Evaluation of Botanicals Insecticide ~~Botanicals~~ against Stem Borer *Scirpophaga incertulas* (Walker) Leaf Folder (*Cnaphalocrosis medinalis*) and Green Leafhopper (Sci. name) and ~~Leaf Folder (*Cnaphalocrosis medinalis*)~~ in Rice

Abstract

A field experiment was conducted during the kharif season of 2020-21 and 2021-22 at Crop Research station, Masodha, Ayodhya to evaluate the efficacy of insecticide-botanicals against rice stem borer, green leafhopper and leaf folder. The experiment was comprising Four combination modules/treatments consisting of three insecticides Chlorantraniliprole 20% SC, Cartap hydrochloride 50% SC and Triflumezopyrim 10% SC, one commercial neem formulation - Neemazal and two plant oils - Neem and Eucalyptus oil procured ~~from local market, Hyderabad (Telangana)~~ were compared along with untreated control (only water spray). The lowest stem borers ~~lowest~~ incidence (1 %) of ~~rice stem borer dead heart~~in all insecticides treatment module recorded ~~mean damage of 1.0% when~~as compared to 14.8% in untreated control. Among modules, all insecticides module was found to be the best with 1.0% mean white ear damage followed by neemazal, eucalyptus oil and cartap hydrochloride module with 5.3% WE. Green leafhopper infestation was all insecticides combination was the most effective treatment showing mean population of 110.7/10 hills followed by all botanical combination (120.7) and were superior to control (158.7/10 hills). **The** mean ~~L~~leaf Folder damage (1.8%) was recorded from all insecticides module ~~was the most effective treatment showing mean leaf damage of 1.8%~~ followed by treatment with neemazl (? %), Eucalyptus oil (? %), and Triflumezopyrim 10% SC (3.9% DL) when compared to untreated control (14.5% ~~DL~~)~~4~~). Grain ~~Yield~~ yield all insecticides treatment - Chlorantraniliprole, Cartap hydrochloride, Triflumezopyrim recorded the highest grain yield of 5212.0 kg/ha with 95.79% increase over control (IOC) followed by neemazal, neem oil and cartap hydrochloride with 4500 kg/ha (69.04% IOC). All the treatments were significantly superior to control plot which showed a yield of 2662 kg/ha.

(Keywords: Stem borers, incidence, Green leaf hopper, Leaf folder, Grain yield,**)**

Introduction

Rice is an important food crop which is cultivated worldwide (Fritz *et al* 2011). It is the major

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food for half the population of the world (Zhang *et al* 2019). The global rice production during 2018-19 was about 495.87 million tons (mt) and global consumption was recorded nearly 490.27 mt (Anonymous 2019). India has the highest rice area and stands second in production. In our state rice crop cultivated in an area 30.46 lakh hectares with annual rice production of 199.72 lakh tones averaging 65.16 quintal yield per hectare (Anonymous 2021). It is a crop of warm humid environment which is also conducive for survival and proliferation of insect-pests. Rice and *Basmati* Rice are major crops for *Kharif* season. Both crops are more economical as compared to other *Kharif* crops. Therefore, farmers preferred to grow rice and basmati rice crops in *Kharif* season. The average yield of rice & basmati rice is very lower. Several factors i.e. poor source of seed, improper selection of varieties, less plant population, excessive use of fertilizers & irrigations, untimely check of weeds, deficiency of micronutrients, severe incidence of insect-pests and diseases are involved for lower productivity. Among these, the insect–pests play major role for reduction of yield and quality of produce (Khan and Ramamurthy 2004). The production is adversely affected by many biotic and abiotic factors. Among these, biotic factors contribute to about 52 per cent rice yield loss at global level and 25 per cent loss occurs due to various insect-pests. The number of insect pests which can be categorized according to their feeding habits like stem borers (yellow, white and pink stem borers), leaf feeders (leaf folder, rice hispa and grasshoppers), sap suckers (plant hoppers) and rice-ear-cutting-caterpillar (Bhogadhi and Bentur 2015). The females of leaf hoppers lay eggs in groups on leaf sheath. Both adults and nymphs of leaf hopper suck plant sap from the base of the tillers, which results in yellowing and drying of the plants. The leaf hopper also act as vector for viral diseases (Atwal and Dhaliwal 1997). The farmers rely heavily on insecticides for management of different insect-pests and almost 50% of the insecticides used in rice are targeted against these pests alone (Reddy et al., 2012). Among the various strategies adopted to combat the insect-pests of rice crop, insecticides are the first line of defense. Most of the insecticides used on rice crop are based on quite limited number of chemically different classes out of them the most important inorganic insecticides that are used against rice insect-pests belongs to synthetic pyrethroids and the indiscriminate use of these chemicals leads to adverse effects i. e. residues in rice grains, environmental contamination, resurgence, resistance and destruction of natural enemies which suggest the need to develop alternative management strategies (Dutta 2015; Brevik and Sauer, 2015). Hence, green chemistry insecticides are being added for their evaluation with an aim to least disruption of environmental quality (Sarao and Randhawa 2019, Kaur et al., 2020). Therefore, an effort has

