Study of Paddy Stem Borers Population Dynamics and Influencing Environmental Factors through Light Trap

ABSTRACT

Rice crop is affected by many insect pests. Rice stem borers are main pests affecting rice crop from nursery to physiological maturity including them in key pests. The insect pest population is influenced by the meteorological parameters such as temperature and relative humidity. These studies had been carried out to discover the encouraging and antagonistic boundaries of weather parameters for the rice stem borers. As per studies, the population was recorded higher from mid-March to 1st week of May and then it escalated again from 2nd week of August to a maximum in September in case of Yellow Stem Borer (*Scirpophaga incertulus* Walker) and White Stem Borer (*Scirpophaga innotata* Walker) of rice during the both years 2017 and 2018; while in case of Pink Stem Borer population recorded from mid-September to the last week of April in 2017 and lasted till 4th week of May 2018. On evaluating the weather conditions specially temperature and relative humidity, it was detected that insect trap catches noted inside a certain range of temperature that varies from 18°C to 35°C in case of White Stem Borer and 17°C to 34°C for Yellow stem borer of rice. Extreme catches were documented in April and September inside a temperature range of 26°C to 32°C considering it ideal series of temperature for insect light trap catches and activity of yellow and white stem borer. However, in case of pink stem borer above 32°C no catch was observed above throughout all the summertime and maximum activity recorded from September to the end of April next year. Relative humidity favors significantly the population the Yellow and White Stem Borers. This study indicated a clear and strong relationship with activity of rice borers and environmental parameters.

Keywords: *Paddy, Stem borers, Population dynamics, Environmental relation*

1. INTRODUCTION

Rice is the 2nd important cash crop of Pakistan after cotton. It is infected by many insect pests. Stem borers are one of the key pest in subtropical to tropical Asia containing Pakistan. Yellow Stem borer and White Stem borer are monophagus, while Pink stem borer is polyphagus. Deadhearts at vegetative stage and white heads appear at reproductive stage attack in case of borers attack [1]. Stem borers attack rice nursery and transplanted crop throughout the season but their activity had been observed at top in the month of September [2, 3] and are reasons of severe damages to the crop [4]. The range of rice produce harms due to YSB has been projected to 20–70 % [5, 6].

Insect pest population dynamics are measured to be subjective by both biotic and abiotic elements (Singh *et al*., 2009). Ecological features such as temperature, shower, and relative humidity considerably influence the surge of the insect population [7, 9]. Populations of stem borers like all other species are thus to fluctuate according to the dynamic circumstances of its location [10, 11]. Therefore the relation of important mortality dynamics, both biotic and abiotic could be used to predict the pest populations. Moreover, figures of the periodic richness and population tendency are vital to warrant timely caution to defy future pest problems and avoid crop losses [12].

Comment [H1]: With number [...]

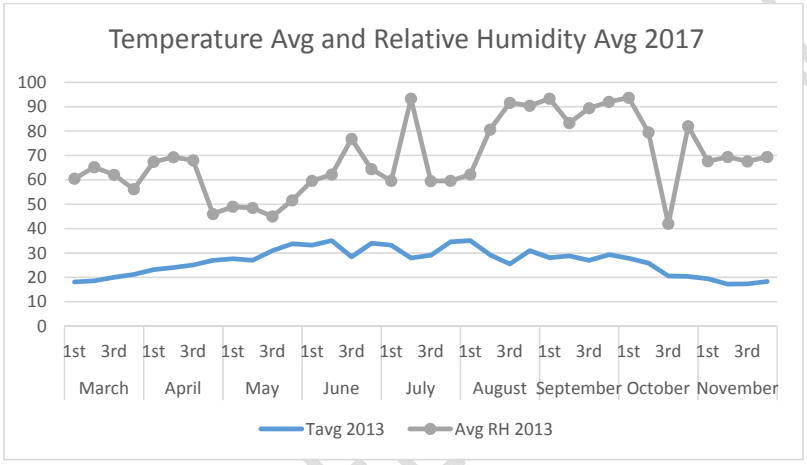
Light traps reap a huge number of species [13, 14] especially nocturnal insect pests [15] and being inexpensive provides a number of gains over other substitute methods. This paper exploit the pest population records collected through light traps during the years 2017 and 2018 which was documented at Rice Research Institute Kala Shah Kaku. The light trap data records were evaluated to meteorological factors essentially with temperature and relative humidity to draw relation among them for the years 2017 and 2018.

