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Evaluation of indigenous plant extracts with cow urine against rice stem borer and rice leaf folder in basmati rice

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Abstract

The Experiment was carried out in randomized block design with three replications during *Kharif*, 2019 at Crop Research Centre of Sardar Vallabh Bhai Patel University of Agri. & Tech., Meerut. The result revealed that Neemoz @ 2500 ml/ha was most effective treatment in reducing the infestation of both rice stem borer and leaf folder followed by Cow urine + *Melia azedarach* @ 7500ml/ha. The Cow urine + *Cannabis sativa* @ 7500 ml/ha was recorded least effective. The maximum yield (37.30 q/ha) was obtained in Neemoz treated plots. The minimum yield (31.20 q/ha) was obtained in Cow urine + *Lantana camara* @ 7500 ml/ha treated plots.

Keywords: plant extracts, Neemoz, cow urine. PB-1509

Introduction

Rice (*Oryza sativa* L.) is the second most important cereal crop after wheat which feeds about 45% of the world population and provides 15% of the global calories intake (Anonymous, 2018) [1]. India is the largest rice growing country, while China is the largest producing rice country in the world. Year 2004 was declared as “International Year of Rice”. Almost 85% of the rice is grown and consumed in Asia (Kakde and Patel, 2015) [5]. Rice is a healthy cereal as it does not contain fat and cholesterol. Rice is an excellent food to include in a balanced diet. It is a good source of carbohydrates, protein, vitamins and minerals such as thiamine, niacin, iron, riboflavin, calcium and fiber. It has low sugar. Rice is gluten free, making rice the essential choice for people with gluten free dietary requirements and diabetic patients (Laskowski *et al.*, 2019) [7]. In India the total area under rice is 43.86 million ha, production is about 115.60 million tonnes and productivity is 2390 kg/ha. Rice cultivated in India is about 21.81% of total rice produced in the world. Uttar Pradesh is the second largest producer of rice after West Bengal occupying 5.87 million ha area under rice with annual production of 12.17 million tonnes and average productivity of 2072 kg/ha. (Anonymous, 2018) [1].

In India, basmati rice is mainly known for its aroma, fragrance, taste and super fine grains and grown mainly in the western part of Uttar Pradesh, Uttarakhand, Punjab and Haryana which accounts for 90% of the total basmati production. Basmati rice cultivation is gaining popularity in western Uttar Pradesh due to higher returns and best climatic condition which is favorable for export quality production. Realizing the importance of crop and availability of irrigation water, the Government of India has identified western Uttar Pradesh as one of the potential basmati rice export zones (Siddiq *et al.*, 2012) [10].

There are some abiotic and biotic factors which cause low production and productivity of rice. Abiotic stresses include high and low temperatures, salinity, submergence, drought and oxygen stress which significantly contribute in decreasing crop yield. More than 45% crop damage has been reported due to these factors. Under biotic stress the most important and widely distributed insect pest species are stem borers, leaf folders, plant hoppers, and gall midge. Stem borers are found in every field in every season. (Bray *et al.*, 2000) [2]. Quantification of important mortality factors, both biotic and abiotic is needed to reliably forecast insect populations. Apart from knowledge of the seasonal incidence and population, build up trend is crucial to ensure timely preparedness to tackle impending pest problems and prevent crop losses and failures. Climate change, especially temperature increase, will affect insect physiology, behavior and development as well as species distribution and incidence. (Das, 2008) [4]. Damages to the rice crop is due to considerable number of insect pests among them rice stem borer, *Scripophaga incertulas* (Walker) is the most important causing dead

hearts at vegetative stage and white ears at reproductive stage leading to major economic damage. In India the rice stem borer solely causes 5-20% damage (Satpathi *et al.*, 2012) [9].

