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Effect of certain chemical-based insecticides on the incidence of green leaf hopper, (GLH) (*Nephotettix nigropictus* and *N. virescence*), infesting rice

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Abstract
Green leaf hopper (*Nephotettix nigropictus*) is one of the major insect pests of rice in India. The field experiments were carried out during *kharif*, 2016 and 2017 to assess the bio-efficacy of new molecule of insecticides against green leaf hopper. Among the nine insecticides, application of Spinetoram 6SC +Methoxyfenozide 30 SC @400 ml/ha (3.24 GLH/10 hills) was found to be most effective against rice green hopper damage. But it was statistically at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (5.22 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.50 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.76 GLH/10 hills), acephate 95 SG @ 526 g/ha (5.96 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (6.17 GLH/10 hills) and triflumezopyrim 106 SC @ 237.5 ml/ha (6.51 GLH/10 hills). Peak duration of occurrence of green leaf hopper was observed almost from 80 DAT and onward period during both years of experimentations. The highest infestation (26.24 GLH/10 hills) was recorded in the unprotected control plots throughout the experimental periods.

Keywords: Green leaf hopper, *Nephotettix spp.*, new molecule, bio efficacy

Introduction
Rice (*Oryza sativa* L.) is a staple food for over half of the world population, but serious yield losses are caused annually by insects and diseases [1]. It can be grown on over 158 million hectares which produced over 465 million tons in 2012. The increase in the volume of rice production is an immediate requirement in the world due to rapidly growing populations [2]; however, achieving this task seems impossible due to various obstacles. Predicting climate change impacts along with managing the different kinds of pests which attack rice fields is a major problem. To date, 266 different kinds of herbivores (including non-arthropod species such as rats) have been recorded from rice ecosystems, and of these, 232 are arthropod species identified and recorded in the world which directly or indirectly cause rice production losses [3]. However, total number narrows to only 15–20 species if those considered as major insect pests that cause significant yield loss when sufficiently large numbers occur [4]. Recent scientific studies have demonstrated that insecticides have a strong collateral effect on both human and other non-target organisms, as well as pests. Therefore, the challenge before the agricultural scientists of today is to identify novel management practices for controlling rice insect pests other than unilateral usage of agrochemicals. The rice green leafhoppers (GLH), are one of the most devastating rice pests throughout the rice growing areas of Asia [5, 6]. Rice green hopper is also known as Jassid. The insect feeds mainly on the adaxial surface of the leaf blade and rarely on the leaf sheath [7]. The insect causes direct damage to the rice plant by sucking the sap from vascular tissues and reduces the vigour, number of tillers and yield of rice [8]. Both nymphs and adults of the green leafhopper feed on rice by sucking the plant sap and plugging the vascular bundles with stylet sheaths. They cause damage to the rice crop by either directly sucking the sap or indirectly by transmitting virus diseases such as dwarf, transitory yellowing, yellow dwarf and yellow-orange leaf [9]. The population densities and abundance of *Nephotettix* sp is varied due to the flight activity of *Nephotettix* which is influenced by seasonal factors and their relationship varies depending upon the location too [10]. Pest resistance problems have arisen in recent years due to improved cultural practices.

The goal of doing this experiment was to find out to what extent the pest populations can be reduced by the use of this new insecticide.

Methods and Materials

In order to evaluate field bio-efficacy of newer molecules of different insecticides against green leaf hopper of rice, a field trial was conducted at Rice research farm, RAC, B.A.U, Kanke, Ranchi, Jharkhand during *kharif*, 2016 and 2017.

Treatment application: Periodical and need based application of the respective test insecticidal treatments were applied based on the ETL of the pest species at the different stages of the crop. Observations on pest incidence were to be recorded at 4th, 7th, & 10th days after insecticidal application (DAA).

Table 1: Details of experiment

Design **Insecticidal treatments**	**RBD (Randomized block design)** **10**
Replications	3
Spacing (plant to plant)	15 cm
Spacing (row to row)	20 cm
Plot size	5 x 4 m
N:P:K	80:40:20 ka/ha (As per local recommendation)
Date of sowing	3rd July
Date of transplanting	22th July
Date of insecticide application	80 DAT
Date of harvesting	7th November
Crop variety	Naveen

Table 2: Treatment details of field bio-efficacy of some selected commercial formulations of newer molecules of chemical insecticide against green leaf hopper:

