Population dynamics and eco-friendly management of rice stem borer and leaf folder in Punjab region.

A

Synopsis

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By

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Certificate

This is to certify the work recorded in this thesis entitled **"Population dynamics and eco-friendly management of rice stem borer and leaf folder in Punjab."** Submitted by Anil Kumar (Reg. number- 11719063) in partial fulfilment of the requirements for the award of Degree of Master of Science (Agriculture) in Agriculture Entomology of Lovely Professional University, Phagwara, Punjab is the faithful and bonafide research work under my personal supervision and guidance.

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DECLARATION

I hereby declare that **"population dynamics and eco-friendly management of rice stem borer and leaf folder in Punjab region"** is an authentic record of my work carried at Lovely Professional University as requirement of project for the award of degree- Master of science in Department of Entmology, under the guidance of Dr. Satish Krushna Gharde, Assistant Professor, School of Agriculture, Lovely Professional University, Phagwara, Punjab (India).

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Introduction

Rice (*Oryza sativa*) is the seed of grass species belonging to Graminae family. It is most important cereal crop after the wheat. It is staple food of whole world, mostly Asian region. Everyone known as rice consumption is good for health that gives much nutritive value for health. According to International Rice Research Institute Philippines, the nutritive value of rice include, proteins, fat, crude fibre, carbohydrates, ash, minerals Ca, P, Fe, Na, K and vitamins viz. Thiamine, Riboflavin, Niacin and Tocopherol. It is play an important role in prevention of high blood pressure, heart disease, cancer prevention and skin care. (Deepak and Kirti, 2011)

Rice is grown in more than hundred countries (approximately 111 countries) and cover 158 million hectare of total area. According to most recent official data 482 million metrics tonnes of rice was produced in the last harvesting year (2017) worldwide. Total global consumption of rice accounts (470 million metrics tonnes of milled rice) more than 700 million tonnes annually.

India is the second largest producer of rice after China and cover 43.86 million hectare area under cultivation of rice. The production is 104.80 million tonnes and the productivity is about 2390 kg/ha. (Agricultural Statistics at a glance- 2015).

According to government of India, total food grain is estimated at record 275.68 million tonnes out of rice estimated at record 110.15 MT; wheat 98.38 MT, coarse cereal estimated 44.19 MT, oil seed 32.10 MT. (Ministry of Agriculture & Farmer welfare 2017).

West Bengal show leading production of rice grain 146.05 Lakh tonnes, U.P 140.22 LT, Andhra Pradesh 128.95 LT, Punjab 105.42 LT, Tamil Nadu 74.58 LT, Bihar 71.62 LT, Chhattisgarh 60.28 LT, Assam 45.16 LT and Karnataka 39.55 LT. (Fazlani exports Pvt. Ltd.).

Chhattisgarh in the 3rd position among the Indian *states* in rice production. It is refereed as the *"***Rice-Bowl of India***"* and also 10th largest state in India in term of area. According to 68th National Sample Survey, rural Indian eats 6 kg of rice per month as compared to 4.3 kg wheat but an urban person consumes 4.5 kg of rice per month.

Rice ecosystem attacked by 800 species of insects worldwide. Out of that, 20 insects considered as rice pest, cause the economic damage of crop include stem borer, plant hopper, grass hopper, defoliators and gall midge. In China and South Asia having important pest of rice like yellow stem borer, leaf folder, plant hopper and gall midge. (Noor and Hussain, 2015).

Rice is attacked by the numbers of pest viz. stem borer (yellow stem borer, pink stem borer, white stem borer), leaf folder, plant hopper (brown plant hopper, green leaf hopper, white

backed plant hopper), gall midge, gundhi bud, Swarming caterpillar, panicle mites, rice horned caterpillar and rice hispa (approximately 15 pest) in India (NICRA, 2011). There are three main factors which cause maximum yield loss weed 37.02 % followed by insect-pest 27.9%anddisease 15.6 % (Mondal *et al*, 2017). Out of 27.9% of damage caused by different insect stem borer alone cause 8.77%. It was positively correlated with 'dead heart' or 'white head' infestations of vegetative, reproductive and mature phases of the crop. (Rahman, 2004). Leaf folder show highest infestation at reproductive stage and reduce yield up to 6.2%, respectively. (Chhavi, 2017).