The rice leaf folder feeds on leaves, stops the photosynthesis of the leaves resulting in the reduction of rice yield. The caterpillars feed inside the folded leaf creating longitudinal white and transparent streaks on the blade and ultimately fold them. Indiscriminate use of nitrogenous fertilizers and insecticides has been attributed as the causes of this minor pest gaining major pest status (Dhaliwal *et al.*, 1979) [3]. Yield loss caused by leaf folder reported to the extent of 6 to 25 per cent (Kulgagod *et al.*, 2011) [6]. Recently, emphasis is being given on ecological based control based on integrated pest management strategies. Seasonal incidence studies help in planning need-based application of insecticides as it clearly reveals the insect's peak activity as well as insect free periods during crop growth. The insect pest population shows fluctuations depending on abiotic factors and biotic factors of environment. Insecticides are nowadays commonly used because of their quick knock down effect. Indiscriminate use of such insecticides causes environmental pollution, human and livestock health risk, buildup of pest resistance and resurgence and disturbance in the ecological balance. (Mehrotra, 1992) [8].

Materials and Methods

The experiment was conducted in randomized block design (RBD) replicating thrice, there were total eight treatments including control. The plot size for each treatment was kept 4 x 3 m². The provision was made to irrigate small plots separately with the help of irrigation channels in the experimental area, with a plot size of 4x3 m² and spacing of 15x20 cm at CRC of Sardar Vallabh Bhai Patel University of Agriculture and Technology Modipuram, Meerut, which is located at the distance of about 10Km from Meerut city on Delhi - Dehradun highway. It lies between 77° 15' E and 70° 30' E longitude and 28° 43' N and 29° 17' N latitude at an altitude of 237 meters above the mean sea level. The total geographical area of Meerut district is 2564 Km². The seeds of rice variety Pusa Basmati - 1509 were sown in 5 x 8 m² plot size on 22nd June, 2019. Before sowing seed, treatment was done with *Trichoderma viridae* for the protection against fungal diseases.

Preparation of plant extracts

To prepare the extracts of six indigenous plant species viz; *Azadirachta indica*, *Melia azedarach*, *Lantana camara*, *Jatropha gossypiflora*, *Eucalyptus oblique*, *Cannabis sativa* only leaf parts was collected separately. 250 g of fresh leaves of each plant were soaked in one litre of cow urine in separate covered earthen pots for twenty-five days, so that leaves get mixed and fermented properly in cow urine and then filtered through muslin cloth. The filtered mixture of cow urine and plant extract was used @ 7500 ml/ha. The commercial neem-based insecticide i.e. Neemoz was used @ 2500 ml/ha. Only water is used for spraying in control plot.

Transplanting and application of treatments

The field was prepared by tractor drawn implements with one deep ploughing by soil turning plough and two cross harrowing with disc harrow to get fine tilth followed by leveling and puddling. Twenty-five days old seedlings were transplanted on 16th July, 2019 in a plot size of 4 x 3m². Row to row and plant to plant distance was maintained at 10 x 15

cm, respectively. Recommended dose of N, P₂O₅ and K₂O (150:80:60) was applied for crop production. Half of the nitrogen, total quantity of phosphorous and potash were applied as basal at the time of final preparation of field. While, the rest quantity of nitrogen was top dressed 40 days after transplanting. Uniform application of zinc sulphate @ 25 kg/ha was also broadcast at the time of field preparation.

All the treatments were applied twice during the crop season i.e. Kharif 2019, first at 21 days and second at 36 days after transplanting with hand operated Knap-sac sprayer. The treatments comprised of six plant extracts (Cow urine + *Azadirachta indica* (Neem), Cow urine + *Melia azedarach* (Wild Neem), Cow urine + *Lantana camara* (Wild sage), Cow urine + *Jatropha gossypiflora* (Jatropa), Cow urine + *Eucalyptus oblique* (Eucalyptus), Cow urine + *Cannabis sativa* (Hemp), one commercial neem based insecticide (Neemoz) and one untreated control. In untreated control plot, only water was sprayed. The spray volume used for foliar application of insecticides was 7500 ml/ha. During spraying, care was taken to prevent insecticide drift to other plots.

Each treatment in the form of spray was applied twice during the crop season from 21st day of transplanting and second spray at 36 days after transplanting. Observations on infestation of yellow stem borer as 'dead hearts' and 'white ear head', while infestation of leaf folder as number of larvae per hills was recorded on ten randomly selected plants from three central rows one day before and 3, 7, 14 and 21 days after each spray application.

