

TEMPORAL DISTRIBUTION OF MAIZE STEM BORER *Chilo partellus* (Swinhoe) IN RELATION TO WEATHER FACTORS

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ABSTRACT

Temporal distribution of *Chilo partellus* (Swinhoe) on maize (*Zea mays*) crop was correlated with humidity, temperature, wind velocity and rainfall. Pest infestation measured by the percent stem damage was negatively correlated with minimum humidity and maximum temperature. One percent increase of average minimum humidity during the period of second and third week after emergence of the crop, decreased the percentage stem damage by 1.96 %. Similarly, 1°C increase in maximum temperature for the same period, decreased the stem damage by 7.94%. Also 1% increase in minimum humidity and 1°C increase in maximum temperature for the same period, decreased the log number of larvae + pupae + adults + 1 by 0.065 and 0.296, respectively. No relationship of wind velocity and rainfall was found with either the percentage stem borer damage or the stem borer population. Minimum humidity between 43.9% to 59% and maximum temperature of 32°C prevailed at the second and third weeks after emergence of the maize crop resulted in the increase of maize stem borer - *C. partellus* population and percent stem damage at 7 weeks after emergence.

KEY WORDS: *Chilo partellus*, Population dynamics, Temporal distribution, Weather factors.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in Sri Lanka. The extent of maize cultivation in the country is around 55,000 ha and more than 90% of the crop is produced in the dry zone (Anon, 1996). Maize can easily be cultivated in the dry zone because of its ability to withstand moisture stress conditions frequently encountered in the region. Maize cultivation in the Yala season is gradually increasing because irrigation water available in some of the major tanks is not enough for rice and other field crops such as chilli or onion. In Yala 1995 the maize extent was 6 times more than that of Yala 1993 (Anon. 1993, 1995). However, maize stem borer - *Chilo partellus* is one of the most important production

constraints especially in the Yala season (Subasinghe and Amarasena, 1988). Modern insect control methods rely on a sound knowledge of insect seasonality. In controlling harmful insects the need for rapid and accurate method of monitoring their population has been widely recognized. Subasinghe and Amarasena (1988) reported that the population of *C. partellus* increased in March at the end of Maha season and June, July and August in the Yala season. However, they had not studied the relationship of the population dynamics of the maize stem borer with the climatic factors. According to a study conducted in Tamil Nadu, India, there was a positive correlation between maximum daily temperature and the percentage stem damage (Mahadevan and Chelliah, 1986). Therefore the present work was carried out to study the

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population dynamics of maize stem borer in relation to weather factors that prevail in the dry zone of Sri Lanka, in order to explore the possibility of predicting the damage. This would enable farmers to control the pest effectively.

MATERIALS AND METHODS

The study was undertaken at the Field Crops Research and Development Institute, Maha Illuppallama. Badra I, a susceptible variety to stem borer, was sown at 10 day intervals from May 1990 and continued up to April 1991, in 3.6 m x 4.2 m plots with two replications, in a pesticide free environment.

Maize stem borer infestation was assessed at 7 weeks after emergence (WAE) of the crop. The percent stem borer damage was estimated by the number of plants with stem borer larvae, pupae or exit holes of adult emergence against the total number of plants per plot. Number of exit holes were counted in all the plants and then dissected to count the total number of larvae and pupae. Number of exit holes were considered as the number of adults emerged.

Singh and Sandu (1981) observed the maximum number of stem borer eggs when the plant height was 2 - 4 cm above the ground level. It takes nearly one week after emergence (WAE) for a plant to grow up to 4 cm in height. Therefore, the eggs laid in the first WAE start hatching in the second week after emergence and early instar larval development takes place in the second and third WAE of the plant. Hence, weather factors namely maximum and minimum humidity, maximum and minimum temperature, wind speed and rainfall were daily recorded from the second and third WAE of the crop. Mean of maximum and minimum humidity, maximum and minimum temperature and

wind speed for the period from second and third week after planting were correlated with percent stem damage and log number of (larvae + pupae + adults + 1) recorded at the 7 WAE of the crop. Total rainfall for the same period was also correlated with the same parameters. The log value of the number of larvae + pupae + adults + 1 was used in the analysis because the data was based on counts.

