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Efficacy of different botanical and chemical insecticides against rice hispa (*Dicladispa armigera*)

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Abstract

An experiment was carried out in the Entomology Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh to determine the efficacy of six botanicals and four chemical insecticides for controlling rice hispa, *Dicladispa armigera* during the period of July to December 2013. In conducting the experiment BR11 rice variety was selected where ten treatments namely six botanicals such as Neem oil, Mahogany oil, Mixture of Neem and Mahogany oil, Bishkatali leaf extract, Pitraj leaf extract and Mixture of Bishkatali and Pitraj leaf extract and four chemical insecticides Sevin85SP, Advantage20EC, Cup50EC, Kinalux 25EC were laid out in the Randomized Complete Block Design (RCBD). Overall leaf infestation by rice hispa and infestation by adults and grubs separately were recorded at different time intervals. In addition to these, overall effect of pest infestation on the grain yield of rice was also examined. Among the six botanicals, Neem oil was most effective in controlling rice hispa, as overall leaf infestation was 21.20% and the infestation by adults and grubs were 14.43% and12.57%. On the other hand, among chemical insecticides, maximum efficacy was found under the treatment of Sevin 85SP where minimum leaf infestation was 9.22%, infestation by adults and grubs were 5.88% and 5.00% respectively. In case of yield, Sevin 85SP (4.62 ton/ha) showed the best efficacy in comparison to other treatments. Therefore, application of Sevin 85SP (3.46ml/L) and Neem oil (2ml/100ml) were examined as the best options in controlling rice hispa. So, it could be recommended to use Sevin 85 SP and Neem oil for the management of rice hispa.

Key words: Efficacy, botanicals, chemical insecticides, rice, hispa

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Introduction

Rice (*Oryza sativa* L.) is one of the most important crops in the world, providing food for nearly half of the global population (Khuhro, 1988; FAO, 2004). It is grown on over 145 million hectares in more than 110 countries. It occupies one fifth of the world crop land under cereal (Pathak & Khan, 1994). It is used as a food for more than two billion people in developing countries of Asia (FAO, 1995; Khush & Brar, 2002). More than 90% of the world's rice is grown and consumed in Asia, where 60% of the earth's people live. This crop accounts for 35%–60% of the calories consumed by 3 billion Asians (Khush, 1997).

Rice is the staple food of about 135 million people of Bangladesh. It provides nearly 48% of rural employment, about two-third of total calorie supply and about half of the total protein intakes of an average person in the country. Rice sector contributes half of the agricultural GDP and one-sixth of the national income in Bangladesh. Almost all of the 13 million farm families of the country grow rice. Rice is grown

on about 10.5 million hectares which has remained almost stable over the past three decades. About 75% of the total cropped area and over 80% of the total irrigated area is planted to rice (BBS, 2010). It is grown all the year round as Aus, Aman and Boro crop in our country.

Rice is infested by many insect pest species. So far, above 175 species of insect has been recorded as rice pests (BRRI, 1985).The rice cultivation all over the world is more or less hindered by many major insects pests, among them rice hispa (*Dicladispa armigera*, Olivier) commonly known as Pamri poka is now drawing attention to a greater extent. Both grubs and adult beetles feed on rice plants. The adult hispa are external feeders, adults scrap the epidermis of the leaves and produce whitish streaks. The adult beetle feeds on the green portion of the leaf, leaving only the epidermal membranes. The feeding damage shows as characteristic white streaks along the long axis of the leaf. Soon after hatching, the larvae mine into the leaf between the epidermal membranes, producing irregular longitudinal white patches. The damage starts from the site of ovipositor near the leaf tip and extends towards the base of the leaf blade. The affected leaves gradually wither and die. A single beetle can consume 6.2-54.5 (av. 25.3) mm^2 of leaf area/day (Rao *et al.,* 1971).

Rice hispa is generally known to attack young rice plants, but in epidemic situation it invades mature plants as well. Heavy infestations in outbreak-prone areas starts in December on the local *Boro* and continues upto the following November on transplanted *Aman* crops. Rice hispa causes considerable damage to vegetative stages of rice resulting in yield loss of upto 52% in deepwater rice, whereas it may be as high as 100% in the rice transplanted post flood in Bangladesh (Hazarika & Dutta 1991, Hazarika & Rajkhowa, 2004).