Calculation of the percent incidence of rice stem borer was done by using the following formula.

$$\text{Percent DH/WH} = \frac{\text{No. of DH/WH}}{\text{Total number of tillers/Panicles}} \times 100$$

Where,

DH = Dead heart WH = White ear head

Calculation of the percent incidence of rice leaf folder was done by using the following formula.

$$\text{Percent DH/WH} = \frac{\text{No. of DH/WH}}{\text{Total number of tillers/Panicles}} \times 100$$

Results and Discussion

Effect of plant extracts treatments against rice stem borer: After first spray

Three days after first spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum dead hearts of 4.56. The second most effective treatment was Cow urine + *Melia azedarach* @ 7500 ml/ha (4.92 per cent dead hearts) followed by Cow urine + *Jatropha gossypiflora* (@ 7500 ml/ha (4.94 per cent dead hearts), Cow urine + *Eucalyptus oblique* @ 7500 ml/ha (4.98 per cent dead hearts), Cow urine + *Azadirachta indica* (5.16 per cent dead hearts), Cow urine + *Lantana camara* (5.42 per cent dead hearts) and Cow urine + *Cannabis sativa* (5.62 per cent dead hearts). However, maximum dead hearts (6.95 per cent) were recorded in untreated control.

Seven days after first spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum dead hearts of 3.04 per cent and it was significantly superior over rest of the treatments. The second most effective treatment was Cow

urine + *Eucalyptus oblique* @ 7500 ml /ha (3.80 per cent dead hearts) followed by Cow urine + *Jatropha gossypiflora* (@ 7500 ml /ha (3.81 per cent dead hearts), Cow urine + *Melia azedarach* @ 7500 ml /ha (3.82 per cent dead hearts), Cow urine + *Azadirachta indica* (4.00 per cent dead hearts), Cow urine + *Lantana camara* (4.32 per cent dead hearts), and Cow urine + *Cannabis sativa* (4.50 per cent dead hearts). However, maximum dead hearts (6.58 per cent) were recorded in untreated control.

Fourteen days after first spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum dead hearts of 2.75 per cent and it was significantly superior over rest of the treatments. The second most effective treatment was Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (3.01 per cent dead hearts) followed by Cow urine + *Melia azedarach* (@ 7500 ml /ha (3.12 per cent dead hearts), Cow urine+ *Azadirachta indica* @ 7500 ml /ha (3.31 per cent dead hearts), Cow urine + *Jatropha gossypiflora* (3.58 per cent dead hearts), Cow urine + *Lantana camara* (3.68 per cent dead hearts), and Cow urine + *Cannabis sativa* (3.87 per cent dead hearts). However, maximum dead hearts (5.92 per cent) were recorded in untreated control.

Twenty-one days after first spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum dead hearts of 2.21 per cent and it was significantly superior over rest of the treatments. The second most effective treatment was Cow urine + *Melia azedarach* @ 7500 ml /ha (2.41 per cent dead hearts) followed by Cow urine + *Azadirachta indica* (@ 7500 ml /ha (2.73 per cent dead hearts), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (2.95 per cent dead hearts), Cow urine + *Lantana camara* (2.99 per cent dead hearts), Cow urine + *Jatropha gossypiflora* (3.01 per cent dead hearts) and Cow urine + *Cannabis sativa* (3.03s per cent dead hearts). However, maximum dead hearts (5.05 per cent) were recorded in untreated control.

After second spray

Three days after second spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum white ear heads (WH) of 3.32 per cent. The second most effective treatment was Cow urine + *Melia azedarach* @ 7500 ml /ha (3.54 per cent WH) followed by Cow urine + *Azadirachta indica* (@ 7500 ml /ha (3.85 per cent WH), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (3.96 per cent WH), Cow urine+ *Lantana camara* (3.98 per cent WH), Cow urine + *Jatropha gossypiflora* (4.09 per cent WH) and Cow urine + *Cannabis sativa* (4.22 per cent WH). However, maximum WHs (7.15 per cent) were recorded in untreated control.