Treatments	**Trade name**	**Common Name**	**% a.i. in formulations**	**Dose of the formulated product (ml or g /ha)**	**Dose ml or g/l of water**
T 1	Spinetoram 6 SC+ methoxyfenozide 30 SC	Spinetoram 6 SC+ methoxyfenozide 30 SC	36 SC	375 ml	0.75 ml
T 2	Spinetoram 6 SC+ methoxyfenozide 30 SC	Spinetoram 6 SC+ methoxyfenozide 30 SC	36 SC	400 ml	0.80ml
T 3	DPX-RAB55	Triflumezopyrim	106 SC	238 ml	0.475 ml
T 4	Fame	Flubendiamide 480 SC	48 SC	50 ml	0.10 ml
T 5	Coragen	Rynaxypyr	20 SC	150 ml	0.30 ml
T 6	Hunk	Acephate	95SG	526 g	1.053
T 7	Osheen	Dinotefuran	20 SG	200g	0.40 g
T 8	Hostathion	Triazophos	36 SL	1500 ml	3 ml
T 9	Furadan + Hostathion (in form of alternate use)	Carbofuran + triazophos (in form of alternate use)	3G+40 EC	30kg+1500ml	30kg+ 3 ml
T 10	Untreated control	-	--	-	-

Result and Discussion

The results are presented in Table-3. The incidence of GLH was found to occur almost throughout the cropping season. The observations on the incidence of the pest were recorded to determine the bio-efficacy of the test insecticides at 4, 7 & 10 DAA (days after application) during both of the year of experimentations, 2016 and 2017. Peak duration of occurrence of green leaf hopper was observed almost from 80 DAT and onward period during both of years of the experimentations.

1. Incidence of GLH recorded at 4 days after application (4 DAA)

i. Incidence of GLH recorded at 4 DAA, during 2016

The effect of the test insecticides on the incidence of green leaf hopper (GLH/10 hills) was found to be significant. The minimum GLH of the pest (3.24 GLH/10 hills) was found in the treatment of the combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was superior over all the test insecticides, but it was at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (3.57 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (3.81 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with either of triazophos 40 EC @ 1500 ml/ha (4.02 GLH/10 hills), acephate 95 SG @ 526 g/ha (4.25 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (4.34 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (4.55 GLH/10 hills) and rynaxypyr 20 SC (4.97 GLH/10 hills). The highest GLH i.e.17.64 GLH/10 hills were observed in case of the untreated plant of rice.

ii. Incidence of GLH recorded at 4 DAA, during 2017

The effect of insecticides on the incidence of green leaf hopper was found to be significant. The minimum population of the pest (3.86 GLH/10 hills) was found in the treatment of readymade combination of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was superior over all the test insecticides, but it was at par with spinetoram 6SC plus methoxyfenozide 30 SC @ 375 ml/ha (4.19 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (4.43 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (4.65 GLH/10 hills), acephate 95 SG @ 526 g/ha (4.87 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (4.96 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (5.17 GLH/10 hills) and rynaxypyr 20 SC (5.59 GLH/10 hills). The next best treatment was dinotefuran 20 SG with 6.05 GLH/10 hills was recorded. The highest population of the pest (18.26 GLH/10 hills) was observed in case of the unprotected plants of rice.

iii. Pooled mean incidence of GLH recorded at 4 DAA, during 2016 and 2017

The effect of insecticides on the incidence of green leaf hopper was found to be significant. The minimum population of the pest was harboured by the plants treated with the combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha which recorded 3.55 GLH/10 hills. This was superior among all insecticides, but it was at par with spinetoram 6 SC+ methoxyfenozide 30 SC @ 375 ml/ha (3.88 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (4.12 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (4.34 GLH/10 hills) and acephate 95 SG @ 526g/ha (4.56 GLH/10 hills). The next best treatments were triazophos 40EC @ 1500 ml/ha (4.65 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (4.86 GLH/10 hills), rynaxypyr 20 SC (5.23 GLH/10 hills) and dinotefuran 20 SG (5.74 GLH/10 hills) recorded and found at par with each other's. The highest incidence of the pest i.e., 17.95 GLH/10 hills was observed in case of the unprotected crop of rice.

2. Incidence of GLH recorded at 7 days after application (7 DAA)

i. Incidence of GLH recorded at 7 DAA, during 2016

The effect of the test insecticides on the incidence green leaf hopper remained significant results. The minimum GLH (4.49 GLH/10 hills) was found in the treatment of the new combination product of spinetoram spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was found to be superior as compare to other test insecticides, but it was at par with spinetoram 6 SC+ methoxyfenozide 30 SC @ 375 ml/ha (4.67 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (4.90 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.20 GLH/10 hills), acephate 95 SG @ 526g/ha (5.32 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (5.55 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (5.88 GLH/10 hills), rynaxypyr 20 SC (6.23 GLH/10 hills) and dinotefuran 20 SG (7.06 GLH/10 hills). The highest GLH i.e., 21.71 GLH/10 hills were observed in case of the unprotected crop of rice.

