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Assessment of the efficacy of neem based insecticides for the management of yellow stem borer, *Scirpophaga incertulas* Walk. in paddy field

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Abstract

The investigation entitled "Assessment of the efficacy of Neem based insecticides for the management of yellow stem borer, *Scirpophaga incertulas* Walk. in paddy field" was carried out at Research cum Instructional Farm of IGKV, Raipur (C.G.) during *Kharif*, 2015-16 and Six commercial biopesticides like, Neembaan Neemazal, Nimbecidine, Multineem, Neem oil, NSKE and a chemical insecticide i.e., Dinotefuran were evaluated against stem borer in the field conditions. As per the performance of different treatments, treatment involving Nimbecidine @ 5 ml/l was most effective with overall mean 6.36 percent dead heart and 14.00 percent white ear head. It was closely followed by Neem oil @ 5ml/l overall mean 6.82 percent dead heart and 16.58 percent white ear head.

Keywords: Rice, Biopesticides, Neem, Insecticides, stem borer

Introduction

Rice (*Oryza sativa* L.) occupies the prominent place in Indian agriculture. It is the most important staple food crop of the developing world for more than 3 billion people. The production and productivity of rice is low in Chhattisgarh and India as compared to world production. Chhattisgarh popularly known as "Rice Bowl of India" occupies an area around 3756.80 thousand hectares with the production of 5.22 million tones and productivity of 2050 kg per hectares (Krishi Dairy, 2016). Amongst various constraints for low productivity of rice the insect pests and diseases are very important. The hot and humid environment in which rice is grown is very conducive for proliferation of insects and diseases. The rice plant is attacked by more than 128 species of insects, 20 of them can cause serious economic loss (Kalode, 2005) [9]. YSB causes 1% to 19% yield loss in early planted and 38% to 80% in late transplanted rice crops.

Various control strategies have been adopted to check insect pest of rice, use of synthetic insecticides is a common method of pest control. But The indiscriminate uses of insecticides have resulted in a number of undesirable side effects such as the development of resistant strain of insects, environmental pollution and health hazards to farmers (Hassall, 1990) [7]. Pesticides have also entered into the food chain and have bioaccumulated in the higher tropic level. More recently, several human acute and chronic illnesses have been associated with pesticides exposure. Therefore, it has now become necessary to search for the alternative means of pest control, which can minimize the use of synthetic pesticides. Botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides. Botanicals with different modes of action may minimize insecticide resistance and pest resurgence problems while being safe and ecologically acceptable.

Biopesticides are a good alternative to the synthetic pesticide. Neem is one of the most reliable botanical sources of biopesticides. Neem plant has been known for three decades for its potential against insect pests. Leaves and seed extract of Neem plant have been observed for their deleterious effects on insects. The principle component that has insecticidal activity in Neem extracts is a limonoid, azadirachtin. Azadirachtin is non-toxic to mammals, rat, oral acute LD₅₀ is more than 5000 mg/kg. A 90 day oral feeding of rats with 10,000ppm of azadirachtin did not show chronic toxicity (Mehlhorn *et al.*, 2011) [13]. Neem products were neither mutagenic nor carcinogenic and they did not produce any skin irritation or organic alteration in mice and rats even in high concentration. From ecological and environmental stand points, azadirachtin is non toxic to fish. Azadirachtin induce no accumulation in plants and no adverse effect in water and ground water. (Mehlhorn *et al.*, 2011) [13].

Materials and methods

To determine the bio- efficacy of different Neem based insecticides, field experiment was conducted during *kharif* 2015-16 in randomized block design with eight treatments and three replications. The seedling of variety Swarna was transplanted in plot size of 20 m² with a spacing of 20x15 cm and normal agronomical practices were adopted. The knapsack sprayer and spray volume @ 500 l/ha was used with hollow cone nozzle to impose the spray treatments

Method of observation: Observation on stem borer incidence were recorded on 10 randomly selected hills from each plot one day before application of insecticides as pre-treatment observation followed by 10 days after insecticide application as post treatment observation. The dead heart and white ear percent were computed by using following formula:

$$\text{Dead heart percent} = \frac{\text{Number of Dead hearts} \times 100}{\text{Total number of tillers}}$$

$$\text{White ear percent} = \frac{\text{Number of White ear heads} \times 100}{\text{Total number of panicles}}$$

For calculating the Percent avoidable losses by various treatments, the following formula was used:

$$\text{Avoidable yield loss (\%)} =$$

$$\frac{\text{Actual Increase in yield over control} \times 100}{\text{Yield of Treatment}}$$

Method of Insecticide application-The doses of insecticides were applied after duly mixing with water (375-500 l/ha) with due care for preventing insecticides drift. Bunds were formed around the treatment plot to avoid the mixing of running water from one plot to another. Initial application of all insecticides was given as soon as pest infestation was noticed.