Seven days after second spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum WH of 3.19 per cent and it was significantly superior over rest of the treatments. The second most effective treatment was Cow urine + *Azadirachta indica* @ 7500 ml /ha (3.34 per cent WH) followed by Cow urine + *Eucalyptus oblique* (@ 7500 ml /ha (3.40 per cent WH), Cow urine + *Melia azedarach* @ 7500 ml /ha (3.72 per cent WH), Cow urine + *Lantana camara* (3.89 per cent WH), Cow urine + *Jatropha gossypiflora* (3.99 per cent WH) and Cow urine + *Cannabis sativa* (4.21 per cent WH). However, maximum WHs (8.66 per cent) were recorded in untreated control.

Fourteen days after second spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum white ear heads of 2.65 per cent. The second most effective treatment was Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (2.81 per

cent WH) followed by Cow urine + *Melia azedarach* (@ 7500 ml /ha (2.86 per cent WH), Cow urine + *Azadirachta indica* @ 7500 ml /ha (2.95 per cent WH), Cow urine + *Lantana camara* (3.04 per cent WH), Cow urine + *Jatropha gossypiflora* (3.15 per cent WH) and Cow urine + *Cannabis sativa* (3.38 per cent WH). However, maximum WHs (7.36 per cent) were recorded in untreated control.

Twenty-one days after second spray Neemoz @ 2500 ml/ha proved most effective treatment showing minimum WH of 1.96 per cent WH. The second most effective treatment was Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (2.08 per cent WH) followed by Cow urine + *Melia azedarach* (@ 7500 ml /ha (2.29 per cent WH), Cow urine + *Azadirachta indica* @ 7500 ml /ha (2.50 per cent WH), Cow urine + *Lantana camara* (2.45 per cent WH), Cow urine + *Jatropha gossypiflora* (2.60 per cent WH) and Cow urine + *Cannabis sativa* (2.87 per cent WH). However, maximum WHs (6.90 per cent) were recorded in untreated control.

Effect of plant extracts treatments against rice leaf folder: After first spray

Three days after first spray Neemoz @ 2500 ml/ha was found most effective with lowest larval population (1.07 larvae/hill) and it was followed by Cow urine + *Melia azedarach* (@ 7500 ml /ha (1.14 larvae/hill), Cow urine + *Azadirachta indica* @ 7500 ml/ha (1.32 larvae/hill), Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (1.30 larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (1.38 larvae/hill), Cow urine+ *Cannabis sativa* @ 7500 ml/ha (1.46 larvae/hill) and Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (1.70 larvae/hill). However, maximum number of larvae (3.66 larvae/hill) was recorded in control.

Seven days after first spray Neemoz @ 2500 ml/ha was found most effective and recorded lowest number of larvae (0.93 larvae/hill). The second-best effective treatment was Cow urine + *Melia azedarach* (@ 7500 ml /ha (0.91 larvae/hill) followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha (0.98 larvae/hill), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (1.05 larvae/hill) Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (1.20 larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (1.25 larvae/hill) and Cow urine + *Cannabis sativa* @ 7500 ml/ha (1.39 larvae/hill). However, maximum number of larvae (2.82 larvae/hill) was recorded in control.

Fourteen days after first spray Neemoz @ 2500 ml/ha was found most effective and recorded lowest number of larvae (0.63 larvae/hill) and it was significantly superior to the rest of the treatments. The second-best effective treatment Cow urine + *Melia azedarach* (@ 7500 ml /ha (0.70 larvae/hill) followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha (0.76 larvae/hill), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (0.91 larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (0.96 larvae/hill), Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (0.98 larvae/hill) and Cow urine + *Cannabis sativa* @ 7500 ml/ha (0.99 larvae/hill). However, maximum number of larvae (1.50 larvae/hill) was recorded in control.

Twenty-one days after first spray Cow urine + *Melia azedarach* (@ 7500 ml/ha was found most effective and recorded lowest number of larvae (0.59 larvae/hill). The second-best effective treatment Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (0.66 larvae/hill) followed by Cow urine + *Azadirachta indica* (0.69 larvae/hill), Neemoz @ 2500 ml /ha (0.74 larvae/hill), Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (0.99 larvae/hill), Cow urine + *Lantana camara* @

7500ml/ha (1.18 larvae/hill), and Cow urine + *Cannabis sativa* @ 7500 ml/ha (1.26 larvae/hill). However, maximum number of larvae (2.12 larvae/hill) was recorded in control.