RESULTS AND DISCUSSION

The percent stem damage due to stem borers at 7 WAE ranged from 0 to 72% depending on the time of planting (Fig.1). Similarly, log number of larvae + pupae + adults + 1 ranged from 0 to 2.53 (Table 1). Percent stem damage was high during Yala season especially when the crop was planted in the months of June, July and August and low in mid October, November and May (Fig. 1). Subasinghe and Amarasena (1988) also observed a similar trend for the same pest in the same location. With exceptions of being low damage in August and September, October to November is the planting time of the Maha season. Based on the results of the present study, maize crop can be established in late March to mid May for low stem borer damage in the Yala season.

Dang and Doharey (1971) reported that the temperature below 27°C and above 35°C greatly affected the reproductive potential of the pest through low fecundity, fertility and extended life period. However, the average maximum day temperature in the dry zone of Sri Lanka is around 30°C which is the optimum for the multiplication of the pest. There was a negative relationship ($p=0.05$) of maximum temperature with percentage stem damage and log no.of (larvae + pupae + adults + 1) (Table 2 and 3).

Table 1. Weather parameters and maize stem borer population from May 1990 to April 1991 at Maha Illuppallama, Sri Lanka

Month	Humidity (%)		Temp ² (°C)		Wind Velocity (Km/h)	Rain Fall (mm)	Pop
	Max	Min ³	Max	Min			
May _e	83	63	33.4	24.5	5.0	86.2	0.00
May _m	84	69	32.3	25.0	7.0	25.3	1.23
May _i	87	71	30.7	24.5	13.3	37.4	0.70
Jun _e	76	53	33.0	24.9	15.0	0.0	1.48
Jun _m	81	57	32.1	24.2	15.2	4.3	2.53
Jun _i	77	51	32.8	24.3	14.9	1.2	1.85
Jul _e	79	52	33.4	24.4	10.8	67.7	2.12
Jul _m	76	57	31.6	24.4	15.0	0.0	2.33
Jul _i	80	52	32.9	24.3	11.2	50.0	2.07
Aug _e	71	51	33.3	24.0	9.9	50.0	2.09
Aug _m	72	51	33.4	24.3	11.1	9.2	2.00
Aug _i	80	51	33.7	24.2	8.7	71.4	1.78
Sep _e	76	53	32.7	24.2	11.5	0.0	1.98
Sep _m	7.4	47	33.5	24.3	11.2	0.0	2.07
Sep _i	91	61	32.3	22.9	2.5	212.9	1.26
Oct _e	95	71	30.6	22.8	3.4	283.6	0.00
Oct _m	90	72	29.5	22.5	4.1	84.1	1.08
Oct _i	85	63	30.9	22.5	3.4	26.7	1.98
Nov _e	84	62	31.4	22.5	2.6	26.7	1.85
Nov _m	89	70	30.1	22.3	2.3	56.6	0.60
Nov _i	90	72	29.4	22.6	6.2	67.4	1.23
Dec _e	90	71	29.8	21.9	7.2	29.9	1.76
Dec _m	90	70	30.0	21.2	53.0	64.6	0.95
Dec _i	92	74	29.0	21.5	5.3	101.6	0.95
Jan _e	90	69	28.9	20.4	6.0	58.8	1.56
Jan _m	89	62	29.7	19.4	5.2	25.5	1.86
Jan _i	87	51	30.8	18.7	5.9	0.0	2.28
Feb _e	91	64	31.6	21.5	7.0	39.3	2.16
Feb _m	88	58	32.9	22.2	5.5	24.3	1.43
Feb _i	82	43	34.9	22.1	5.8	0.6	0.60
Mar _e	84	49	35.1	23.3	6.0	24.2	1.45
Mar _m	86	55	34.4	23.2	7.8	49.9	1.15
Mar _i	85	55	34.3	22.9	6.2	64.7	1.32
Apr _e	84	57	34.0	23.3	5.6	67.0	1.28
Apr _m	86	58	33.6	24.4	8.8	50.2	1.04
Apr _i	86	55	34.4	23.2	7.8	49.9	1.15