For the control of hispa, many methods have been adopted but insecticides are still playing a key role for its control. But non judicial and repeated application of insecticides at improper doses may causes several problems such as disrupting natural enemy complexes, secondary pest outbreak, pest resurgence, development of insecticide resistance and environmental pollution. In order to find alternatives to these harmful insecticides, many plant parts and plant extracts can be used effectively because they have insecticidal properties and biodegradable, hence environmentally suitable. Therefore, it is now urgently needed to use safe and effective biodegradable pesticides with less toxic effects on non-target organisms. In Bangladesh traditional botanical products for pest control are being used by the farmers since long before. Among them, the Neem and Mahogany are proved to be unique source for numerous active ingredients of insecticidal properties. Ingredients of Neem affect insects in various ways including repellent, antifeedant, toxic, growth regulatory effects and effect on fecundity. However, Neem-based products were proved as medium to broad spectrum insecticides against various field and store pests (Schmutterer, 1990). Under this circumstance, the present research was condcuted with Neem oil, Mahogany oil, Pitraj & Bishkatali leaf extracts and their mixtures as well as four chemical insecticides.

Materials and Methods

The experiment on the efficacy of selected botanicals and chemical insecticides against rice hispa (*Dicladispa armigera*) was carried out in the Entomology Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh during July to December 2013. BR-11 rice variety was used as host plant. The entire experimental field was divided into 33 plots. Two adjacent unit plots were separated by 50 cm apart at both sides to facilitate different intercultural operations. Each experimental plot was $4m^2$. At first the land was ploughed with a power tiller and kept open to sunlight. The land was then gradually ploughed and cross-ploughed several times with a power tiller to obtain good tilth. All weeds and stubbles were removed from the field during land preparation. The unit plots were prepared with the application of

cow dung at the rate of 15 ton/ ha. The phosphate potassium and zinc fertilizers were applied in the experimental plots at the rate of 100, 70, 10kg /ha respectively in the form of triple super phosphate, muriate of potash and zinc sulphate respectively. The entire amount of TSP, MoP and zinc sulphate were broadcast and incorporated into the soil during final land preparation. Urea used at the rate of 135 kg/ ha was applied as top dressing in three installments at 15, 30 and 50 days. The plant spacing was followed as 25×20 cm. All suitable agronomic practices were done for proper growth and development of the plants. The field trial comprised ten treatments viz Neem oil, Mahogany oil, Mixture of Neem & Mahogany oil, Bishkatali leaf extract, Pitraj leaf extract and lastly Mixture of Bishkatali & Pitraj leaf extract and four chemical insecticides namely Sevin 85SP, Advantage 20EC, Cup50EC, Kinalux 25EC. Efficacy of the insecticides and the botanicals were determined in the field on the basis of percentage leaf infestation and effect on the yield. A standard dose was selected for applying in the field. Six concentrations (2%, 2%, 2%, 10%, 20% and 10%) for botanicals and four (3.46ml, 2.96ml, 2.96ml, and 2.47ml) for chemical insecticides were selected for each treatment. Ten treatments were laid out following the Randomized Complete Block Design (RCBD) and each treatment was replicated three times. Neem and Mahogany oil were collected from Dhaka. Bishkatali and Pitraj leaf extract was prepared by crushing the leaves using a hand blender in the Entomology Laboratory. The first spray was done at 30 DAT (Days after Transplanting). All ten treatments were sprayed three times at ten days interval with three replications in the field. Data were collected after ten days of each spraying. Data were analysed following ANOVA with the help of computer package MSTATC. The mean differences among the treatments were adjudged as per test with Duncan's Multiple Range Test (DMRT) and Least Significant Difference (LSD) when necessary (Gomez and Gomez, 1984).

