts, 1976; Farrow, 1977). Population assessments on crops planted regularly is of equal importance in studying insect seasonality. However, no records are available in Sri Lanka on population dynamics of *C. partellus.*

In view of this, a programme of light-trapping and regular planting of maize was initiated with the long-range objectives to develop models by which this data could be used to predict when the pest attacks the crop. Despite the many undesirable aspects of insecticides, they too occupy a significant place in pest control programmes until effective alternatives are developed. Therefore, easy application methods such as granular application to whorl of the plant and soil treatments were evaluated along with spray applications. This paper discusses the results of these studies.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Regional Agricultural Research Centre, Maha Illuppallama which is situated at approximately 8°10' latitude, 80°30' longitude and at an elevation of 150 m above mean sea level. An important characteristic of the rainfall is that the annual mean of 1400 mm is distributed bimodelly during October to January (maha season) and late March to May (yala season) while February, July, August and September are dry months.

Regular crop sampling

Routine 15-day plantings of maize (variety 'Badra' — a selection from Thai Composite) were initiated in April, 1976. The site of plantings was quite free from insecticidal use. After 45 days of planting, 100 stems were randomly selected and total number of larvae and pupae were counted by dissecting the stems. This work was continued till August, 1979, covering four yala seasons and three maha seasons.

Light-trapping

A Robinson type 125 watt Mercury Vapour light-trap was operated nightly from 6.00 p.m. to 6.00 a.m. starting from March, 1976, and continued until August, 1979. The trapping site was open to the horizon in all directions. Daily records on rainfall and catches of *C. partellus* were maintained. During the first 14 months total insect catch including non-pest species was oven-dried daily at 70°C for 24 hours and its weight recorded.

Chemical control

Maize (variety 'Badra') was planted during maha 1976/77. Nine insecticidal treatments (Table 1) were evaluated and the chemicals were applied to plots (8m × 5m) arranged in a randomized block design with 4 replicates. Row to row distance was 76 cm while plant to plant distance was 25 cm. Phorate granules were applied at the base of the plants immediately after germination. Carbofuran and diazinon granules were applied once only into the whorl of the plants 25 days after germination. The remaining treatments were applied as high volume sprays using a manual knapsack sprayer. The first foliar application was made 25 days after germination and a second 12 days later. In order to avoid spray-drifts in treating plots, a chipboard screen was used. Assessment was made by counting all live larvae per plant on 25 randomly selected plants per plot.

RESULTS AND DISCUSSION

Regular crop sampling and light trapping

In Sri Lanka, rainfall is a dominant feature of physical environment and Fig. 1 (a) shows that total insect catch including non-pest species in the light-trap follows a strong bimodel pattern closely related to rainfall (Fig 1(b).

Fig. 2 represents the light-trap catch and crop sampling data for *C. partellus*. This pest shows two distinct peaks during both yala and maha. In the dry zone normally maize is sown within the first week of October during maha. The variety widely used is 'Badra' which takes 115 days for maturity. Since maha peak of *C. partellus* population occurs during January and February (Fig. 2), maha maize crop can escape damage by this insect. On the other hand, during yala, maize has to be sown during the last week of April. That crop is readily attacked by *C. partellus* population available right from the beginning of April to almost end of June (Fig. 2). Therefore, there is hardly any possibility of adjusting the crop planting date during yala to escape or minimize damage by *C. partellus* as is possible in case of planting of grain legumes in yala against beanfly, *Ophiomyia phaseoli* (Tryon) (Subasinghe and Amarasena, 1983). Therefore, the farmers are discouraged to grow maize during yala and practically no substantial acreage comes under this crop during yala in Sri Lanka. Moreover, considering the heavy expense involved in the use of insecticides, that practice can hardly be adopted by an average farmer in Sri Lanka, particularly in view of the fact that maize is comparatively a low-profit crop. On the other hand, farmers can easily cultivate maize during maha without the use of insecticides provided they prepare the land and sow the crop within the month of October. Accordinly, almost all the annual acreage under this crop appears only in maha.

Sorghum (*Sorghum vulgare* Link) crop when grown by the farmers is usually sown during the last part of October or early November in order to mature the ears after December-January rains; otherwise disease problems become severe during grain maturity. It is clear from Fig. 2 that crops thus planted cannot escape the damage by high populations of *C. partellus* since the duration of sorghum variety grown (IS 2941) extends over a period of about 110 days. Accordingly, it is a common observation that *C. partellus* infestations are more common on sorghum than on maize during maha season (C. B. Hindagala, personal communication).