Comment [H2]: Add your novelty

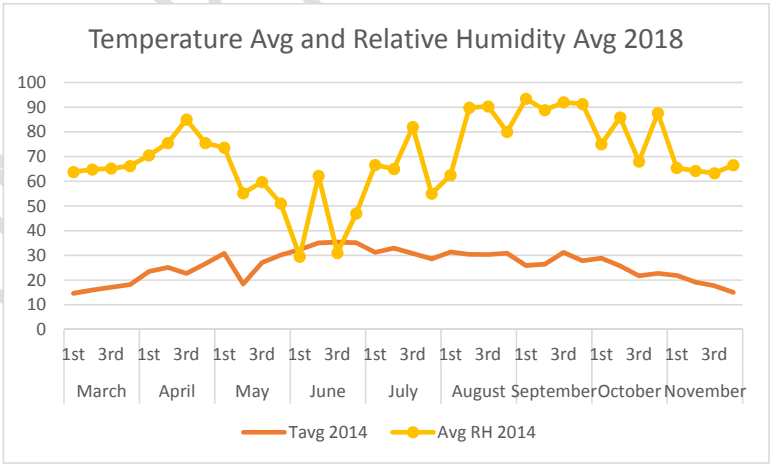
2. MATERIALS AND METHODS

The current research was carried out to find out the relation among light trap catches of rice stem borers and environmental factors for the year 2017 and 2018 Kala Shah Kaku, Lahore, Pakistan. The rice nursery was planted in the 1st week of June and transplanted after one month. All the customary endorsements for plant production and plant safety were implemented in agreement with the suggested

timetable. The light trap fixed for collection had four parts i.e. gathering bottle, funnel molded lid, a bulb of 100W as light source and a top lid to cover it from unexpected rainfall. Potassium cyanide was used to kill the insect pests trapped in the collection chamber. Killing bottles were substituted manually and trapped moths were identified and calculated. The meteorological data was collected by the Pest Warning and Quality control of Pesticides Department Lahore, Pakistan.



(a)



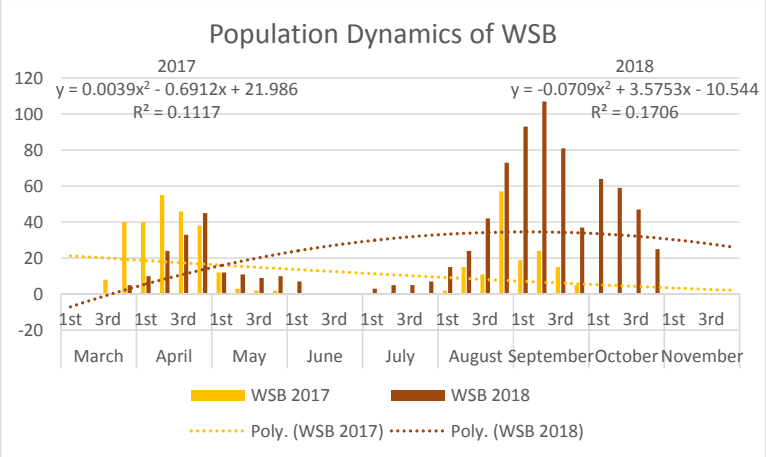
(b)

Figure 1. Weekly total rainfall, percentage, relative humidity and average temperature for the years, 2017 (a) and 2018 (b) from March to November.

Comment [H3]: No rainfall data?