Results and Discussion

Effects of botanicals and chemical insecticides on the leaf infestation caused by rice hispa: *All* the tested botanicals and chemical insecticides gave significantly lower leaf infestation compared to the Control at 1st spray. The minimum leaf infestation was recorded in Sevin 85SP (6.86%) followed by Advantage 20EC (12.87%) and the highest percent leaf infestation was in control (34.54%). Among rest of the treatments Neem oil provided best performance showing 16.88% leaf infestation which was similar to Kinalux 25EC and Cup 50EC. Among all the botanicals except Neem oil, leaf infestation percentages were statistically similar. At 2nd spray, the minimum leaf infestation was recorded in Sevin 85SP (10.98%) followed by Advantage 20 EC (18.97%), Cup 50 EC (21.65%), Kinalux 25 EC (22.91%), Mixture of Neem & Mahogany oil (23.70%) and the highest percent leaf infestation was observed in control treatment (41.78%). In this case the effect of other botanicals was statistically similar. At 3rd spray, the lowest percent leaf infestation was determined in Sevin 85SP (9.84%) treated plots and the highest infestation was in control (39.87%) plots. Kinalux 25 EC was statistically different from other insecticides. Neem oil, Mahogany oil as well as their mixture showed better performance in controlling rice hispa which was similar to Kinalux 25EC. Here the ranking of all treatments in order to efficacy of insecticides was Sevin 85SP>Advantage 20EC>Cup 50EC>Kinalux 25EC>Neem oil>Mixture of Neem and Mahogany oil>Mahogany oil>Pitraj leaf extract>Bishkatali leaf extract>Mixture of Bishkatali and Pitraj leaf extract.

Infestation percentages of the leaf in the plots treated by botanicals at different sprays revealed that significantly lower percentage leaf infestation was found under all the botanicals in comparison to the Control treatment. Percentages leaf infestation of rice by hispa under various treatments ranged from 16.88 to 34.54% at 1st spray, 23.71 to 41.78% at 2nd spray, and 19.91 to 39.87% at 3rd spray. At 1st spray, Neem oil

showed the lowest percentage leaf infestation with 16.88% but the highest infestation was recorded 34.54% in control and rests of the botanicals showed more or less similar results. At 2nd spray, though mixture of Neem and Mahogany oil gave the lowest infestation 23.71%, all other botanicals were statistically identical. The highest infestation was recorded 41.78% in control plot. At 3rd spray, the lowest leaf infestation was 19.91% in the Neem oil treated plots followed by Mahogany oil and Mixture of Neem & Mahogany oil. Pitraj leaf extract and Mixture of Bishkatali leaf extract & Pitraj leaf extract showed the similar results. At this time the highest leaf infestation was also found under control treatment (39.87%). The present results is similar to the findings of Negahban & Azim (2006) who examined Neem extracts prove to be one of the promising leaf extract for insect control at the present time. These products did not leave harmful residue with lower toxicity to mammals. BRRI Annual Report (2005-2006) also stated that the Neem oil (4%) along with 0.1% emulsifier achieved significantly higher mortality of rice hispa.

Table 1. Effects of botanicals and chemical insecticides on the leaf infestation caused by rice hispa, *Dicladispa armigera*

Treatments	Dose	Percent leaf infestation			
		at 1st spray	at 2nd spray	at 3rd spray	Mean
Neem oil	2ml/100ml	16.88^{b}	26.83^{bc}	19.91^{b}	21.20
Mahogany oil	2ml/100ml	22.52^{c}	27.98^{bc}	24.88^{b}	25.12
Neem+Mahogany oil	(1+1)ml/100ml	21.79^{c}	23.71^{b}	23.92^{b}	23.14
Bishkatalileaf extract	10ml/100ml	24.99^{c}	30.81^{c}	28.83^{c}	28.21
Pitraji leaf extract	20ml/100ml	24.54^{c}	31.78^{c}	27.98^{c}	28.10
Biskathali + Pitraji leaf extract	(5+5)ml/100ml	28.78^{c}	31.58^{c}	28.65^{c}	29.67
Sevin 85SP	3.46ml/L	6.86^{a}	10.98^{a}	9.84^{a}	9.22
Advantage 20EC	2.96ml/L	12.87^{ab}	18.97^{b}	11.65^{ab}	14.49
Cup 50EC	2.96ml/L	16.76^{b}	21.65^{b}	13.87^{ab}	17.42
Kinalux 25EC	2.47ml/L	14.99^{b}	22.91^{b}	18.42^{b}	18.77
Control	-	34.54^{d}	41.78^{d}	39.87^{d}	38.73
F test		**	**	**	
$LSD_{0.05}$		4.08	6.75	5.25	

*Means followed by same letter at the same column are not significantly different (P ≤0.05)

Infestation percentages of the leaf in the plots treated with four insecticides at different sprays revealed that all the chemicals gave significantly lower leaf infestation compared to the Control. Among the four insecticides Sevin 85SP showed the highest efficacy and the lowest efficacy was observed when the plants were treated with Kinalux 25EC followed by Cup 50EC. Here percent leaf infestation under various treatments ranged from 6.86 to 34.54% at 1st spray, 10.98 to 41.78% at 2nd spray, and 9.84 to 39.87% at 3rd spray. At 1st spray, Sevin 85SP provided the lowest percentage leaf infestation (6.86%) followed by Advantage 20EC (12.87%). At the second and third sprays similar results were found. This finding was similar with report of Sharma & Ajai-Srivastava (2008) who showed that Monocrotophos and Acetamiprid

0.4% + Chlorpyriphos 20% EC were also found to be superior for the control of rice hispa, *Dicladispa armigera*.