ii) Incidence of GLH recorded at 7 DAA, during 2017

The effect of insecticides against green leaf hopper was found to be significantly effective. The minimum pest population (5.15 GLH/10 hills) was found in the ready mix combination of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was superior over all the test insecticides, but it was at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (5.33 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.56 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.85 GLH/10 hills), acephate 95 SG @ 526g/ha (5.98 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (6.20 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (6.53 GLH/10 hills), rynaxypyr 20 SC (6.89 GLH/10 hills) and dinotefurain 20 SG (7.72 GLH/10 hills). The highest population of the pest (22.37 GLH/10 hills) was observed in case of the untreated crop of rice.

iii) Pooled mean of incidence of GLH recorded at 7 DAA, during 2016 and 2017

The population of the pest varied from 4.82 to 22.04 GLH/10 hills. The treatments were found to be significant. The minimum population was harboured by the rice plants having the protection cover provided with the combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha which recorded lowest pest population (4.82 GLH/10 hills). This was superior among all insecticides, but was at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (5.00 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.23 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.53 GLH/10 hills), acephate 95 SG @ 526 g/ha (5.65 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (5.88 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (6.21 GLH/10 hills) and rynaxypyr 20 SC (6.56 GLH/10 hills). The highest incidence of the pest i.e. 22.04 GLH/10 hills was observed in case of the unprotected crop of rice.

3. Incidence of GLH recorded at 10 days after application (10 DAA)

i. Incidence of GLH recorded at 10 DAA, during 2016

The effect of insecticides on the incidence of green leaf hopper was found to be significant. The minimum GLH of the pest (6.02 GLH/10 hills) was found in the treatment of new combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was superior among all insecticides, but was at par with spinetoram 6SC plus methoxyfenozide 30 SC @ 375 ml/ha (6.42 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (6.79 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (7.04 GLH/10 hills), acephate 95 SG @ 526g/ha (7.30 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (7.61 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (8.08 GLH/10 hills), rynaxypyr 20 SC (8.40 GLH/10 hills) and dinotefuran 20 SG (9.04 GLH/10 hills). The highest pest population i.e., 25.87 GLH/10 hills was observed in case of unprotected crop of rice.

ii. Incidence of GLH recorded at 10 DAA, during 2017

The effect of insecticides on the incidence of green leaf hopper was significant. The minimum pest population (6.76 GLH/10 hills) was found in the treatment of the ready mix combination of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was superior over all the test insecticides, but it was at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (7.16 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (7.53 GLH/10 hills), carbofuran 3G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (7.78 GLH/10 hills), acephate 95 SG @ 526g/ha (8.03 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (8.34 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (8.82 GLH/10 hills), rynaxypyr 20 SC (9.13 GLH/10 hills) and dinotefuran 20 SG (9.77 GLH/10 hills). The highest population of the pest (26.60 GLH/10 hills) was registered in case of the unprotected crop of rice.

iii. Pooled mean incidence of GLH recorded at 10 DAA, during 2016 and 2017

The population of the insect pest varied from 6.39 to 26.24 GLH/10 hills. The treatments were found to be significant. The minimum pest population (6.39 GLH/10 hills) was harboured by the plants receiving treatment with the combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha This treatment was found superior among all test insecticides, but it was at par with spinetoram 6SC + methoxyfenozide 30 SC @ 375 ml/ha (6.79 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (7.16 GLH/10 hills), carbofuran 3G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (7.41 GLH/10 hills), acephate 95 SG @ 526g/ha (7.67 GLH/10 hills) and triazophos 40 EC @ 1500 ml/ha (7.98 GLH/10 hills). The highest incidence of the pest i.e. 26.24 GLH/10 hills was

harbored in case of the unprotected crop of rice.

4. Overall mean population of GLH recorded at 4, 7 and 10 days after application (DAA)

i. Mean of GLH of recorded at 4, 7 and 10 DAA, during 2016

A perusal of results pertaining mean pest population of three dates observations (4, 7 & 10 DAA), indicated that the effect of insecticides on the incidence of green leaf hopper was found to be significant (Table 4.5.6). The minimum population of the pest (4.58 GLH/10 hills) was found in the treatment of the ready mix combination spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha, which was found superior among all the test insecticides, but it was at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (4.89 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.17 GLH/10 hills), granular application of carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.42 GLH/10 hills), acephate 95 SG @ 526g/ha (5.62 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (5.83 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (6.17 GLH/10 hills) and rynaxypyr 20 SC (6.53 GLH/10 hills). The highest population of the insect pest (21.74 GLH/10 hills) was harbored by the rice plants which were left unprotected for natural infestation population of the pest.

