Influence of Weather Parameters on the Occurrence of Rice Yellow Stem Borer, *Scirpophaga incertulus* (Walker)

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Abstract

The rice stem borer infestation was montiored during two year study period along with weather parameters. Results showed high pest incidence during months of March *(Navarai – Rabi,2005*), August- September (*Kuruvai –Kharif,2006*) and October-November (*Samba – Rabi,2006*). The favourable weather conditions for high stem borer incidence were 27.6ºC, 30.1ºC, 26.1ºC as mean temperatures and relative humidity per cent ranged between 95.9 and 65.7, 82.2 and 54.5, 95.3 and 82.8 pertaining to the *Navarai, Kuruvai* and *Samba* seasons, respectively.

Rice is affected by more than 100 insects, among which 10-12 pose an economic threat to rice cultivation. Rice stem borers occupy the major status as pest and cause considerable damage to the rice cultivation in almost in all the seasons through out the rice growing stages. Eight species of stem borers of rice are known to be of significant importance in Asia (Hattori, 1971). Among these stem borers, the yellow stem borer(YSB), *Scirpophaga incertulas* (Walker) has been found to be predominant. YSB causes significant yield loss in lowland rice grown during September–February and November-March seasons. In India, the extent of damage caused by YSB is reported to range from 3 to 9 per cent (Gosh,1962). For developing any pest management programme for a specific agro-ecosystem information on abundance and distribution of pest in relation to weather parameters is a basic requirement (Patel and Shekh,2006). The study of agricultural meteorology in relation to insects (Entomoclimatology) will be very useful to farmers in all areas where major insect pests are appearing year after year and causing serious damage to crops. In the light of the severity of damage by yellow stem borer on rice grown in this the part of U.T. of Puducherry and the influence of weather factors on their growth, multiplication and distribution, investigations were taken up at the Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal to study the seasonal influence of weather parameters on the incidence of YSB.

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Materials and Methods

Field experiments were conducted during *Navarai (rabi)* (December-April**,** 2005), *Kuruvai (khariff)* (June-October, 2006) and *Samba (late kharif)* (August-December, 2006) seasons. During *Navarai* and *Kuruvai* seasons, the field trial was conducted with short duration variety, ADT 36 and in *Samba* season with medium duration variety, White Ponni. Each treatment was replicated thrice in $20m^2$ (5 x 4) plots. The seed rate for short duration variety was 12 Kgs (4 cent) while for medium duration variety it was 8 Kgs (4 cent). Prior to sowing, the seeds were treated with Carbendazim @ 2g per Kgs of seed. Twenty five days old ADT 36 seedlings were transplanted with a spacing of 15x10cm during *Navarai* and *Kuruvai* seasons while White Ponni seedlings at an age of 28 days were transplanted with 20x10cm spacing during *Samba* season. The individual treatment was planted @ 3-4 seedlings per hill. Herbicide (Butachlor) was applied on the third day after transplanting @2.5lit/ha. Insecticide was not applied during any of the seasons. The experiment was laid out in a Factorial concept of Randomized Block Design (FRBD).The land was fertilized during *Navarai* and *Kuruvai* season with urea, Single Super Phosphate (SSP) and Muriate of Potash @ 120, 38 and 38 Kgs of NPK ha^{-1}. During *Samba*

the land was fertilized with urea, Single Super Phosphate and Muriate of Potash @ 150, 50 and 50 Kgs of NPK ha^{-1}. Single Super Phosphate and Muriate of Potash fertilizer were applied as basal dressing while the nitrogenous fertilizers was applied both as basal and top dressing.

Rice yellow stem borer damage assessment

$$\% \text{ Dead heart} = \frac{\text{No.of dead hearts}}{\text{No.of total tillers}} \times 100$$

$$\% \text{ White ear} = \frac{\text{No. of white ears}}{\text{No. productivetillers}} \times 100$$

(Heinrichs *et al.*, 1985)

Statistical analysis

Influence of weather parametes *viz.*, mean maximum temperature (ºC), mean minimum temperature (ºC), mean temperature (ºC), mean morning relative humidity (%), mean evening relative humidity (%), average wind velocity (Kmph), total sunshine hours (hrs), total rainfall (mm), total evaporation (mm), total dewfall (mm) were correlated with the catches of stem borer moths and they were analysed using SPSS Package. The data collected from Factorial concept of Randomized Block design (FRBD) field experiments were analysed by SPSS package. Simple correlation was worked out and regression equation was developed between the ten weather parameters *viz.*, maximum temperature (T max), minimum temperature (T min), mean temperature (T mean), morning relative humidity (MRH), evening relative humidity (ERH), wind velocity (WV), sunshine hours (SH), rainfall (RF), evaporation (EP) and dewfall (DF) and stem borer damage per cent for different crop growth stages for all the three seasons.