2 Temperature: 3 Population: 4 Maximum: 5 Minimum

*Log number of larvae+pupae+adults+1 ^eearly ^mmid ⁱlate

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Table 2. Multiple regression analysis of the influence of weather factors on the percentage maize stem borer damage.

Weather factor	Regression coefficient	S.E.	't' value
Maximum humidity	0.266	0.924	0.287
Minimum humidity	-1.961*	0.799	-2.454*
Maximum temperature	-7.041*	3.190	2.489*
Minimum temperature	2.292*	2.920	0.985
Wind velocity	0.902	0.247	-1.221
Rainfall	0.066	0.045	-1.469

$R^3 = 0.5140$

Table 3. Multiple regression analysis of the influence of weather factors on the maize stem borer population.

Weather factor	Regression coefficient	S.E.	't' value
Maximum humidity	-0.018	0.036	-0.500
Minimum humidity	-0.064*	0.031	-2.071*
Maximum temperature	-7.298*	0.123	-2.407*
Minimum temperature	0.030	0.113	0.267
Wind velocity	-0.003	0.009	-0.315
Rainfall	-0.003	0.002	-1.534

$R^3 = 0.5496$

*Significant at probability level 0.05 SAS version 6 computer package was used to analyse the data.

Furthermore, there was a negative relationship of the minimum humidity with % stem damage (larvae + pupae + adults + 1).

Incontrast, Mahadevan and Chelliah (1986) reported that there was a positive correlation between maximum daily temperature and the percentage stem damage. However, present study shows that increase in maximum temperature by 1°C decreases the percentage stem damage by 7.94 %. Similarly, an increase in minimum humidity by 1% decreases the % stem damage

by 1.96 %. This is not in agreement with the results of Mahadevan and Chelliah (1986) who reported no correlation between humidity and stem damage. The reason for this difference may be that the humidity range in the dry zone of Sri Lanka is higher than that of Tamil Nadu where the previous experiment had been conducted (Table 1).