Keeping in view the severity of infestation caused by rice stem borer and leaf folder mainly in Punjab region, I conduct a field study to know the "**population dynamics and eco-friendly management of rice stem borer and leaf folder in Punjab"** with the following objective.

- To study the population dynamics on staggered planting of rice stem borer (*Scirpophaga incertulas*) and leaf folder *Cnaphalocrocis mainsails.*
- To study the evaluation of new molecules against rice stem borer and leaf folder.
- To study the effect of new molecules on natural enemies in rice ecosystem.

Review of Literature

Rani *et al.,* 2007 conduct a field experiment Madurai district to investigate the diversity of rice leaf folders and their natural enemies. They observed the three species of rice leaf folders viz., *Cnaphalocrocis medinalis* (Guenee), *Marasmia patnalis* (Bradley) *and Marasmia ruralis* (Walker) among which the former was dominant and found throughout the year.

Gangwar, (2015) conducted the trail on life cycle and abundance of rice leaf folder, *cnaphalocrocis medinalis*. Before the existence of high yielding and Basmati rice varieties the leaf folder has been considered a miner pest of rice growing areas but present time it occur in major pest of rice and cause severe yield loss. First three instars larvae show more damaged as compare with fourth and fifth instars. They observed the feeding rates of the first three larval instars rice leaf folder on rice plants were significantly lower than those of the fourth and fifth instars. The feeding rate also decreases with increasing the plant age.

Rahaman *et al.* (2014) tested the relative abundance of Yellow stem borer (*Scirpophaga incertulas),* Pink stem borer (*Sesamia inferens*), Dark headed stem borer (*Chilo polyhcrysus*), White stem borer *(Scirpophaga innotata*), Stripped stem borer *(Chilo suppressalis*), and nine different natural enemies was also collected from the rice fields. The population of natural enemies and stem borers was highest in tillering stage and lowest in seedling stage.

Determination of the seasonal incidence of stem-borer and leaf-folder in wet land rice eco-system. Three species of stem-borer including yellow stem-borer, *Scirpophaga incertulas*, white stem-borer, *Scirpophaga innotata* and stripped stem-borer, *Chilo suppressalis* were found highest attacking in rice crop as compared them, *S.incertulas* dominated. Relative humidity and rainfall were positively correlated with increasing the population of pest which lead the yield loss. (Baskaran M. *et al.*,2017)

U. A. Noor *et al.* (2015)In the world major rice growing country studied in terms of pest diversity in the rice fields that included China, India, Bangladesh, Philippines, Thailand and Sri Lanka. They observed the major rice pests show sever infestation in rice fields of all major rice growing countries of the world.

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The impact of climatic parameters on rice yellow stem borer, *Scirpophaga incertulas* (Walker) and its natural enemies tested by Mondal *et al.*, 2017 and they found the incidence of dead heart gradually increases attaining the maximum level. Formation of dead heart and white head are significantly increased with plant growth.

A study was conduct in 2018 to assess the influence of yellow stem borer on different stages of rice crop. They recorded different parameter of climatic conditions which effect the population rate and observed the maximum dead heart damage (10.47%) at 60 DAP and minimum (3.98%) at 45 DAP by YSB.(Reuolin, *et al*., 2018)

An experiment was conduct on the light trap to study the emergence rate and sex ratio of yellow stem borer. (Ali, 2015). First moth was captured during 4th week of March and moth activity reached to its first peak during April. Moth activity reached to its second peak during 1st week of October. They found female moths were more attracted than the males toward light trap.

An experiment was conduct by Madhuri, *et al* (2017) to determine the effect of weather parameters on population dynamics of paddy pests. They observed the temperature favours stem borer, leaf folder, green leaf hopper and whorl maggot, brown plant hopper and white backed plant hopper, but relative humidity was not ideal for leaf folder and whorl maggot. Rainfall decrease the infestation of stem borer, leaf folder, whorl maggot and green leaf hopper but increase rate of brown plant hopper and white backed plant hopper.