3. RESULTS AND DISCUSSIONS

The population of paddy stem borers varied according to change in climatic and temporal phase. White stem borer (WSB) (*Scrpophaga innotata* Walker) of rice population was more in March and April while highest September. Yellow stem borer YSB (*Scrpophaga incertulus* Walker) showed the same population dynamics highest in September then lower in March and April while zero activity from mid-May to mid-July. Pink stem borer showed no activity from mid-May to early September however it remained active for the rest of year.



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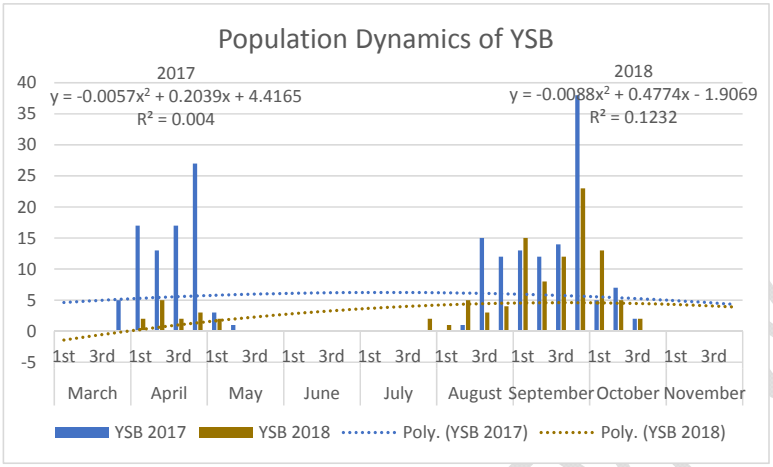
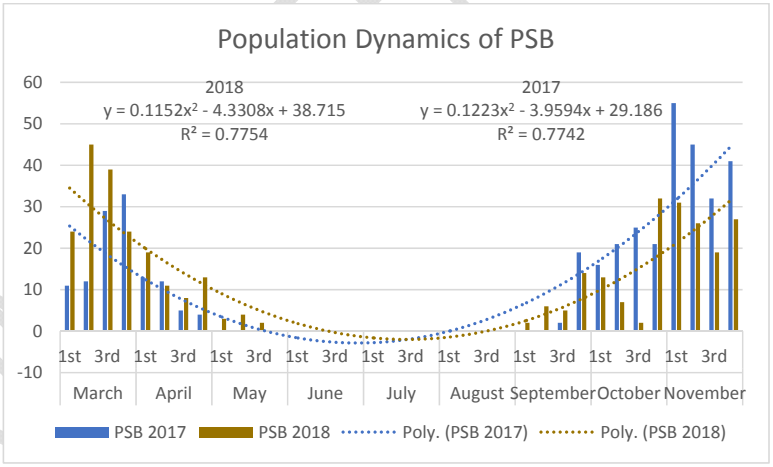


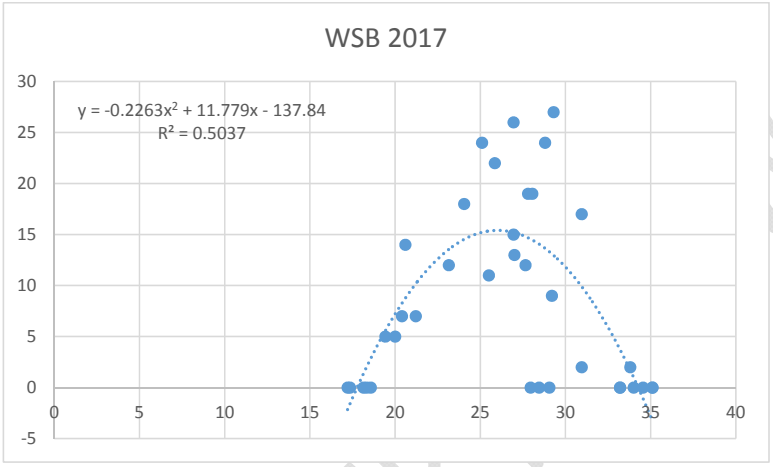
(4)



(5)

By matching the insect light trap catches (Fig2.a, b) it is evident that the white stem borer is very active between 22°C to 32°C and no flight was observed below 17°C and above 35°C. As shown in the Fig (a)

and (b) it is clear that polynomial trend line shows no activity below 16°C temperature and zero activity above 34°C for the year 2017, statistically. For the year 2018 the upper temperature limit increased one degree i.e. 35°C while it has fallen to 16°C in case of lower temperature limit.



