Original Research Article

EFFECT OF NITROGEN, PHOSPHORUS AND POTASSIUM (NPK) APPLICATION ON INSECT PESTS INFESTING TRANSPLANTING AMAN RICE (*ORYZA SATIVA* L.)

ABSTRACT

The study was conducted in the experimental area of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh during the period from July to October 2016 to find out the effect of different levels of NPK on insect pests in transplant aman rice. BRRI dhan33 was used as the test crop in this experiment. The experiment comprised the different NPK (Nitrogen, Phosphorus and Potassium) fertilizers dose as treatment where, T_0 = absolute control, no NPK fertilizers, T_1 = NPK @ 45, 50, 40 kg/ha, T_2 = NPK @ 70, 25, 40 kg/ha, T_3 = NPK @ 70, 50, 20 kg/ha, T_4 = NPK @ 70, 50, 40 kg/ha, T_5 = NPK @ 70, 50, 60 kg/ha, T_6 = NPK @ 70, 75, 40 kg/ha and T_7 = NPK @ 95, 50, 40 kg/ha. The experiment was laid out in a Randomized complete block design (RCBD) with three replications. Data were recorded on different types of insect pests that were identified for the entire growing period with their number and incidence on rice plants. During the entire growing period 5 selected hills/plot were monitored with clear observation and yellow stem borer, leaf folder, rice hispa, grasshopper, brown plant hopper, green leaf hopper and rice bug insects and pests were observed. The lowest number of infestation of insects and pest was observed from T_5, whereas the highest number was found from T_7 treatment. In case of incidence percent of dead heart, data was observed at 25, 45 and 65 days after transplanting (DAT), respectively. Data recorded from each plot revealed that the lowest incidence of dead heart was observed from T_5 (3.64%, 4.23% and 4.47% at NPK 70, 50, 60 kg/ha), while the highest incidence of dead heart was found from T_7 (10.37%, 13.56% and 14.73%, respectively) treatment. In terms of white head incidence, at 60, 70 and 80 DAT, data recorded from each plot revealed that the lowest incidence of white head was found from T_5 (2.35%, 2.66% and 3.12%, respectively), whereas the highest incidence of white head was observed from T_7 (7.57%, 8.26% and 8.64% at NPK @ 95, 50, 40 kg/ha).

Keywords: *Oryza sativa*, *nitrogen, phosphorus, potassium, insects pests*

1. INTRODUCTION

Rice (*Oryza sativa*) is the most important food crop around the world and the staple food for approximately more than two billion people in the Asia (Hien *et al*., 2006). Rice is among the most nutritious cereal crops and is an ideal host for over 800 species of insect (Barr and Smith, 1975). In tropical Asia, more than 100 species of insects are persistent to rice. In Bangladesh, about 175 insect pest species have been reported, which cause damage to the rice plants (Mustafi *et al*., 2007), of these 20-30 species are economically important (Miah and Karim, 1984). The estimated loss of rice in Bangladesh due to insect pests and diseases amounts to 1.5 to 2.0 million tons (Siddique, 1992). At high population density, crop loss may be 100% (Rahman *et al*., 2004). Major pests cause damage about 28% to Aman crops and the estimated annual loss of rice in Bangladesh due to insect pests and diseases amounts 1.5 to 2.0 million tons (BRRI, 1989). Nutrient management is the most important practice in rice production system, but it may affect response of rice to insect pests. Positive interaction between nutrients and pest can be identified and provide guidelines for optimizing total agro-ecosystem function (Magdoff *et al*., 2000). Some aman rice pests are green leaf hopper, rice hispa, green stink bug, rice leafroller, yellow stem borer and rice bug. The beneficial insects are categories as predator and parasites, collectively known as natural enemies which are able to interact with their prey and consequently regulate them at reasonably lower level. Ninety nine species of parasites and 88 species of predator of rice insect pests have been recorded in Bangladesh (Wahiduzzaman, 1993). The application of nitrogen fertilizer in plants can normally increase herbivore's feeding preference, food consumption, survival, growth, reproduction, and population density, except few examples that nitrogen fertilizer reduces the herbivore performances. Higher nitrogen doses cause for higher sucking pests incidence. Phosphorus has not been considered as important or limiting as nitrogen for phytophagous insects. However, phosphorus is determinant of