Effects of botanicals and chemical insecticides on the leaf infestation caused by adult rice hispa: The efficacy of all treatments varied significantly. All the treatments gave significantly lower leaf infestation compare to the control at 1st spray. The lowest leaf infestation was recorded in Sevin 85SP (4.98%) treated plots and the highest percent leaf infestation was recorded in control (22.71%). Among the botanicals only Neem oil showed better performance which was more or less similar to the insecticides Advantage 20EC, Cup 50EC and Kinaux 25EC. Except Neem oil rest of the botanicals were statistically similar in reducing infestation by adults.

At 2nd spray, the minimum leaf infestation was recorded in Sevin 85SP (6.91%) which was nearly identical to Advantage 20EC, but different from Cup 50EC, Kinalux 25EC. All the botanicals were statistically similar in reducing adult infestation. After 3rd spray, though the lowest leaf infestation was recorded in Sevin 85SP (5.75%), all the insecticides were significantly identical in controlling adult infestation. All the botanicals were similarly effective against adult hispa except the botanical oil. Both in the second and third sprays the highest percentage leaf infestation done by adult hispa in the control plots. Here the ranking of all treatments in order to efficacy of insecticides was Sevin 85SP>Advantage 20EC>Cup 50EC>Kinalux 25EC>Neem oil>Mixture of Neem and Mahogany oil>Mahogany oil>Bishkatali leaf extract>Pitraj leaf extract>Mixture of Bishkatali and Pitraj leaf extract.

Table 2. Effects of six botanicals and four chemical insecticides on the infestation of adult hispa

Treatments	Dose	Percent leaf infestation			Mean
		at 1st spray	at 2nd spray	at 3rd spray	
Neem oil	2ml/100ml	8.65ab	14.73b	19.91b	14.43
Mahogany oil	2ml/100ml	13.93b	14.01b	24.88b	17.60
Neem +Mahogany oil	(1+1)ml/100ml	12.87b	13.71b	23.92b	16.83
Bishkatali leaf extract	10ml/100ml	12.99b	14.41b	28.83b	18.74
Pitraji leaf extract	20ml/100ml	14.76b	15.83b	27.98b	19.52
Biskathali + Pitraji leaf extract	(5+5)ml/100ml	13.76b	16.98b	28.65b	19.79
Sevin 85SP	3.46ml/L	4.98a	6.91a	5.75a	5.88
Advantage 20EC	2.96ml/L	7.83ab	10.97ab	8.93ab	9.24
Cup 50EC	2.96ml/L	8.81ab	12.54b	7.98ab	9.77
Kinalux 25EC	2.47ml/L	8.65ab	11.62b	9.73ab	10
Control	-	22.71c	27.98c	29.43b	26.70
F test		**	**	**	
$LSD_{0.05}$		7.09	9.98	8.25	

Means followed by same letter at the same column are not significantly different (P ≤0.05)

Infestation percentages of the leaf by adult in the plots treated by botanical oils at different sprays revealed that all the botanicals gave significantly lower leaf infestation compared to the control. Adult Infestation among various treatments ranged from 8.65 to 22.71% at 1st spray, 14.01 to 27.98% at 2nd spray, and 19.91 to