Results and Discussion

Navarai 2005: Correlation between the ten weather parameters and stem borer damage in respect of different crop growth periods is furnished in Table1. The derived linear regression equation predicted that for every one unit increase in maximum temperature (30DAT, 37DAT, 72DAT), minimum temperature (44DAT), rainfall (51DAT), evaporation (65DAT), there would be a 0.77, 1.12, 0.61, 0.46, 0.03 and 0.05% decrease in stem borer incidence respectively. The linear regression equation was fitted to study the relationship of weather parameters with stem borer incidence indicated that for every one unit increase in evening relative humidity there would be an increase of 0.20% damage. According to Mishra et al.(2005), stem borer damage had a positive significant correlation with maximum, minimum temperature and a negative correlation with relative humidity. However in the present study a negative correlation was observed with maximum temperature, minimum temperature, rainfall and evaporation. However positive correlation was obtained only with evening relative humidity. A positive significant correlation was observed with maximum temperature while relative humidity had a negative correlation with stem borer damage (David, 1995).The findings of the present study indicated a highly positive significant correlation with relative humidity and maximum temperature while rainfall had negative correlation with the stem borer damage, which is not in agreement with the findings of David (1995).

Kuruvai 2006: The results of the study indicated that the stem borer damage maintained a significant positive and negative correlation with different weather parameters during different crop growth stages which are presented in Table 2. For every one unit increase in morning relative humidity (30DAT), evening relative humidity (37DAT, 44 DAT and 51 DAT), wind velocity (79DAT) there would be a 0.42, 0.24, 0.22, 0.61 and 0.37 increase of stem borer damage, respectively. Whereas the linear regression equation further predicted that for every one unit increase in wind velocity (58 DAT) and evaporation (72 DAT) there would be a decrease of 0.26 and 0.04% damage. The present finding in respect of relative humidity and its correlation to rice yellow stem borer damage is in agreement with the findings of Balasubramanian et al. (1981).

*Samba, 2006***:** A significant positive correlation with sunshine hours (30DAT), morning relative humidity (51DAT), evening relative humidity (58 DAT, 65DAT), dew fall (86DAT) and wind velocity (101DAT) and a significant negative correlation with wind velocity (37DAT, 44 DAT), morning relative humidity (72DAT), minimum temperature (79 DAT), evening relative humidity (94DAT) was observed in respect of the stem borer damage (data not shown).

The linear regression equation indicated that for every one unit increase in morning relative humidity (51DAT), evening relative humidity (58 DAT, 65DAT), wind velocity (101DAT), sunshine hours (30 DAT) and dewfall (86DAT) there would be 0.09, 0.08, 0.34, 0.09, 0.12 and 0.40 % increase of stem borer damage (Table 6). However, every one unit increase in minimum temperature (79DAT), morning relative humidity (72DAT), evening relative humidity (94DAT), wind velocity (37DAT, 44 DAT) there would be 0.17, 1.198, 0.0875, 1.115, 1.235 per cent decrease of stem borer incidence respectively. The minimum temperature and wind velocity showed a negative relationship and accordingly the correlation coefficient values were -0.470 and -0.0045 respectively. Morning relative humidity and sunshine hours exhibited a significant positive relationship at one per cent level with the stem borer damage recording the `r´ values of 0.610 and 0.203 respectively (David, 1995).This findings are in agreement with present study which revealed that minimum temperature and wind velocity (37 DAT) showed negative relationship recording the correlation coefficient values of -0.365 and -0.623 respectively. Morning relative humidity (51 DAT) and sunshine hours exhibited a significant positive relationship with the stem borer damage at one per cent level recording the 'r' values of 0.427 and 0.639 respectively during *Samba* season.