After second spray

Three days after second spray Neemoz @ 2500 ml/ha was found most effective with lowest larval population (0.66 larvae/hill). The second-best treatment was Cow urine + *Azadirachta indica* @ 7500 ml /ha (0.73 larvae/hill) followed by Cow urine + *Melia azedarach* (@ 7500 ml /ha (0.77 larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (0.98 larvae/hill), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (0.99 larvae/hill) Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (1.05 larvae/hill) and Cow urine + *Cannabis sativa* @ 7500 ml/ha (1.16 larvae/hill). However, maximum number of larvae (3.66 larvae/hill) was recorded in control.

Seven days after second spray Neemoz @ 2500 ml/ha was found most effective and recorded lowest number of larvae (0.54 larvae/hill) and it was significantly superior to the rest of the treatments. The next effective treatment Cow urine + *Melia azedarach* (@ 7500 ml /ha (0.64 larvae/hill) followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha (0.65 larvae/hill), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (0.76 larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (0.79 larvae/hill) Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (0.85 larvae/hill) and Cow urine + *Cannabis sativa* @ 7500 ml/ha (1.00 larvae/hill). However, maximum number of larvae (5.90 larvae/hill) was recorded in control. Fourteen days after second spray Neemoz @ 2500 ml/ha was found most effective and recorded lowest number of larvae (0.48 larvae/hill) and it was significantly superior to the rest of the treatments. The next effective treatment was Cow urine + *Melia azedarach* (@ 7500 ml /ha (0.57 larvae/hill) followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha (0.59 larvae/hill), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (0.69 larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (0.73 larvae/hill), Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (0.80 larvae/hill) and Cow urine + *Cannabis sativa* @ 7500 ml/ha (0.96 larvae/hill). However, maximum number of larvae (5.73 larvae/hill) was recorded in control. Twenty-one days after second spray Neemoz @ 2500 ml/ha was found most effective and recorded lowest number of larvae (0.45 larvae/hill) and it was significantly superior to the rest of the treatments. The next effective treatment Cow urine + *Melia azedarach* (@ 7500 ml /ha (0.51 larvae/hill) followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha (0.53 larvae/hill), Cow urine + *Eucalyptus oblique* @ 7500 ml /ha (0.57

larvae/hill), Cow urine + *Lantana camara* @ 7500ml/ha (0.63 larvae/hill), Cow urine + *Jatropha gossypiflora* @ 7500ml/ha (0.65 larvae/hill) and Cow urine + *Cannabis sativa* @ 7500 ml/ha (0.67 larvae/hill). However, maximum number of larvae (5.58 larvae/hill) was recorded in control.

Rice stem borer

Stem borer infestation at vegetative stage produce dead hearts ranging from 2.21 to 3.03 per cent and white ear heads ranging from 1.96 to 2.87 per cent. Neemoz @ 2500 ml/ha provided significantly better control of the stem borers than other treated plots. Among remaining treatments Cow urine + *Melia azedarach* @ 7500 ml /ha treated plots was observed with low per cent dead hearts when compared with Cow urine + *Azadirachta indica* @ 7500 ml /ha, Cow urine+ *Eucalyptus oblique* @ 7500 ml /ha, Cow urine + *Lantana camara* @ 7500ml/ha Cow urine + *Jatropha gossypiflora* @ 7500ml/ha and Cow urine + *Cannabis sativa* @ 7500 ml/ha. Similar result was obtained by Yumnam *et al.* (2017) ^[12] when they found that Neemoz @ 2500 ml/ha treated plots showed least population of stem borer.

Rice leaf folder

In the present study Neemoz @ 2500 ml/ha was found to be most effective against rice leaf folder and significantly superior over the other treatments. Among the other treatments, Cow urine + *Melia azedarach* (@ 7500 ml /ha treatment stood second followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha, Cow urine + *Eucalyptus oblique* @ 7500 ml /ha, Cow urine + *Lantana camara* @ 7500ml/ha, Cow urine + *Jatropha gossypiflora* @ 7500ml/ha and Cow urine + *Cannabis sativa* @ 7500 ml/ha. These results are in agreement with Yumnam *et al.* (2014) ^[11].