Data in Fig. 2 also indicate that there is a direct relationship between light-trap catch and the field infestation of *C. partellus*. Light-traps have been widely used for the detection, analysis and forecasting of outbreaks of insect pests. Outbreaks of the African armyworm, *Spodoptera exempta* (Wk.), have been successfully forecast in East Africa since 1969 (Betts, 1976). Predictions are based on peak catches at nineteen light-traps, complemented by information on current outbreaks, the weather and analogous events in previous years.

The light-trap catch is probably governed by several factors. Brown *et al.* (1969) found a significant association between size of catch and rain. The present studies suggest that the seasonal influence of rainfall on total insect catch is rather significant (Fig. 1). Linear regression analysis between log transformed data of total insect catch and rainfall gave a correlation coefficient of 0.83.

Light-trap catch is chiefly dependent upon the two factors, activity and population. The light-trapping work, whenever it is done, should be carried out with about four traps working simultaneously under similar conditions. This will give larger number of a single species and reduce the sampling error. The precision of light-trap estimates could be improved by setting them properly near fields and also by adopting a standard trap and trapping procedure depending on the species to which the trap is intended.

As shown in the present studies there is a definite relationship between light-trap catch and the field infestation of *C. partellus* (Fig. 2). Therefore, it appears that light-traps can be used as simple and effective way of predicting pest outbreaks. Light-traps would not need to be operated throughout the year but can be confined to certain months of the year. Therefore, it appears that use of light-trap data in pest population prediction is possible and thus potential involvement of light-traps in integrated pest management systems at Maha Illuppallama is suggested.

Chemical control

Results on the chemical control trial, (i.e. live larvae counts at 5 and 12 days after first treatment, and 5 days after second treatment), are given in Tables 1, 2 and 3 respectively. On the first assessment (Table 1) all treatments were found to be significantly better than control. At the same time, the best 3 treatments, i. e. endosulphan, diazinon and carbofuran, were significantly better than the worst two, methamidophos and prothiophos.

Table 2 reveals that there was no significant difference between control and most of the treatments, except carbofuran and diazinon. Table 3 indicates that all treatments were significantly lower than control and there were no significant differences among treatments except endosulphan and prothiophos. In no case was there any significant difference between phorate granules plus monocrotophos and monocrotophos alone, indicating that the phorate granules had little or no effect.

Application of chemicals is probably the most expensive but also the most effective control method. Apart from the heavy expenses involved, insecticides do have many undesirable aspects which prevent their widespread application. In certain dry zone areas of Sri Lanka, among other factors, shortage of equipment and shortage of water, limit the wider usage of insecticides. Therefore, low cost methods of insecticidal application such as granular application into the whorl of the maize plant may be desirable.

According to the present studies single application of carbofuran or diazinon granules or two applications of sprays can all give satisfactory control of *C. partellus*. Marwatha *et al.* (1984) also reported that the soil treatment with carbofuran granules at 1.0 kg ai/ha and seed treatment with carbofuran at 301g ai/ha were very effective in controlling *C. partellus*. There is a trend for the granular applications into the whorl to be more effective and more residual than sprays. According to a conservative estimate made, it is economical to use granular formulations on maize rather than applying two consective sprayings (S. M. C. Subasinghe, unpublished). In addition, avoiding foliar sprays by way of using granular formulation can go a long way in conserving and promoting biological control mechanisms.

CONCLUSIONS

The population dynamics data reveal that *C. partellus* population has two distinct peaks during both yala and maha. It is also found that there is a direct relationship between light trap catch and the field infestation of *C. partellus*. Population dynamics studies also indicate that it is possible to adjust maize planting date to escape/minimize damage during maha but not during yala.

Chemical control experiments revealed that single application of carbofuran or diazinon, or two applications of sprays all gave satisfactory control of *C. partellus*. The application of granules into the central whorl of the plant appears to be more effective and residual than sprays.