Zainab,. *et al* (2015), to the study the factor affecting the environment conditions on yellow stem borer and leaf folder at department of Entomology and agriculture Zoology Banaras Hindu University Varanasi, India. They found the dead heart incidence and white ear head in yellow stem borer were negatively correlated with mean- temperature, positively correlated with relative humidity and show significant correlation with rain fall.

Review on managements:

Chormule *et al*., (2014) an experiment were conduct on new insecticide molecules against yellow stem borer at research farm collage of agriculture Kolhapur. They were used the different molecules viz., flubendiamide 480 SC, cartap hydrochloride 50 SP, indoxacarb 14.5 SC, and fipronil 5 SC. Out of these fipronil 5 SC @ 30 g a.i/ha were most effective against stem borer followed by flubendiamide 480 SC @ 30 g a.i/ha, indoxacarb 14.5 SC @ 30 g

a.i/ha, cartap hydrochloride 50 SP @ 375 g a.i/ha. whereas flubendiamide 480 SC @ 30 g a.i/ha is safe for natural enemies but fipronil 5 SC @ 30 g a.i/ha cost effective against stem borer.

Sharanappa *et al*., (2017) determine the efficacy of certain chemical molecules against rice stem borer. Application of two spray is effective to manage the stem borer, where monocrotophos show highest reduction of stem borer followed by chloropyriphos, flubendamide and cartap hydrochloride.

Sandhu and Dhaliwal (2016) an experiment conduct to evaluate different insecticide application for reduction of stem borer during kharif season at Krishi Vigyan Kendra, Sri Muktsar Sahib, Punjab. They used different chemical viz., flubendamide 39.35% SC, chloropyriphos 20% EC @ 2500ml/ha, trizophos 40% EC @ 875ml/ha. Whole insecticide show superior to control but flubendamide 39.35% SC @ 50ml/ha most effective to reduce the dead hear, white ear and leaf folder.

Schan, *et al*., (2018) determine efficacy of new insecticide to reduction the yellow stem borer. All the treatment show significant result with application of chlorantrailiprole 18.5 SC @ 150 ml/ha followed by chlorantrailiprole 0.4 % @ 10kg/ha.

Test the different new insecticide against stem borer and leaf folder of rice during kharif season at agriculture research station, Sakoli, Dist. Bhandara. Application of insecticide viz., flubendiamide 240% g/l plus thiacloprid and rynaxypyr 20 SC show significant result in reduction of white earhead and dead heart followed by flubendiamide 480 SC, dinotefuran 20 SG and thiacloprid 240 SC. (Chaudhari *et al*., 2017).

Sarao and Mahal (2008) evaluate the eight different insecticides to reduce against yellow stem borer and leaf folder viz., cartap hydrochloride 4 G, monocrotophos 36 SL, chlorpyiphos, triazophos 40 EC, imidacloprid 200 SL, endosulfan 35 EC, quinalphos 25 EC and methyl parathion 50 EC. Out of these cartap hydrochloride is superior than other insecticide and increase grain result.

Materials and method

The present study entitled "population dynamics and eco-friendly management of rice stem borer and leaf folder" will be conduct at Agricultural Research Farm, School of Agriculture, Lovely Professional University, Phagwara , Punjab during 2018-19. The research field is located at 31^0 15' North latitude, 75^0 32' East longitudes at an 228 meter above mean sea level.

Soil

The soil of research field is typically sandy loam to clayey (pH 7.5 to 7.8) with moderate fertility and having good drainage facility.

Climatic condition during the period of experiment

The climatic conditions of Punjab are sub humid to semi-arid with temperature conditions. The climate is remains excessively hot and dry between April and July with approximately 41-46 °C temperature. Into the middle of August temperature is decrease up to 5-7 °C but humidity increase.