Grain yield

The yield was found to be highest in Neemoz @ 2500 ml/ha treated plots giving 37.30 q/ha and was followed by Cow urine + *Melia azadirah* (@ 7500 ml/ha (36.10 q/ha) treated plots. Among all the treatments lowest yield was recorded in plots treated with of Cow urine + *Lantana camara* @ 7500 ml/ha (31.20 q/ha) but the yield was significantly higher than the mean yield recorded in untreated control plots. Cow urine + *Melia azadirah* @ 7500 ml /ha ranked first indicating the maximum return Rs.21.44 per rupee invested followed by Cow urine + *Azadirachta indica* @ 7500 ml /ha. Neemoz @ 2500 ml/ha has the lowest cost benefit ratio (1:7.19).

Table 1: Efficacy of different plant extracts against rice stem borer following first application

Treatments	Dose/ha	Stem borer infestation (% dead heart)				
		Before spray	3 DAS	7 DAS	14 DAS	21 DAS
Cow urine + <i>Azadirachta indica</i>	7500 ml	4.85 (12.71)	5.16 (13.12)	4.00 (11.53)	3.31 (10.47)	2.73 (9.50)
Cow urine + <i>Melia azedarach</i>	7500 ml	4.91 (12.79)	4.92 (12.81)	3.82 (11.26)	3.12 (10.16)	2.41 (8.91)
Cow urine + <i>Lantana camara</i>	7500 ml	5.46 (13.40)	5.42 (13.45)	4.32 (11.99)	3.58 (10.90)	2.99 (9.95)
Cow urine + <i>Jatropha gossypiflora</i>	7500 ml	4.86 (12.72)	4.94 (12.23)	3.81 (9.31)	3.68 (8.88)	3.01 (8.12)
Cow urine + <i>Cannabis sativa</i>	7500 ml	5.45 (13.46)	5.62 (13.69)	4.50 (12.24)	3.87 (11.33)	3.03 (10.01)
Cow urine + <i>Eucalyptus oblique</i>	7500 ml	4.97 (12.86)	4.98 (12.48)	3.80 (10.93)	3.01 (9.74)	2.95 (8.64)
Neemoz	2500 ml	6.36 (14.59)	4.56 (12.32)	3.04 (10.03)	2.75 (9.53)	2.21 (8.54)
Control	Water	5.27 (13.26)	6.95 (15.27)	6.58 (14.85)	5.92 (14.07)	5.05 (12.98)
SE(m)±		0.37	0.19	0.10	0.23	0.21
CD (P = 0.05)		N.S.	0.59	0.31	0.71	0.64

Figures in parentheses are angular transformed values DAS = Days after spray

Table 2: Efficacy of different plant extracts against rice stem borer following second application

Treatments	Dose /ha	Stem borer infestation (% dead heart/ White ear head)				
		Before Spray	3 DAS	7 DAS	14 DAS	21 DAS
Cow urine + <i>Azadirachta indica</i>	7500 ml	4.08 (10.97)	3.85 (9.36)	3.34 (8.79)	2.95 (7.81)	2.50 (7.02)
Cow urine + <i>Melia azedarach</i>	7500 ml	3.85 (10.93)	3.54 (10.83)	3.72 (11.11)	2.86 (9.73)	2.29 (8.70)
Cow urine + <i>Lantana camara</i>	7500 ml	4.12 (11.65)	3.98 (11.50)	3.89 (11.36)	3.04 (10.03)	2.45 (9.00)
Cow urine + <i>Jatropha gossipiflora</i>	7500 ml	4.34 (11.87)	4.09 (11.66)	3.99 (11.51)	3.15 (10.21)	2.60 (9.26)
Cow urine + <i>Cannabis sativa</i>	7500 ml	4.57 (11.97)	4.22 (11.85)	4.21 (11.83)	3.38 (10.59)	2.87 (9.74)
Cow urine + <i>Eucalyptus oblique</i>	7500 ml	3.75 (11.79)	3.96 (11.47)	3.40 (10.61)	2.81 (9.64)	2.08 (8.28)
Neemoz	2500 ml	3.76 (10.87)	3.32 (10.48)	3.19 (10.28)	2.65 (9.36)	1.96 (8.03)
Control	Water	6.07 (14.98)	7.15 (15.50)	8.66 (17.10)	7.36 (15.73)	6.90 (15.22)
SE(m)±		0.20	0.12	0.30	0.07	0.19
CD (P = 0.05)		N.S.	0.386	0.922	0.225	0.589