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been made in present investigation to evaluate the efficacy botanicals insecticides against major lepidopterous pests and green leaf hopper in rice crop.

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~~Rice is a major staple food crop of the state, it is necessary to increase the productivity of rice to meet the food requirement of the population. Not only the productivity has to be increased but it should be sustainable also over the years. There are over 70 pests infesting rice in India and 20 are of regular occurrence (Pathak, 1975). The pest causes 25-30% damage to rice crop (Lal, 1996). Among the major pest attacking rice crop the stem borer, Scirpophaga incertulas (Walker) is the number one pest, which attack the crop both at vegetative and reproductive stages (Pasalu et.al., 2002). Rice stem borer (*Scirpophaga incertulas*.), Leaf folder (*Cnaphalocrosis medinalis*) have been reported from all major rice growing areas and causes severe damage to the rice crop. The young larvae of stem borer primarily enter to the leaf sheath and feed on the green tissue for 2-3 days after which the larvae enter to the basal parts usually 5-10cm above water level and at heading stage boring usually occurs at the peduncle node and the white ear head formed. The leaf folder larvae cause injury to rice leaves by scrapping folding and webbing them up to 60%.(Prakash and Rao, 1999). In the field against rice stem borer the insect pest caused 25 to 30 percent yield loss in rice (Agarwala 1995, Sen 1956 and Shukla et. Al, 1986). The larval stage of stem borers mostly remain concealed inside the stem and it is difficult to control (Abro et al., 2013). Rice leaf folder, *Cnaphalocrocis medinalis* (Pyraulidae; Lepidoptera) has attained the status of a major pest in rice growing areas of Eastern Uttar Pradesh.~~

~~Hence keeping the above facts in mind the present study was undertaken to identified the most suitable insecticide against rice stem borer (*Scirpophaga incertulas*) (Walker) and leaf folder (*Cnaphalocrosis medinalis*) in kharif season of rice crop.~~

Material and Methods

The e~~E~~xperiments for evaluation of botanicals insecticides were conducted during WS 2020-21 and 2021-22 at Crop Research Station, Masodha, which is situated at 26.47^{0}N (latitude), 82.12 ^{0}E (longitude) and at 113 m (altitude). The 35 days old nursery of cv. Pusa Basmati-1 was transplanted in hill in the 1st week of July during experimental years. ~~The soil is sandy loam low in organic carbon. It is rich in potassium, medium in phosphorus and possesses good water holding capacity. To evaluate the different insecticide to rice stem borer, green leafhopper and leaf folder. The susceptible rice variety Pusa Basmati 1 was used as test variety. The nursery of Pusa Basmati 1 was sown in raised beds and 23 days old seedling were transplanted keeping 2-3~~