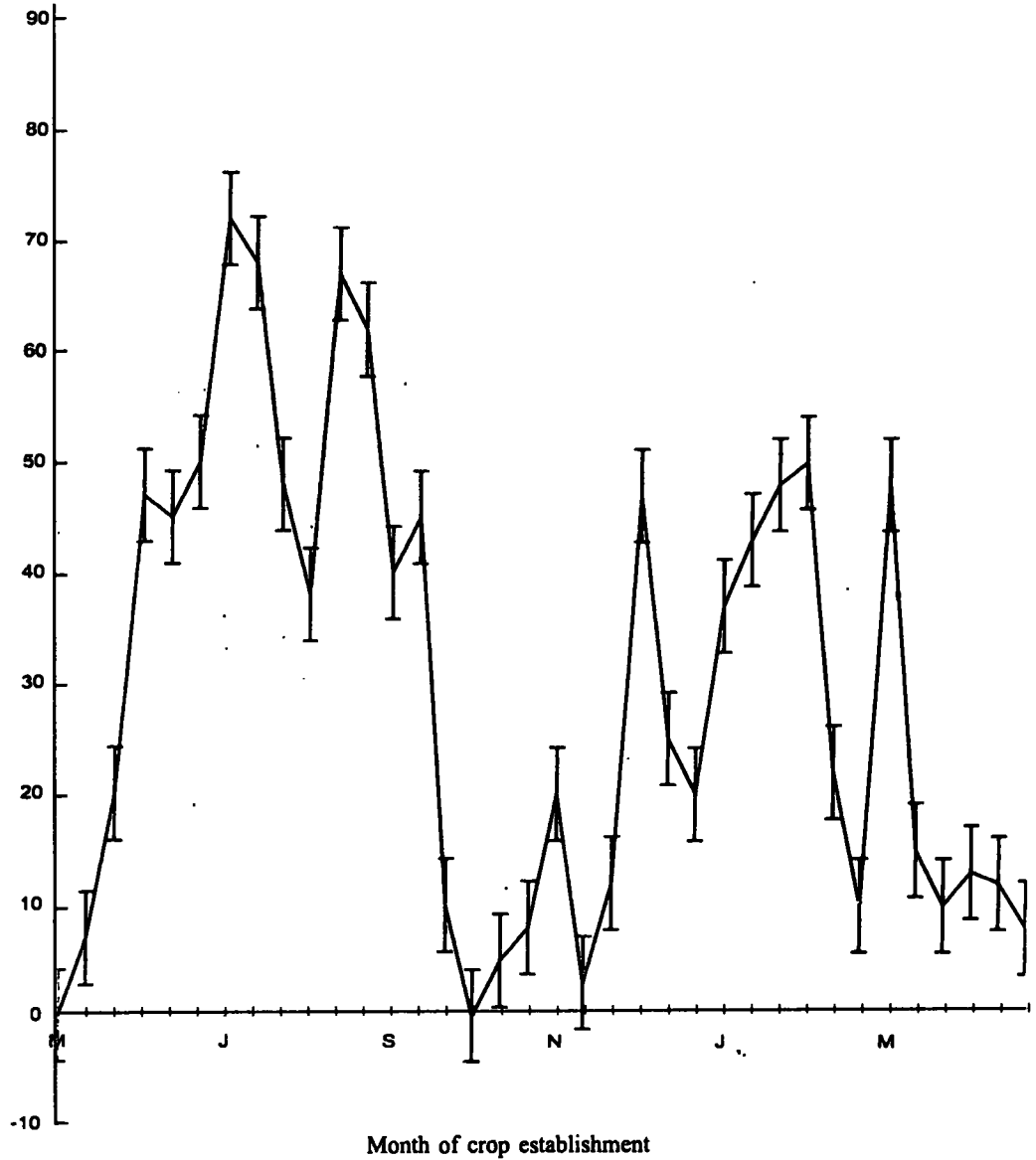


Fig. 1: Temporal distribution of maize stem borer from May 1990 to April 1991 at Maha Illuppallama, Sri Lanka.

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According to the weather data minimum humidity ranged from 43% to 74% while maximum temperature ranged from 28.9 to 35.1 (Table 1). The fact that these two parameters are negatively correlated with stem borer population and stem damage, imply that a favourable conditions for the rapid multiplication of the pest occur when the minimum humidity is between 43% and 59% $\{(74 + 43) / 2 = 59\}$ while maximum temperature is between 28.9°C and 32°C $\{(28.9 + 35.1) / 2 = 32\}$. These conditions may increase fecundity and larval survival of the pest. Therefore, it is necessary to study how temperature and humidity changes affect the reproductive potential of the adults and development of maize stem borer larvae, pupae and adults. Temperature around 30°C and low humidity may increase hatchability of *C. partellus* eggs. This may be a contributory factor for higher stem borer population when maximum temperature is below 32°C and minimum humidity is below 59%. Probably, these conditions may hinder the multiplication of the natural enemies of the maize stem borer.

Therefore, it is necessary to study the population dynamics of the natural enemies of *C. partellus* because the effect of maximum temperature and minimum humidity on the fecundity and the longevity of the natural enemies are important factors governing the population dynamics of any pest. No significant relationship was observed with percentage stem damage or log no. of (larvae + pupae + adults + 1) as far as the rainfall and wind velocity are concerned. This is in agreement with Mahadevan and Chelliah

(1986) who reported no correlation between percentage stem damage with rainfall and wind velocity. Results of the present study clearly show the importance of humidity and temperature during the second and third weeks of the crop in predicting the stem borer damage and stem borer population in maize.

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