Figures in parentheses are angular transformed values DAS = Days after spray

Table 3: Efficacy of different plant extracts against rice leaf folder following first application

Treatments	Dose/ha	Mean no. of larvae/hill				
		Before spray	3 DAS	7 DAS	14 DAS	21 DAS
Cow urine + <i>Azadirachta indica</i>	7500 ml	1.07 (1.44)	1.32 (1.52)	0.98 (1.40)	0.76 (1.32)	0.69 (1.30)
Cow urine + <i>Melia azedarach</i>	7500 ml	1.08 (1.44)	1.14 (1.46)	0.91 (1.38)	0.70 (1.30)	0.59 (1.26)
Cow urine + <i>Lantana camara</i>	7500 ml	1.16 (1.47)	1.38 (1.54)	1.25 (1.50)	0.96 (1.40)	1.18 (1.47)
Cow urine + <i>Jatropha gossipiflora</i>	7500 ml	1.09 (1.44)	1.30 (1.51)	1.20 (1.48)	0.98 (1.40)	0.99 (1.41)
Cow urine + <i>Cannabis sativa</i>	7500 ml	1.02 (1.42)	1.46 (1.56)	1.39 (1.54)	0.99 (1.41)	1.26 (1.50)
Cow urine + <i>Eucalyptus oblique</i>	7500 ml	1.18 (1.47)	1.70 (1.64)	1.05 (1.43)	0.91 (1.38)	0.66 (1.28)
Neemoz	2500 ml	1.05 (1.43)	1.07 (1.41)	0.93 (1.32)	0.63 (1.27)	0.74 (1.23)
Control	Water	1.19 (1.47)	3.66 (2.17)	2.82 (1.95)	1.50 (1.58)	2.12 (1.76)
SE(m)±		0.01	0.01	0.01	0.03	0.01
CD (P = 0.05)		N.S.	0.03	0.03	0.02	0.04

Figures in parentheses are square root transformed values DAS = Days after spray

Table 4: Efficacy of different plant extracts against rice leaf folder following second application

Treatments	Dose /ha	Mean no. of larvae/hill				
		Before spray	3 DAS	7 DAS	14 DAS	21 DAS
Cow urine + <i>Azadirachta indica</i>	7500 ml	0.97 (1.43)	0.73 (1.26)	0.65 (1.21)	0.59 (1.17)	0.53 (1.16)
Cow urine + <i>Melia azedarach</i>	7500 ml	0.85 (1.44)	0.77 (1.33)	0.64 (1.28)	0.57 (1.25)	0.51 (1.22)
Cow urine + <i>Lantana camara</i>	7500 ml	1.16 (1.46)	0.98 (1.40)	0.79 (1.33)	0.73 (1.31)	0.63 (1.27)
Cow urine + <i>Jatropha gossipiflora</i>	7500 ml	1.09 (1.44)	1.05 (1.43)	0.85 (1.36)	0.80 (1.34)	0.65 (1.28)
Cow urine + <i>Cannabis sativa</i>	7500 ml	1.19 (1.42)	1.16 (1.47)	1.00 (1.41)	0.96 (1.40)	0.67 (1.29)
Cow urine + <i>Eucalyptus oblique</i>	7500 ml	1.18 (1.47)	0.98 (1.40)	0.76 (1.32)	0.69 (1.30)	0.57 (1.25)
Neemoz	2500 ml	0.73 (1.43)	0.66 (1.28)	0.54 (1.24)	0.48 (1.21)	0.45 (1.20)
Control	Water	1.19 (1.47)	4.95 (2.43)	5.90 (2.62)	5.73 (2.59)	5.58 (2.56)
SE(m)±		0.01	0.01	0.01	0.01	0.01
CD (P = 0.05)		N.S.	0.02	0.03	0.01	0.02

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