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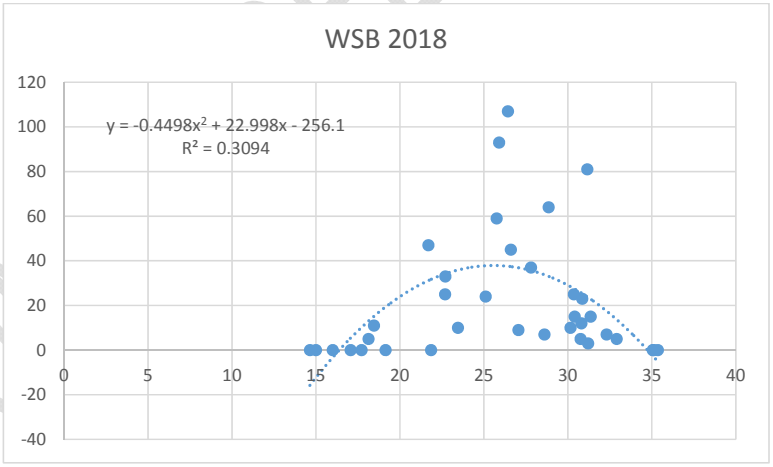

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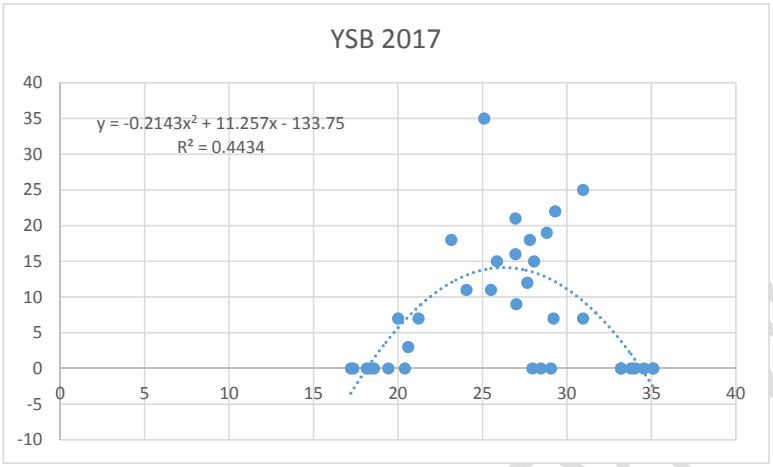
YSB 2017
y = -0.2143x² + 11.257x - 133.75
R² = 0.4434
40
35
30
25
20
15
10
5
0
-5
-10
0
5
10
15
20
25
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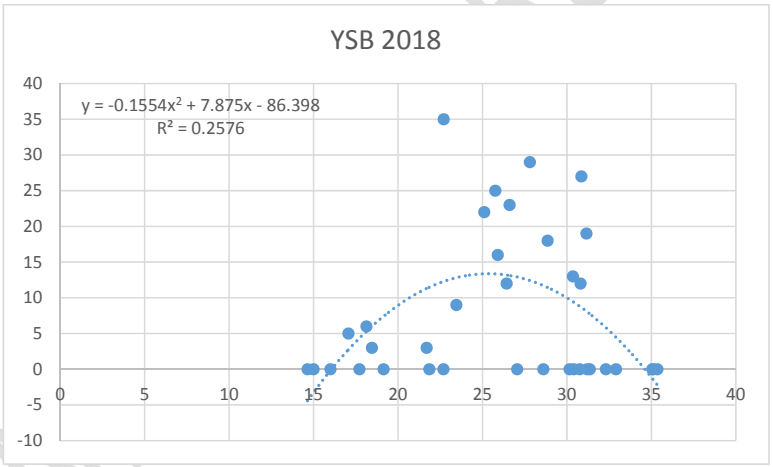
35
40