29.43% at 3rd spray. At first spray, Neem oil gave the lowest infestation 8.65%, significantly different from other botanicals. The rest of the botanicals were identical in reducing the infestation. At 2nd spray, though mixture of Neem and Mahogany oil provided the lowest infestation 13.71%, all the botanicals were statistically identical. The highest infestation was recorded 27.98% in control plots. In case of 3rd spray, Neem oil exhibited the highest efficacy against adult hispa with the lowest infestation 19.91%. The other botanicals also showed the similar efficacy against the infestation of adult hispa. Similar to first and second sprays at this time the highest leaf infestation was found in the control plots. Islam & Singh (1983) found that ether and ethanol extracts of leaves and seeds of *A. indica, M. azedarach, A. ruhituka* and *A. reticulate* repelled the adult and larvae of rice hispa. Again, Hedaetullah & Ghosh (1941) found that rice hispa could be controlled by spraying against the adult with a mixture of kerosene emulsion and pyrethrum dust. It was found from the results that all the chemical insecticides showed significant efficacy against adult rice hispa. Significantly lower leaf infestation was present in the insecticides treated plots compare to the control plots. Adult infestation among various treatments ranged from 4.98 to 21.76% at 1st spray, 6.91 to 27.98% at 2nd spray, and 5.75 to 24.86% at 3rd spray. At 1st spray, Sevin 85SP provided the highest efficacy with the lowest infestation 4.98% followed by Advantage 20EC (7.83%), Kinalux 25EC (8.65%) and Cup 50EC (8.81%). At 2nd spray, the highest efficacy was showed by Sevin 85SP followed by Advantage 20EC but rest of the two insecticides provided comparatively lower but the similar efficacy results. In the 3rd spray, Sevin 85SP gave the best performance (5.75%) and the other insecticides were significantly different in their efficacy from Sevin 85SP. The maximum percent leaf infestation was recorded in control in all the sprays. Khan & Ahmed (1965) reported that 0.15% of both Folithion and Lebaycid gave 89.0 & 50 and 88.4 & 93.2 percent mortality of grubs & adult respectively. He further observed that 0.2 and 0.3% Folithion gave in both cases 100% mortality of grubs after 24 hours of treatment, while 0.1 and 0.2%t Lebaycid killed 69.2 & 96.1%t grubs after 24 hours, 85.2 & 98.6% after 48 hours and 94.7 & 100% after 72 hours respectively.

Effects of botanicals and chemical insecticides on the infestation caused by rice hispa grub: There was a significant variation in Percent leaf infestation by the grub under six botanical and four chemical insecticides (Table 3). Grub infestation among various treatments ranged from 3.56 to 25.71% at 1st spray, 6.91 to 27.98% at 2nd spray, 4.55to 33.43% at 3rd spray.

All the treatments gave significantly lower leaf infestation compare to the control at 1st spray. The minimum leaf infestation was recorded in Sevin 85SP (3.56%), and the maximum infestation was in control (25.71%). Among the botanicals only Neem oil showed better performance which was more or less similar to the insecticides Advantage 20EC, Cup 50EC and Kinalux 25 EC. Except Neem oil the other botanicals were statistically similarly effective in reducing infestation by grubs. At the later two sprays, though the minimum leaf infestation was recorded in Sevin 85SP (6.91% & 4.55%) but all other insecticides were significantly identical in controlling grub infestation. Similar to the chemical insecticides all the botanicals were statistically similar effective against the grub of rice hispa. There was no exception in case of control exhibiting highest infestation. Here the ranking of all treatments in order to efficacy of insecticides was Sevin 85SP>Advantage 20EC>Cup 50EC>Kinalux 25EC>Neem oil>Mahogany oil>Mixture of Neem and Mahogany oil>Pitraj leaf extract>Bishkatali leaf extract>Mixture of Bishkatali and Pitraj leaf extract.

Infestation percentages of the leaf by grub in the plots treated with six botanicals at different sprays revealed that all the botanicals gave significantly lower leaf infestation compare to the control. Grub infestation among various treatments ranged from 9.47 to 25.71% at 1st spray, 12.53 to 27.98% at 2nd spray, and 15.71 to

33.43% at 3rdspray. At both 1st& 2nd sprays, Neem oil gave the lowest infestation (9.47% & 12.53%), significantly different from other botanicals. The rest of the botanicals were identical in reducing the infestation. At 3rd spray, though Neem oil gave the lowest infestation 15.71% but it was similarly effective to Mahogany oil, Mixture of Neem & Mahogany oil, Bishkatali leaf extract, Pitraj leaf extract and Mixture of Bishkatali & Pitraj leaf extract. The highest infestation was recorded in control plot in all the sprays. Kandibane & Nadarajan (2009) showed that bio-efficacy of four leaf extracts viz., *Holarrhena antidysenterica*, Mikeniascandens, *Chromolaena odorata* and *Datura stramonium* in three different solvents (i.e. Petro-spirit, Ethyl alcohol and Methanol) respectively were evaluated against rice hispa, *Dicladispa armigera* (O.). Another findings of author Dash, *et al*. (2007) on the evaluation certain newer insecticides along with commercial Neem formulations under field conditions revealed that Indoxacarb (KN-128, 15 EC) at g a. i./ha was the most effective insecticide against the leaf folders (*Cnaphalocrocis medinalis*) and hispa (*Dicladispa armigera*) of rice followed by Cartap hydrochloride and Monocrotophos.