ii. Mean of GLH recorded at 4, 7 and 10 DAA, during 2017

A perusal result of the mean population of the pest of three dates observations (4, 7 & 10 DAA) indicated that, the effect of insecticides against the incidence of green leaf hopper was found to be significant. The minimum pest population (5.26 GLH/10 hills) was harboured by the plants receiving treatment with the combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha. The combination product of spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha remained superior among all the test insecticides, but it was also at par with spinetoram SC + methoxyfenozide 30 SC @ 375 ml/ha (5.56 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.84 GLH/10 hills), carbofuran 3G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (6.09 GLH/10 hills), acephate 95 SG @ 526 g/ha (6.30 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (6.50 GLH/10 hills), triflumezopyrim 106 SC @ 237.5 ml/ha (6.84 GLH/10 hills), rynaxypyr 20 SC (7.21GLH/10 hills) and dinotefuran 20 SG (7.85 GLH/10 hills). The highest population of the pest (22.41 GLH/10 hills) was registered in case of the unprotected crop of rice.

iii Pooled mean of GLH recorded at 4, 7 and 10 DAA, during 2016 and 2017

Overall mean of GLH of three dates of observations (4, 7 & 10 DAA), in respect of the different test treatments remained significant. The population of the pest varied from 4.92 to 22.08 GLH/10 hills. The minimum pest population (4.29 GLH/10 hills) was found in case of the treatment new combination product spinetoram 6 SC + methoxyfenozide 30 SC @ 400 ml/ha which was apparently superior among all insecticides, but it was statistically at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (5.22 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.50 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.76 GLH/10 hills), acephate 95 SG @ 526 g/ha (5.96 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (6.17 GLH/10 hills) and triflumezopyrim 106 SC @ 237.5 ml/ha (6.51 GLH/10 hills). The highest incidence of the pest i.e., 22.08 GLH/10 hills was observed in case of the unprotected crop of rice.

Earlier, various scientists evaluated the bioefficacy of different chemical insecticides against green leaf hopper in rice. Nigam *et al.* (1989) [11] found that among the various test treatments, carbofuran 3G and cartap 4G @ each @ 1.0 kg ai/ha and phosalone 35 EC @ 0.50 kg ai/ha proved substantially effective against GLH, leaf folder, ear bug and ear cutting caterpillar infesting rice. Their results are almost in the agreement of the findings of the present experimentations. Prasad and Prasad (2011) [12] found almost the similar results almost in line of the present findings indicating the highest superiority of the combination product comprising of (imidacloprid 40EC plus ethiprole 40%) 80 WG @ 125 g/ha over the sole use of individual form of the test insecticide(s). In the present studies also the combination product, spinetoram 6SC plus methoxyfenozide 30SC proved superior over the sole use of the individual form of test insecticides in reducing the incidence of GLH. Prasad and Prasad (2010) [13] also found effective reduction of the pest (GLH) through foliar spray of monocrotophos, which also endorsed the findings of the present studies.

Table 3: Effect of chemical insecticides on the incidence of green leaf hopper (GLH) (*Nephtottetix nigropictus*), infesting rice