(8)


YSB 2018
y = -0.1554x² + 7.875x - 86.398
R² = 0.2576
40
35
30
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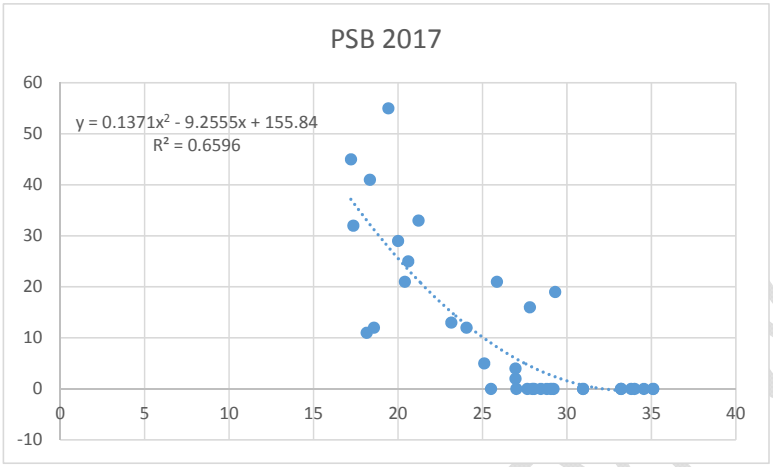
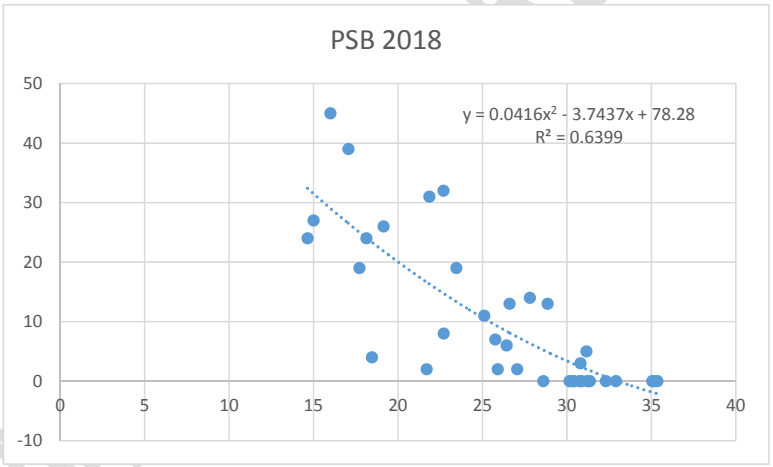
(9)



(10)



(11)

Figure 2. Weekly Total Light Trap catches of White Stem Borer (6, 7), Yellow Stem Borer (8, 9) and Pink Stem Borer (10, 11) and weekly Average Temperature for the years, 2017 and 2018.

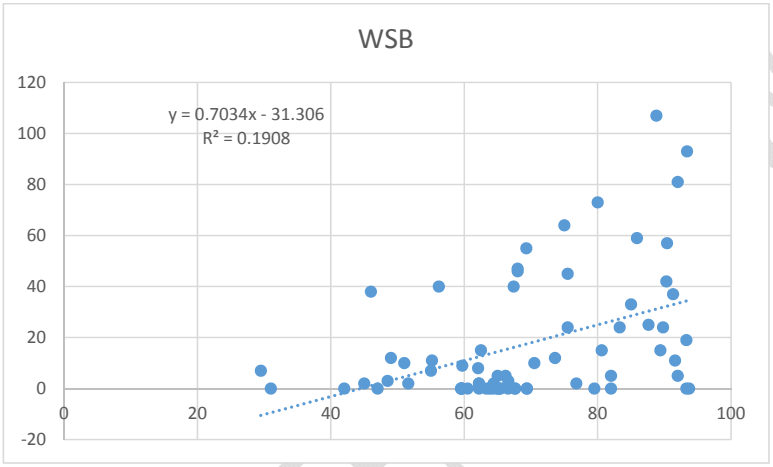
Activity of white stem borer started in the third week of March in 2017 when temperature rose to 20°C as compared to 23.5°C average temperature of 21st week of April while in 2018 the light trap catches were observed in the month of March when temperature was again 18°C till end of March as compared to 2nd