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Table 1. **Live larvae number as affected by different insecticidal treatments (5 days after first application) — maha 1976/77.**

Treatment		*Active ingredient (%)*	*Mean live larvae (Number/100 stems)*	*Reduction over control (%)*
Control		—	136.7 a	—
Methamidophos	60 EC	0.1	79.0 b	42.2
Prothiophos	50 EC	0.1	72.2 b	48.6
Methomyl	90 SP	0.1	60.0 b c	56.1
Carbaryl	85 WP	0.25	44.1 b c	67.7
Monocrotophos	60 EC	0.1	38.8 b c	71.2
Phorate 10 G+		1.5 (kg ai/ha)+		
Monocrotophos	60 EC	0.1	34.7 b c	74.6
Carbofuran	3 G	0.75 (kg ai/ha)	28.8 c d	78.9
Diazinon	5 G	0.75 (kg ai/ha)	23.9 d	82.5
Endosulfan	35 EC	0.1	14.8 d	89.2
CV (%)			15.5	

Values followed by a common letter are not significantly different (p=0.05)
Analysis of variance was done on arcsine transformed values

Table 2. **Live larvae number as affected by different insecticidal treatments (12 days after first application) — maha 1976/77**

Treatment		*Active ingredient (%)*	*Mean live larvae (Number/100 stems)*	*Reduction over control (%)*
Control		—	148.2 a b	—
Methamidophos	60 EC	0.1	98.1 a b c	33.4
Prothiophos	50 EC	0.1	173.0 a	—
Methomyl	90 SP	0.1	90.1 a b c	39.2
Carbaryl	85 WP	0.25	73.7 a b c	50.3
Monocrotophos	60 EC	0.1	67.9 a b c	54.2
Phorate 10G+		1.5 (kg ai/ha)+		
Monocrotophos	60 EC	0.1	104.7 a b c	29.3
Carbofuran	3 G	0.75 (kg ai/ha)	25.9 d	82.5
Diazinon	5 G	0.75 (kg ai/ha)	21.0 d	85.8
Endosulfan	35 EC	0.1	79.1 a b c	46.6
CV (%)			21.5	

Values followed by a common letter are not significantly different (p=0.05)
Analysis of variance was done on arcsine transformed values

Table 3. Live larvae number as affected by different insecticidal treatments (5 days after second application) — maha 1976/77

Treatment		*Active ingredient (%)*	*Mean live larvae (Number/100 stems)*	*Reduction over control (%)*
Control		—	189.9 a	—
Methamidophos	60 EC	0.1	12.6 c	93.4
Prothiophos	50 EC	0.1	38.3 b	79.8
Methomyl	90 SP	0.1	11.9 c	93.7
Carbaryl	85 WP	0.25	25.0 c	86.8
Monocrotophos	60 EC	0.1	18.9 c	90.0
Phorate 10 G +		1.5 (kg ai / ha) +	11.5 c	93.9
Monocrotophos	60 EC	0.1	4.4 c	97.7
Carbofuran	3 G	0.75 (kg ai/ha)	21.4 c	88.7
Diazinon	5 G	0.75 (kg ai/ha)	38.7 b	79.6
Endosulfan	35 EC	0.1	—	—
CV (%)			13.0	

Values followed by a common letter are not significantly different ($p=0.05$)