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~~seedling/hill in the 1st week of July in the be both years of study. Transplanted of randomized block design with four replication in 20m^2 plot size, spacing 20x15 cm. Variety specific agronomic practices were adapted to raise the crop.~~ The experiments were laid out with three replication and five treatments (Chlorantraniliprole 20% SC, Cartap hydrochloride 50% SC and Triflumezopyrim 10% SC, one commercial neem formulation - Neemazal and two plant oils - Neem and Eucalyptus oil) in a randomized block design (RBD). The plot size of each treatment was kept 20 m^2 and buffers were maintained by 1.0 and 0.5 meter between replication and treatment plots, respectively. The crop was raised by following all recommended practices except plant protection measures. The tested insecticides were sprayed by using 500 litres water per hectare at economic threshold level . Standard observation procedures were followed to record insect-pests incidence in data sheets at regular intervals throughout the crop growth period. To assess stem borer damage, observations were recorded on total tillers, dead hearts at 30 and 50 DAT, at earing stage was recorded white ears. The damage due to foliage feeders such as leaf folder was assessed based on counts of damaged leaves/10 hills (what GLH) .At maturity, the crop was harvested with single plot thresher; grains were cleaned, dried and weighed separately of each plot and yield converted into per hectare. The data recorded during the course of investigation were subjected to statistical analysis by using analysis of variance technique after square root transformations (Sheoran et al., 1998).

~~**Treatments:** Four combination modules/treatments consisting of three insecticidesChlorantraniliprole 20% SC, Cartap hydrochloride 50% SC and Triflumezopyrim 10% SC, one commercial neem formulation - Neemazal and two plant oils - Neem and Eucalyptus oil procured from local market, Hyderabad (Telangana) were compared along with untreated control (only water spray). There were five treatments replicated four times and laid out in Randomized Complete Block Design (RCBD). Spray applications of the treatments were done based on pest incidence exceeding the economic threshold level guidelines at 10-15 days interval. All the treatments were applied as high volume sprays @ 500 litres of spray fluid/ha. Standard observation procedures were followed to record insect pest incidence in data sheets at regular intervals throughout the crop growth period. To assess stem borer damage, observations were recorded on total tillers (TT), dead hearts (DH) at 30 and 50 DAT, while stem borer damage at heading stage was expressed as percent white ears based on counts of panicle bearing tillers (PBT) and white ear heads (WE). The damage due to foliage feeders such as leaf folder was assessed based on counts of damaged leaves/10 hills. At the time of harvest, the grain yield from net plot leaving 2 border rows on all sides was collected and expressed as kg/ha. The data so obtain were subjected to statistical analysis after necessary transformation for final statistical analysis (Gomez and Gomez, 1983).~~

Results and Discussion

Use of plant extracts or botanicals is one of the earliest and traditional practice adapted in control of insect pests of crops. Botanicals can play a key role in sustainable management of pests as they are environment-friendly, safe to nontarget organisms, renewable and cost effective. Integration of botanicals in rice IPM will reduce pesticide load in environment, prevent

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insecticide resistance and help in conserving natural enemy populations. Increasing emphasis on natural and organic farming in the recent past makes use of botanicals all the more relevant in pest control. Earlier efforts under AICRIP were mainly focussed on evaluation of efficacy of various commercial botanical formulations and insecticides against insect pests. Hence, it was felt necessary to test combination of insecticide and botanicals as modules against major pests of rice in order to identify the effective combination and strategically integrate use of botanicals for ideal rice IPM. So, a trial consisting of various treatments having combinations of effective and commercially available essential oils, neem formulations with recommended insecticides was evaluated during kharif 2021 to evaluate their performance against major insect pests.

Pest Infestation:

Stem Borers (dead hears)~~DH:~~: I~~-~~infestation (table 1) was recorded ~~in damage~~ during vegetative stage ranged from 1.0 to 26.8% ~~dead hearts (DH) in all insecticide treatments and 1.0 to 17.9% in other combination treatments compared to 26.8% in untreated control, during~~at 30 to 50 days after transplanting (DAT). There were significant differences in dead heart damage among the treatments. All insecticides treatment module (mention the name of insecticides) recorded the lowest mean damage of 1.0% when compared to 26.8% in untreated control. Among other treatments, neemazal, ~~-~~neem oil and Triflumezopyrim ~~combination showed~~the mean infestation ~~of~~ (9.5%) was recorded ~~DH~~. ~~These results are in accordance presented in table 1~~

Stem Borers (white ears)~~WE~~: ~~Damage at heading stage in all insecticide treatment~~The white ear infestation ranged from 1.0 to 10.0% in insecticidal treatments as compared to 28.6% untreated ~~in~~ control. Among modules, all insecticides module was found to be the best with 1.0% mean ~~white ear damage~~incidence followed by neemazal, neem oil and Triflumezopyrim module with 3.9% WE.