Experimental details

Experimental Crop	**:**	Rice (*Oryza sativa*)
Name of variety	**:**	Pusa Basmati 1509
Source of Seed	**:**	PAU, Ludhiana
Test insects	**:**	Yellow stem borer and Leaf folder
Design	**:**	Factorial Randomized Block Design (FRBD)
Treatments	**:**	10 (including control)
Replications with different date of transplanting	**:**	4
Total area	**:**	1500 m^2
Date of transplanting	**:**	20 May, 30 May, 10 June and 20 June 2018

Treatments details:

In present research work applied three different eco-friendly new molecules insecticide Fame (Flubendiamide 39.35% SC), Coragen (Chlorantraniliprole 18.5% SC) and Hortale SG (Cartap Hydrochloride 50% SP) will be used against the stem borer and leaf folder of rice. Treatment details are mention in following table.

	Treatments details	**Doses**
Treatments		
T_1	Flubendiamide 39.35% SC	0.25 ml/lit.
T_2	Flubendiamide 39.35% SC	0.2 ml/lit.
T_3	Flubendiamide 39.35% SC	0.15 ml/lit.
T_4	Coragen (Chlorantraniliprole 18.5% SC)	0.7 ml/lit.
T_5	Coragen (Chlorantraniliprole 18.5% SC)	0.6 ml/lit.
T_6	Coragen (Chlorantraniliprole 18.5% SC)	0.5 ml/lit.
T_7	Hortale SG (Cartap Hydrochloride 50% SP)	4.5g/lit.
T_8	Hortale SG (Cartap Hydrochloride 50% SP)	4 g/lit.
T_9	Hortale SG (Cartap Hydrochloride 50% SP)	3.5 g/lit.
T_{10}	Untreated control	Water spray

Calendar of Operations

The crop grown in the open field conditions will follow different cultural practices and data collection.

Selection of field for research work:-

Field selection for nursery growing and for transplanting will near to each other, weed free field, facilities of irrigation and easy for collection of data.

Land preparation for sowing of seed and transplanting of seedling:-

The plot will prepared by using harrow followed by rotavator till the soil became friable. The main purpose of above operation will make the field free from the weeds and make the soil capable enough to germinate. The well rotten FYM @15-20t/ha will incorporated during the last ploughing. The field will divided into 40 plots and each plot size maintained 5 x 5 m^2.

The field was irrigated to provide enough moisture to germination of seeds and for transplanting of nursery provide flood irrigation to main field.

Time period for growing of nursery	Time period for transplanting of nursery
20 May	20 June
30 May	30 June
10 June	10 July
20 June	20 July

Fertilizer application, weed management

The recommended dose of fertilizer will be apply at 10 tonnes of FYM, 90kg Urea, 30 kg DAP and 20 kg MOP. The ratio of NPK before flooding 30:15:10 and remaining fertilizer broadcast after 45 days of transplanting is 60:15:10 per acre. Necessary hand weeding will do time to time during the experiments.

Irrigation:-

The first flood irrigation will apply at the time of before transplanting after one days interval. The irrigation will depend upon the moisture available in the field.

Data collection

Population dynamics of yellow stem borer and leaf folder will record before spray at 7 day intervals and next day after spray application at 7 day of each spray on randomly selected 5 plants from each plot at different growth stage. The insect population will observe before treatment in the selected plot. In each sample plants, number of leaf folder, stem borer larvaeand their adult of test insect are record from selected plant. Population of natural enemies will count during the study period recorded before & 7 days after each spray.

The reduction present over control is calculate by using following formula

$$Reduction\ \%\ overcontrol = \frac{\text{UTP} - \text{TP}}{\text{UTP}} \times 100$$

Where,

UTP= Untreated Plot,

TP= Treated plot

Statistics Analysis:

Analysis of variance of the data will do for each experiment under factorial randomized block design (FRBD). The incidence of insect pest data where subjected to logarithm transformation prior to analysis as treated earlier counting of insect for each plot. Necessary analysis of data will do with the help ANOVA, OPSTAT, DMRT and SPSS.

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