Analysis of variance was done on arcsine transformed values

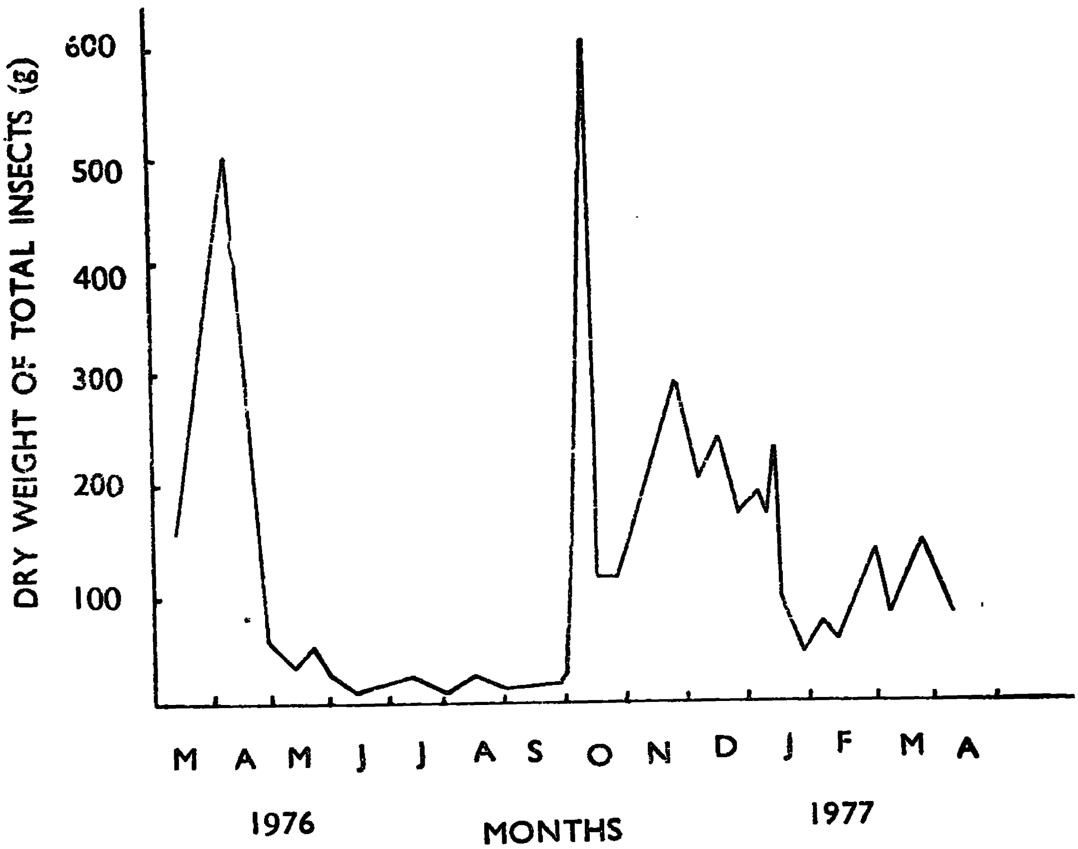

Fig. 1 (a). Dry weight of total light trap catch at Maha Illuppallama (includes all species)