Overall, all insecticides module was found to be superior in reducing stem borer ~~damage~~ incidence as compared to other botanical ~~insecticide~~insecticidal ~~botanical~~ modules and was the most effective treatment at both vegetative and reproductive phases.

Green leafhopper: infestation was high (110.7-158.7 hoppers/10 hills). All insecticides combination was the most effective treatment showing mean population of 110.7/10 hills followed by neeamazal, neem oil and Triflumezopyrim combination (120.7) and were superior to control (158.7 hoppers/10 hills).There were significant differences in hopper populations among the treatments as well as in populations.

Leaf Folder: Damage was recorded from highest leaf damage was recorded in (1.8 to 14.5%) during 30 and 50 DAT. All insecticides module was the most effective treatment showing mean leaf damage of 1.8% followed by treatment with neemazl (%), neem oil (%) and Triflumezopyrim (3.9% DL) when compared to untreated control (14. 7% DL).

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Grain Yield: All insecticides treatments (——Chlorantraniliprole, Cartap hydrochloride, Triflumezopyrim) recorded the highest grain yield of 5212 kg/ha with 95.79% increase over control (IOC) followed by Botanical-Insecticide-1with 4500 kg/ha (69.4% IOC). All the treatments were significantly superior to control plot which showed a yield of 2662 kg/ha.

WHAT bout cost: benefit and effect on natural enemies

All insecticides module was found to be superior in reducing stem borer damage at both vegetative and reproductive phases compared to other insecticide-botanical modules.

Discussion, conclusion , acknowledgment where ()

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Table:1. Field efficacy of insecticidal treatments against major insect-pests of rice ~~Insect-pest's incidence and Yield in different treatments, insecticide-botanicals~~

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Sl No	Common Name	Stem Borer DH		Mean	WE	LF		Mean	GLH	GY	% increase over control
		30 DAT	50 DAT			30 DAT	50 DAT				
1	Botanical-Insecticide 1	10.8	9.8	10.3	5.3	5.0	5.5	5.3	126.2	4500	69.04
2	Botanical-Insecticide 2	13.8	5.1	9.5	4.3	3.9	3.9	3.9	128.5	4175	56.83
3	All Botanical	20.9	14.8	17.9	10	6.6	6.8	6.7	120.7	3837	44.13
4	All Insecticide	1.3	0.7	1.0	1	1.7	1.9	1.8	110.7	5212	95.79
5	Control (Water Spray)	26.5	27.0	26.8	28.6	14.1	14.9	14.5	158.7	2662	-

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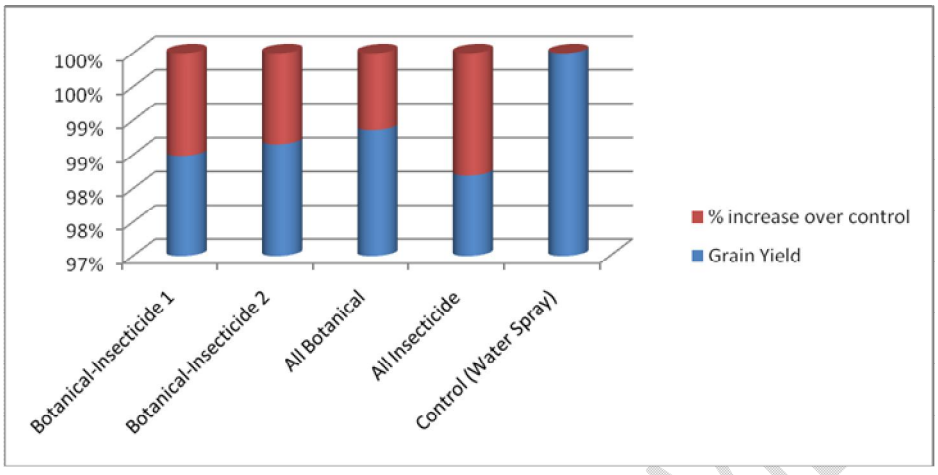
DH: dead hearts, WE: white ears GLH: GY:

Figure 1: Yield and increase % over control in different treatments, insecticide-botanicals



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