Table 3. Effects of six botanicals and four chemical insecticides on the infestation of grub

Treatments	Dose	Percent leaf infestation			Mean
		at 1st spray	at 2nd spray	at 3rd spray	
Neem oil	2ml/100ml	9.47ab	12.53b	15.71b	12.57
Mahogany oil	2ml/100ml	12.96b	17.01b	19.48b	16.48
Neem +Mahogany oil	(1+1)ml/100ml	14.87b	18.71b	18.92b	17.5
Bishkatali leaf extract	10ml/100ml	13.77b	19.41b	26.43b	19.87
Pitraji leaf extract	20ml/100ml	16.63b	16.83b	28.58b	20.68
Biskathali + Pitraji leaf extract	(5+5)ml/100ml	17.86b	18.98b	26.02b	20.95
Sevin 85SP	3.46ml/L	3.56a	6.91a	4.55a	5.00
Advantage 20EC	2.96ml/L	6.53ab	10.97ab	7.98ab	8.49
Cup 50EC	2.96ml/L	7.91ab	12.54ab	8.12ab	9.52
Kinalux 25EC	2.47ml/L	7.65ab	11.62ab	9.09ab	9.42
Control	-	25.71c	27.98c	33.43c	29.04
F test		**	**	**	
$LSD_{0.05}$		9.08	8.15	9.25	

*Means followed by same letter at the same column are not significantly different (P ≤0.05)

Infestation percentages of the leaf by grub in the plots treated with four insecticides at different sprays revealed that all the chemicals were significantly effective against grub infestation and gave significantly lower leaf infestation compare to the control. Grub infestation among various treatments ranged from 3.56 to 19.46% at 1st spray, 6.91 to 24.71% at 2nd spray, and 4.55 to 24.43% at 3rd spray. At 1st spray, Sevin 85SP provided the lowest infestation 3.56% and Advantage 20EC (6.53%), Kinalux 25EC (11.62%), Cup 50EC (12.54%) were similarly effective against grub infestation. In the later two sprays Sevin 85SP showed the highest efficacy (91% & 4.55%) whereas other insecticides were similarly effective against grub infestation. The maximum percent leaf infestation was always recorded in control treatment.

Effects of infestation of rice hispa under different treatments on the yield of rice grain: Grain yield of BR-11 variety gave non-significant response to different treatments under study. Yield of rice grain among various treatments ranged from 3.73 to 4.62 ton/ha. The maximum yield of 4.62 ton/ha was recorded in the plots treated with Sevin 85SP which was similar to Neem oil (4.48 ton/ha), Cup 50EC (4.40 ton/ha) and Advantage 20EC (4.35 ton/ha). More or less medium yield was recorded in case of Kinalux 25EC, Mahogany oil and Mixture of Neem and Mahogany oil with the value of 4.17 ton/ha, 4.10 ton/ha and 4.05 ton/ha. The minimum yield was recorded of 3.73 ton/ha in control plot.

Table 4. Effect of infestation of rice hispa on the yield after application of different treatments

Treatments	Yield (ton/ha)
Neem oil	4.48
Mahogany oil	4.10
Neem + Mahogany oil	4.05
Bishkatali leaf extract	3.92
Pitraj leaf extract	3.81
Bishkatali + Pitraj leaf extract	3.95
Sevin 85SP	4.62
Advantage 20EC	4.35
Cup 50EC	4.40
Kinalux 25EC	4.17
Control	3.73

Conclusion

Among six botanicals, Neem oil was most effective in controlling rice hispa where the leaf infestation by adults and grubs were 14.43% and12.57%, respectively. On the other hand, three chemical insecticides tested maximum efficacy was found under the treatment of Sevin 85SP where minimum leaf infestation was 9.22%, infestation by adults and grubs were 5.88% and 5.00% respectively. In case of yield, Sevin 85SP (4.62 ton/ha) provided the best efficacy among all the treatments. Therefore, it could be recommended to use Neem oil and Sevin 85SP for the management of rice hispa effectively.

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