Treatment details

S. N.	Trade Name	a.i. in formulation	Rate of formulation/ha	Dose/l
T ₁	Neembaan	1.0% Azadirachtin	1000ml	2.0ml/l
T ₂	Neemazal	1.0% Azadirachtin	1000ml	2.0ml/l
T ₃	Nimbecidine	0.03% Azadirachtin	2500ml	5.0ml/l
T ₄	Multineem	0.03% Azadirachtin	2500ml	5.0ml/l
T ₅	Neem Oil	Crude form	-	5.0ml/l
T ₆	Dinotefuran	20 SG	200g	0.5g/l
T ₇	NSKE	Crude form	-	100ml/l
T ₈	Untreated Control	-	-	-

Statistical analysis of the data- Standard statistical procedure was followed as per Gomez and Gomez (1984) The student's t test and contrast test were used for ANOVA and mean comparison respectively.

Results

The Bio-efficacy of Neem based insecticides was studied for their effectiveness against Yellow Stem Borer during Kharif, 2015. Initial application of all insecticides was given at 20 DAT to access the efficacy of different treatments as per the mandate of AICRIP (All India Coordinated Rice Improvement Programme, 2015). The damage caused by stem borer was recorded one day before 1st spraying, 10 days after 1st and 2nd spraying and White ear-head recorded before harvesting of crop are presented in the table 1 and fig 1 and it is found that Neem based insecticides were quite effective against stem borer as compared to untreated control.

The pre treatment observation of stem borer dead heart infestation for all the treatments differs non significantly which ranged from 3.55 to 3.96 percent. The post treatment observation recorded at 10 days after first spray the yellow stem borer incidence (dead heart) varied from 5.13-8.66 percent. Among all the treatments maximum dead heart infestation was recorded under the untreated control i.e. 8.66 percent which was at par with MultiNeem @ 5 ml/l with 7.47 percent dead heart. The Minimum incidence was recorded in treatment Nimbecidine @ 5 ml/l with 5.13 percent dead heart

which was found at par with treatments Neem oil @ 5ml/l with 5.30 percent dead heart, Neembaan @ 2ml/l with 5.46 percent dead heart and Neemazal @ 2ml/l with 5.49 percent dead heart.

At 10 days after second spray the post treatment stem borer incidence (dead heart) ranged from 7.59 to 17.06 percent. Among the treatments, minimum dead heart percent of 7.59 was recorded in treatment Nimbecidine @ 5ml/l which was at par with Neem oil @ 5ml/l with 8.34 percent dead heart, Neembaan with 9.48 percent dead heart and Neemazal with 9.73 percent dead heart. Maximum dead heart of 17.06 percent was recorded in Untreated Control plot with 17.06 percent dead heart.

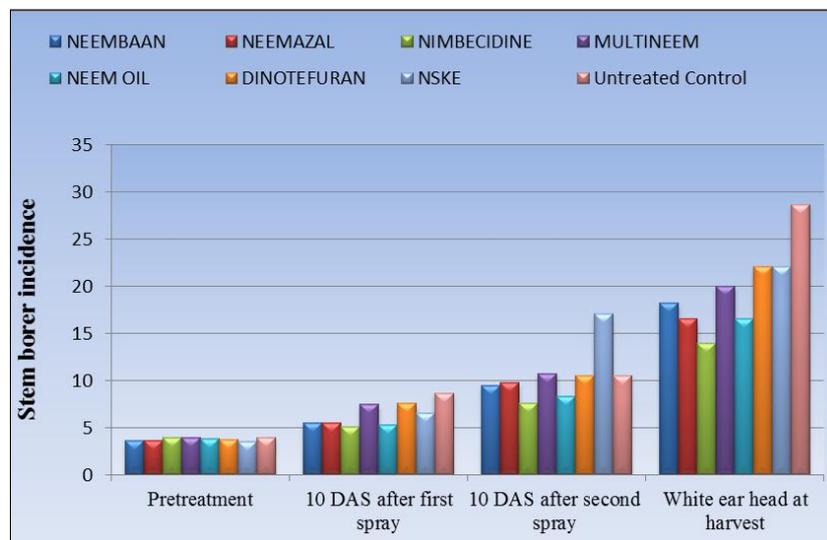
The percent white ear was calculated from the total panicle bearing tillers of hills at the maturity stage of crop. The Percent stem borer white ear damage ranged from 14 to 28.62 percent for different treatment. Among the treatments, minimum white ear head percent was recorded 14% for the treatment Nimbecidine @ 5ml/l which was at par with treatments Neemazal with 16.55 percent white ears, Neem oil with 16.58 percent white ears and Neembaan with 18.22 percent white ears.