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Table 1. Correlation between Rice stem borer, *Scirpophaga incertulus* Walker incidence at various crop growth stages and weather parameters during Navarai season, 2005

Weather Parameters	Crop Stages							
	30 DAT (Booting)	37 DAT (Heading)	44 DAT (Heading)	51 DAT (Soft dough)	58 DAT (Hard dough)	65DAT (Hard dough)	72 DAT (Mature grain)	79 DAT (Mature grain)
Tmax (^{0}C)	-0.546**	-0.723**	-0.634**	-0.408**	-0.534**	-0.387**	-0.418**	-0.009^{NS}
Tmin (^{0}C)	-0.202^{NS}	-0.5770**	-0.662**	-0.553**	-0.213^{NS}	-0.218^{NS}	-0.344**	0.051^{NS}
Tmean (^{0}C)	-0.496**	-0.660**	-0.659**	-0.543**	-0.571**	-0.367**	-0.399**	0.031^{NS}
MRH ($^{\%}$)	-0.448**	-0.169^{NS}	0.637**	0.587**	0.588**	0.337*	0.353*	-0.034^{NS}
ERH ($^{\%}$)	-0.144^{NS}	-0.512**	-0.585**	0.198^{NS}	0.600**	0.384**	0.414**	0.054^{NS}
WV (Kmph)	0.471**	0.037^{NS}	-0.639**	-0.483**	0.357*	-0.263^{NS}	-0.322**	0.012^{NS}
SSH (hrs)	-0.119^{NS}	0.501**	0.631**	-0.015^{NS}	-0.587**	-0.364**	-0.401**	-0.121^{NS}
RF (mm)	-0.450**	-0.633**	-0.464**	-0.594**	0.021^{NS}	0.359*	0.355**	0.124^{NS}
EP (mm)	-0.001^{NS}	-0.174^{NS}	0.095^{NS}	0.503**	-0.266^{NS}	-0.387**	-0.408**	-0.09^{NS}
DF (mm)	-0.367**	0.402**	0.657**	0.419**	-0.483**	-0.289*	0.235^{NS}	-0.086^{NS}

*-Significant at 0.05 level **-Significant at 0.01 level Ns. Non significant

Tmax – Maximum Temperature; Tmin– minimum Temperature; Tmean– Mean Temperature;

MRH – Morning Relative Humidity; ERH– Evening Relative Humidity; WV– Wind Velocity;

SSH– Sun Shine Hours; RF – Rain Fall; EP – Evaporation; DF- Dew Fall.

Table 2. Correlation between Rice stem borer, *Scirpophaga incertulus* Walker incidence at various crop growth; stages and weather parameters during Kuruvai season, 2006

Weather Parameters	Crop Stages							
	30 DAT (Booting)	37 DAT (Heading)	44 DAT (Heading)	51 DAT (Soft dough)	58 DAT (Hard dough)	65 DAT (Hard dough)	72 DAT (Mature grain)	79 DAT (Mature grain)
Tmax (^{0}C)	-0.690**	-0.154^{NS}	0.444**	-0.355*	-0.670**	-0.262^{NS}	-0.392**	0.107^{NS}
Tmin (^{0}C)	-0.696**	-0.373**	-0.223^{NS}	-0.381**	-0.734**	-0.193^{NS}	0.345**	0.138^{NS}
Tmean (^{0}C)	-0.734**	-0.329**	0.06^{NS}	-0.369**	-0.725^{NS}	-0.266^{NS}	-0.383**	0.109^{NS}
MRH ($^{\%}$)	0.748**	0.490**	0.377**	0.507**	0.750**	0.264^{NS}	0.342**	-0.136^{NS}
ERH (%)	0.693**	0.577**	0.523**	0.565**	0.690**	0.262^{NS}	0.327**	-0.329*
WV (Kmph)	-0.330*	0.425**	0.218^{NS}	-0.462**	-0.751**	-0.255^{NS}	-	0.428**
SSH (hrs)	-0.427**	0.386**	0.516**	0.390**	-0.634**	-0.256^{NS}	-0.402**	-0.349**
RF (mm)	0.515**	0.536**	0.369**	0.546**	0.301*	-0.213^{NS}	-0.376**	0.186^{NS}
EP (mm)	-0.726**	-0.321*	0.221^{NS}	-0.312*	-0.728**	-0.263^{NS}	-0.406**	0.013^{NS}
DF (mm)	-	-	0.361*	0.531**	0.670**	0.241^{NS}	0.291*	-0.365^{NS}

*-Significant at 0.05 level **-Significant at 0.01 level Ns. Non significant

Tmax – Maximum Temperature; Tmin– minimum Temperature; Tmean– Mean Temperature;
MRH – Morning Relative Humidity; ERH– Evening Relative Humidity; WV– Wind Velocity;
SSH– Sun Shine Hours; RF – Rain Fall; EP – Evaporation; DF- Dew Fall.