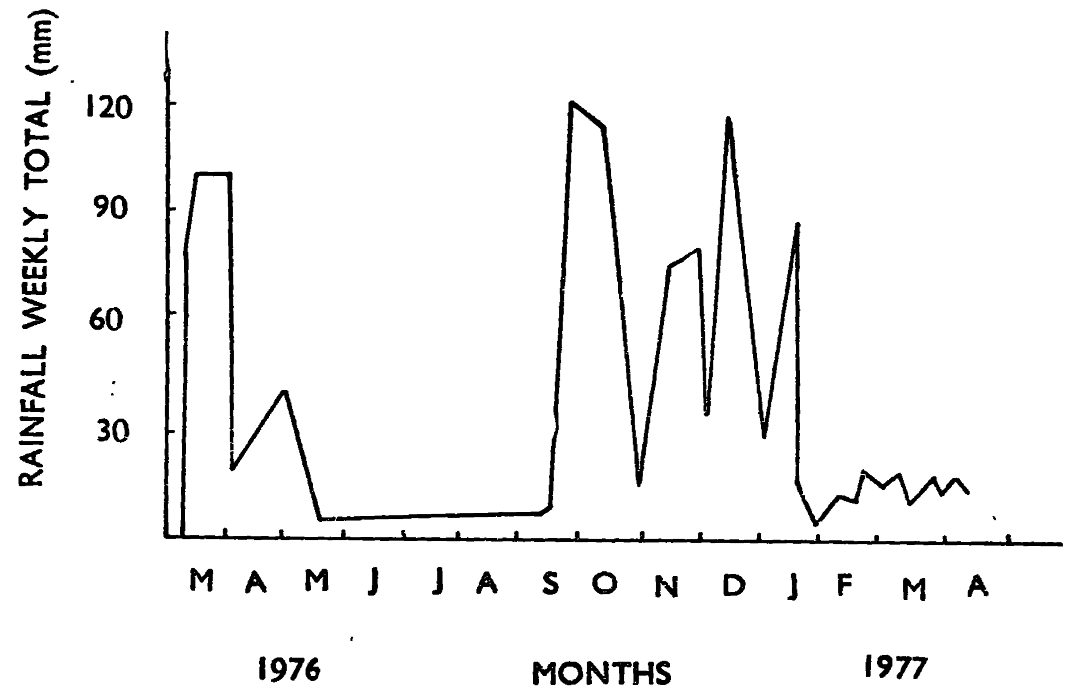

Fig. 1 (b). Weekly rainfall distribution at Maha Illuppallama during 1976–77

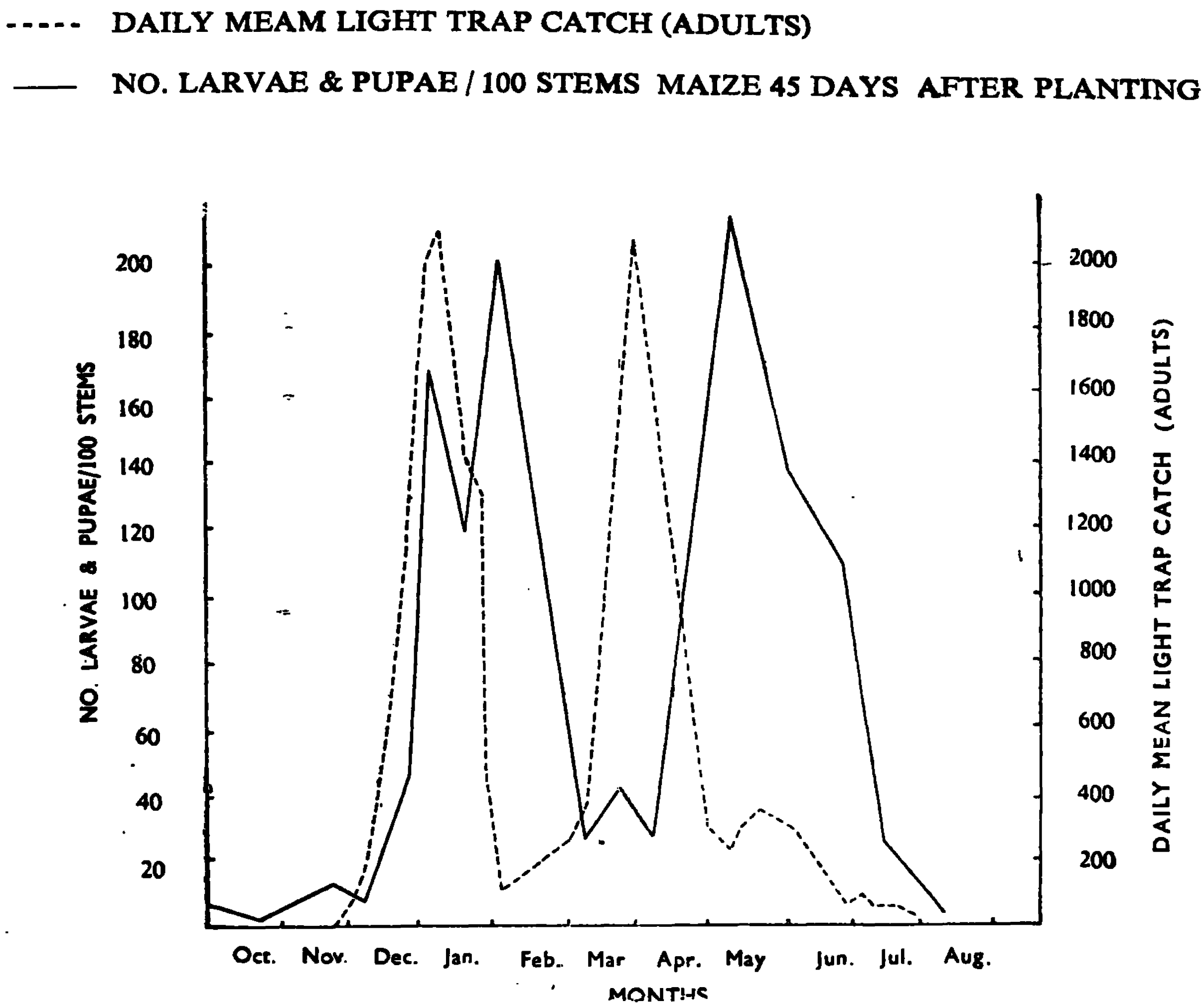

Fig. 2. **Population of the stem-borer,** ***Chilo partellus*** **at Maha Illuppallama (1976 – 79)**