week of March 18°C in 2017. Light trap catches were increased in April when average temperature range was recorded between 27°C till end of April for both the years 2017 and 2018. Catches were dropped in May for both the years and no catch was observed after 4th week of May in 2017 when temperature reached to 34°C and 2nd week of June in 2018 when temperature as recorded 35°C. No flight was observed from 1st week of June to 1st week of August in 2017 while from 2nd week of June to 2nd week of August for the year 2018. The early flights in 2018 may be because of low temperature as compared to 2017. The maximum flights and catches have been observed between 23°C to 32°C for the both years 2017 and 2018 that range could be defined optimum range for white stem borer of rice (Fig. 6, 7).

The activity of yellow stem borer (Fig.8, 9) started in 3rd week of March and lasted till 3rd week of May for the year 2017 and 2nd week of May for year 2018. It has the lower temperature limit of 18°C and 16°C for 2017 and 2018 respectively while 34°C upper temperature limit for the years 2017 and 2018. From 4th week of May to 2nd week of August no flight and light trap catches were observed for 2017 while the flight activity started in after 1st week of August in 2017. Maximum catches for early season in 2017 were observed between 24°C to 32°C for the year 2017. In the year 2018, the activity was observed in 3rd week of March in the early season while for the late season maximum activity was recorded in 4th week of September when temperature was 28°C. The intensity of catches showed that maximum catches were observed between 24°C to 30°C and 25°C to 32°C for the years 2017 and 2018, respectively. After the 3rd week of October no activity was observed in both years and activity cessation for 2017 broken in 3rd week of March 2018 when temperature crosses the 17°C achieved.

In case of pink stem borer catches were recorded in 1st week of March last till 4th week of April in 2017 while it lasted till the 3rd week of May for the year 2018. This may because the average temperature was less in 2018 as compared to 2017. Then it again started from 3rd week of September in 2017 when temperature dropped to 27°C. In the year 2018, again activity recorded till the end of 3rd week of May while it resumed in the 2nd week of September. The catches range was 29°C average temperature for 2017 while 32°C for the year 2018. The frequency of light catches was unanimously divided for the year 2017 and 2018 in case of Pink Stem Borer. The upper temperature limit was recorded 31°C and 33°C for the years 2017 and 2018 respectively (Fig. 10, 11).

The Pink Stem borer of rice, its activity continues in the winter season being a polyphagus insect pest upon end of Kharif season. Therefore lower threshold temperature limit could not be seen in the Fig.2 (10, 11). More studies are required to figure out the lower threshold limit for Pink Stem Borer of rice.



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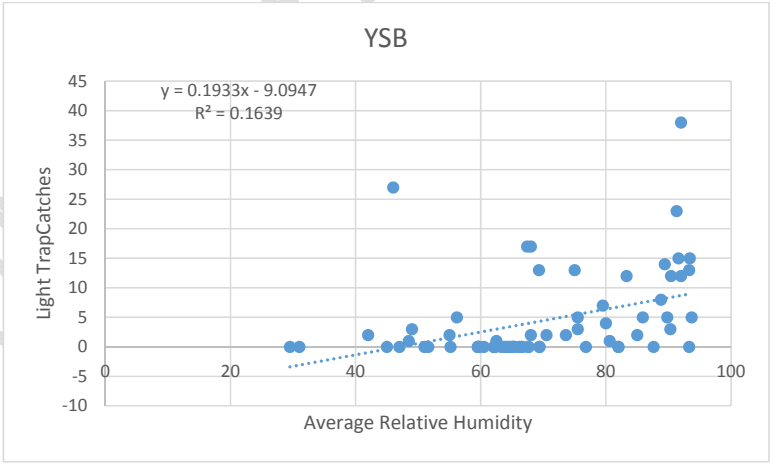