The increase in yield over control is given in table 2. The maximum increase in yield over control was observed in treatment Nimbecidine (11.66 q/ha) followed by treatment Neem oil (10.25 q/ha).

Table 1: Performance of Neem based insecticides against yellow stem borer incidence.

S.NO.	Treatments	DOSE/l	Percent Damage by Yellow Stem borer			
			Pre-treatment	10DAS after 1 st Spray	10DAS after 2 nd Spray	WEH before Harvest
T ₁	Neembaan	2.0ml/l	3.60 (10.92)	5.46 (13.46)	9.48 (17.91)	18.22 (25.23)
T ₂	Neemazal	2.0ml/l	3.63 (10.83)	5.49 (13.51)	9.73 (18.44)	16.55 (23.83)
T ₃	Nimbecidine	5.0ml/l	3.94 (11.43)	5.13 (13.07)	7.59 (15.98)	14.00 (21.87)
T ₄	MultiNeem	5.0ml/l	3.95 (11.42)	7.47 (15.83)	10.73 (19.10)	20.04 (26.53)
T ₅	Neem oil	5.0ml/l	3.79 (11.21)	5.30 (13.28)	8.34 (16.78)	16.58 (23.99)
T ₆	Dinotefuran	0.5g/l	3.72 (10.98)	7.56 (15.94)	10.55 (18.85)	22.11 (28.01)
T ₇	NSKE	100ml/l	3.96 (11.47)	8.66 (17.11)	10.56 (18.90)	22.07 (27.97)
T ₈	Untreated control	-	3.55 (10.75)	6.54 (14.76)	17.06 (24.37)	28.62 (32.28)
SE(m)			0.763	0.659	0.922	1.48
C.D.			NS	2.01	2.82	4.54

S. No.	Treatments	DOSE/l	Grain yield	Yield increase over control	percent of avoidable losses
T ₁	Neembaan	2.0ml/l	46.75	9.5	20.32
T ₂	Neemazal	2.0ml/l	45.16	7.91	17.51
T ₃	Nimbecidine	5.0ml/l	48.91	11.66	23.81
T ₄	Multineem	5.0ml/l	40.75	3.5	8.58
T ₅	Neem oil	5.0ml/l	47.5	10.25	21.57
T ₆	Dinotefuran	0.5g/l	41.25	4	9.69
T ₇	NSKE	100ml/l	43	5.75	13.37
T ₈	Untrated control	-	37.25	-	-
SE(m)			0.82		
C.D.			2.35		

**Fig 1:** Performance of Neem based insecticides against yellow stem borer incidence.

Discussion

Relative superiority of neem formulations was assessed on different crops. The results of this study reveals that the plots treated with Nimbecidine had the lowest percentage dead hearts and white heads incidence. These results are in line with the findings of Bora *et al.* (2004) [4] who found Neem products to control yellow rice stem borer. Ho *et al.*, have reported that Neem oil can control borer menace at vegetative stage. Efficacy of Neem oil was also reported by Dhaliwal *et al.*, Application of biopesticides during the first crop growth phase at 35 DAT brings about the mortality of the early YSB larval brood. Application of 3% Neem oil could effectively suppress rice borers as suggested by Nanda *et al.*, and Murugabharathi *et al.*, Although ultimate and comprehensive control of stem borers may not be achieved through Neem application alone, their use could still guarantee reasonable levels of protection to a growing crop.

Present findings are in agreement with those of Ponnusamy (2003) from Tamil Nadu have reported a quantum jump of yield generation by 11.79% when the paddy field was treated

with neem formulations. Kaul *et al.*, (1999) [10] have also noted the positive impact of neem products on paddy yield production. Commercial neem derivatives have been found effective against rice leaf folder maize stem borer (Bhatnagar *et al.*, 1997, Akbar *et al.*, 1999) [3, 1], thrips (Kumar *et al.*, 1999) [12] and white backed plant hopper. Antifeedant activity of commercial formulation of neem (Nimbokil) against neonate larvae of maize stem borer was also documented by Ganguli *et al.*, (1998) [6] and Bhanukiran *et al.*, (2000) [2]. Furthermore, pest suppression efficacy of neem oil and neem seed kernel extract on different crop were stated by Akbar *et al.*, (1999) [1], Kumar *et al.*, (1999) [12] and Bhanukiran *et al.*, (2000) [2].

Conclusion

Agriculture being the backbone for Indian economy, accounts for about 30% of GDP and two third of the population is dependent on it. After taking various observations we can be to concluded that among the different Neem based insecticides, Nimbecidine @ 5ml/l was most effective against

stem borer with minimum 6.36 percent dead heart and 14.00 percent white ear head.

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