S.N	Treatment	Formulations (a.i.) or	Dose (ml or g /ha)	No of GLH/10 hills, recorded after spray at											
				4 DAA			7 DAA			10 DAA			Overall Mean		
				2016	2017	Pooled Mean	2016	2017	Pooled Mean	2016	2017	Pooled Mean	2016	2017	Pooled Mean
T1	Spinetoram 6 SC + methoxyfenozide 30 SC	36 SC	375 ml	3.57 (1.98)	4.19 (2.13)	3.88 (2.05)	4.67 (2.23)	5.33 (2.37)	5.00 (2.30)	6.42 (2.57)	7.16 (2.71)	6.79 (2.64)	4.89 (2.27	5.56 (2.41)	5.22 (2.34)
T2	Spinetoram 6 SC + methoxyfenozide 30 SC	36 SC	400 ml	3.24 (1.88)	3.86 (2.04)	3.55 (1.96)	4.49 (2.19)	5.15 (2.33)	4.82 (2.26)	6.02 (2.50)	6.76 (2.64)	6.39 (2.57)	4.58 (2.20)	5.26 (2.35)	4.92 (2.28)
T3	Triflumezopyrim	106 SC	238 ml	4.55 (2.21)	5.17 (2.34)	4.86 (2.28)	5.88 (2.48)	9.80 (2.60)	6.21 (2.54)	8.08 (2.88)	8.82 (3.00)	8.45 (2.94)	6.17 (2.54)	6.84 (2.66)	6.51 (2.60)
T4	Flubendiamide	48SC	50 ml	3.81 (2.05)	4.43 (2.20)	4.12 (2.12)	4.90 (2.28)	5.56 (2.42)	5.23 (2.35)	6.79 (2.65)	7.53 (2.78)	7.16 (2.72)	5.17 (2.34)	5.84 (2.48)	5.50 (2.41)
T5	Rynaxypyr	20SC	150 ml	4.97 (2.30)	5.59 (2.43)	5.28 (2.36)	6.23 (2.55)	6.89 (2.68)	6.56 (2.62)	8.40 (2.93)	9.13 (3.05)	8.77 (2.99)	6.53 (2.61)	7.21 (2.73)	6.87 (2.67)
T6	Acephate	95SG	526 g	4.25 (2.14)	4.87 (2.28)	4.56 (2.21)	5.32 (2.38)	5.98 (2.51)	5.65 (2.45)	7.30 (2.73)	8.03 (2.86)	7.67 (2.80)	5.62 (2.43)	6.30 (2.56)	5.96 (2.50)
T7	Dinotefuran	20 SG	200 g	5.43 (2.39)	6.05 (2.52)	5.74 (2.45)	7.06 (2.69)	7.72 (2.81)	7.39 (2.75)	9.04 (3.03)	9.77 (3.15)	9.41 (3.09)	7.17 (2.72)	7.85 (2.84)	7.51 (2.78)
T8	Triazophos	40 EC	1500 ml	4.34 (2.16)	4.96 (2.30)	4.65 (2.23)	5.55 (2.43)	6.20 (2.55)	5.88 (2.49)	7.61 (2.79)	8.34 (2.92)	7.98 (2.86)	5.83 (2.47)	6.50 (2.61)	6.17 (2.54)
T9	Carbofuran followed by triazophos	3G & 40 EC	30 kg & 1500 ml	4.02 (2.09)	4.65 (2.23)	4.34 (2.16)	5.20 (2.36)	5.85 (2.49)	5.53 (2.43)	7.04 (2.68)	7.78 (2.81)	7.41 (2.75)	5.42 (2.39)	6.09 (2.52)	5.76 (2.46)

T10	Untreated control	Water spray	500 lit.	17.64 (4.22)	18.26 (4.29)	17.95 (4.26)	21.71 (4.63)	22.37 (4.71)	22.04 (4.67)	25.87 (5.07)	26.60 (5.14)	26.24 (5.10)	21.74 (4.66)	22.41 (4.73)	22.08 (4.69)
SEm±				(0.15)	(0.14)	(0.09)	(0.22)	(0.21)	(0.14)	(0.18)	(0.18)	(0.11)	(0.18)	(0.17)	(0.11)
CD 5%				(0.44)	(0.42)	(0.26)	(0.65)	(0.63)	(0.39)	(0.54)	(0.52)	(0.32)	(0.53)	(0.52)	(0.32)
CV %				(10.94)	(10.01)	(10.46)	(14.48)	(13.48)	(13.96)	(10.48)	(9.80)	(10.13)	(11.69)	(10.86)	(11.26)

Figures under the parentheses are square root transformed values. GLH-Green leaf hopper
DAT-Days after transplanting; DAA-Days after application of insecticidal treatment
Foliar spray of the insecticidal treatments was applied at 80 DAT

Conclusion

Thus, the present experiment revealed that all the tested chemical insecticides were effective for rice green leaf hopper management but among the newer insecticide molecules Spinetoram 6SC+ Methoxyfenozide 30SC @ 400 ml/ha (3.24 GLH/10 hills) were very effective for green leaf hopper management. But it was statistically at par with spinetoram 6 SC + methoxyfenozide 30 SC @ 375 ml/ha (5.22 GLH/10 hills), flubendiamide 48 SC @ 50 ml/ha (5.50 GLH/10 hills), carbofuran 3 G @ 30 kg/ha followed by need based foliar spray with triazophos 40 EC @ 1500 ml/ha (5.76 GLH/10 hills), acephate 95 SG @ 526 g/ha (5.96 GLH/10 hills), triazophos 40 EC @ 1500 ml/ha (6.17 GLH/10 hills) and triflumezopyrim 106 SC @ 237.5 ml/ha (6.51 GLH/10 hills). The highest infestation of the pest (26.24 GLH/10 hills) was observed in case of unprotected plots throughout the experimental periods. Peak duration of occurrence of green leaf hopper was observed almost from 80 DAT and onward period during the experimentand.

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