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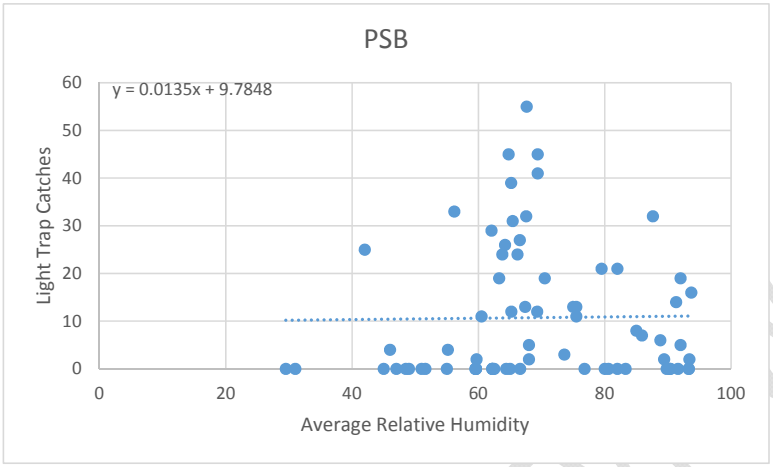

(14)

Figure 4. Weekly Total Light Trap catches of White Stem Borer (12), Yellow Stem Borer (13) and Pink Stem Borer (14) and weekly Average Relative Humidity at Kala Shah Kaku for 2017-18.

In case of relative humidity, it cast a significant positive impact on White Stem Borer (0.409299) and Yellow Stem Borer (0.40485735) of rice. In case of Pink Stem Borer, relative humidity induced an insignificant positive effect (0.014953) on light trap catches relative to the White Stem Borer and Yellow Stem Borer (Fig.12, 13, 14). It is also evident that the number of light trap catches of these three insect pests of rice was increased with increase in average relative humidity.

Our findings are very close to study of Light trap catches of Yellow Stem Borer revealed by Santiago and Sebastian that Yellow Stem Borer remained active from last week of March to third week of May in the early season and from September to October a peak of activity was again observed [16]. The studies of Pathak and Zeyaur [17] also showed that maximum activity of YSB and WSB was detected above at 29°C, while no activity was recorded below 15°C. Lan [18] also found that the overwintering larvae of YSB matures when temperature rise above 16□ in spring season similar to our findings. Maximum catches of Yellow Stem Borer recorded were in the month of September [19] which was in accordance to our studies.

Quyen [20] firmed the bottom temperatures for growth of YSB for adult phase 16°C similar to our findings explaining further that, constructed on the records for the last 40 years, the appearance of adults of the first generation is depended on the temperatures. Insects belong to phylum arthropoda are cold-blooded creatures, temperature plays a pivotal role in their growth and dissemination [21, 22], and YSB has no impunity to this thermal code. Rehman [23] revealed minimum temperature and relative humidity to be important dynamics that influenced the YSB outbursts. As reliable forewarning and monitoring tools are indispensible for pest management, the YSB prediction model would prove useful in forewarning likely occurrence of the pest in Mandya region, thereby paving way for timely action and prevention of yield losses due to the pest.

4. Conclusion

Therefore, the knowledge and information of insect pest catches in light traps could be used for developing integrated pest management measures to safeguard the health of agriculture milieus. Present study, thus, withdraws scientific information on insect attraction to light trap under specific ecological circumstances of temperature and humidity. It also appears from the results that lower and upper temperature limits are significant climatic aspects responsible for insect flight and insect catch. Based on this information, the rice sowing and transplanting could be settled according to the climatic conditions to avoid insect pest attack and crop damages. Moreover, the other pest suppressing techniques could be kept in consideration in the light of these studies for the months favoring insect pest population.

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