growth rate and population density. Phosphorus is an important component for the population growth of phytophagous insects as it is required for RNA synthesis. Potassium induced change in rice plant at profound effect on insect–host interactions. Increase of K in rice plant causes reduction in the feeding rate of Brown Plant Hopper *Nilaparvata lugens* (Vaithilingan *et al.,* 1975) and *Nephotettix* sp. (Subramanian and Balasubramnian, 1976). To make the green revolution successful and to mitigate the adverse effects of fertilizers to the crop productive environment, judicious use of fertilizers is considered as one of the important aspects of cultural practices in IPM which influence the activity of insect pests and ultimate effect on growth, development and yield of crop plant. Some fragmentary works has been done on the effect of fertilizers on some fewer insect pests like stem borer and BPH by different workers like Pathak and Ram (1999), Rangini et al. (2005) and Sarwar (2012) at different parts of the world. But in Bangladesh research work on the effect of NPK on the major insect pests is scanty. The comprehension of these interaction between NPK and insect pests will turn into the reason for outline of the sustainable rice production framework.

The present study was aimed to identify the optimum doses of NPK against field insect pests infesting the rice and for higher grain yields as well as better quality of rice.

2. MATERIALS AND METHODS

2.1 Experimetal site

The experiment was conducted during the period from July to October 2016, in the experimental area of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh. The geographical location of the experimental site was under the subtropical climate and its climatic conditions is characterized by heavy rainfall during the month of April to September and scanty rainfall during the rest period of the year.

2.2 Experimental material

BRRI dhan33, high yielding rice variety developed by Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh was used as experimental material

2.3 Treatments

The experiment comprised of the following NPK dose as treatment.

T_0 = Untreated control, no NPK fertilizers,
T_1 = NPK @ 45, 50, 40 kg/ha
T_2 = NPK @ 70, 25, 40 kg/ha
T_3 = NPK @ 70, 50, 20 kg/ha
T_4 = NPK @ 70, 50, 40 kg/ha
T_5 = NPK @ 70, 50, 60 kg/ha
T_6 = NPK @ 70, 75, 40 kg/ha
T_7 = NPK @ 95, 50, 40 kg/ha

In each of the treatment Nitrogenous fertilizer was applied in three splits at equal amount where phosphorus and potash fertilizer were applied at single dose as basal.

2.4 Experimental design and layout

The experiment was laid out in a randomized complete block design (RCBD) with three replications, where the experimental area was divided into three blocks representing the replications to reduce soil heterogeneity. Each block was divided into 8 unit plots as treatments demarked with raised bunds. Thus, the total numbers of plots were 24. The unit plot size was 4.0 m × 2.5 m. The distance maintained between two blocks and two plots were 0.5 m and 0.5 m, respectively.

2.5 Intercultural operations

Fertilizers other than NPK such as zinc, boron, Sulphur were applied as per recommended for BRRI dhan33 by Bangladesh Rice Research Institute (12.0, 2.0 and 10.0 kg/ha respectively). Other intercultural operations such as raising of seedlings, land preparation, manuring, irrigation and drainage, weeding were done as per necessity.

2.6 Assessment of infestation

Five hills were selected at random per replicate for each treatment. The dead heart tiller and white head infested tiller were counted. In case of dead heart, it was counted in vegetative growth stage and white head infested tillers was counted at reproductive stage converted into per plant. Hopper burn was counted in tillering, panicle initiation, before ripening and after ripening stage. The observation was recorded at the first observation of symptom and was continued up to maturity at 7 days interval.

During the entire growing period 5 selected hills/plot were monitored with clean observation and yellow stem borer, leaf folder, rice hispa, brown plant hopper, green leaf hopper and rice bug insect pests was observed in different growth stage as insect populations of rice plants.

The number of Dead Heart, white head, hopper burn infested tiller per five hills were counted and divided by total number of tillers in five hills and then multiplied by 100 to assess the percentage of infestation. For Example,

$$\% \text{ dead heart/ infested tillers} = \frac{\text{no. of dead heart infested tiller}}{\text{Total no. of tiller per five hills}} \times 100$$

2.7 Collection of data and statistical analysis

The data obtained for different characters were statistically analyzed to observe the significant difference among the treatments. The mean values of all the characters were calculated and analysis of variance was performed by using MSTAT-C software. The significance of the difference among the treatments means was estimated by the Least Significant Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSION

3.1.1. Number of different insect population

The number of identified insects were recorded and presented in Table 1. For different levels of NPK fertilizers number of different insect pests showed statistically significant differences under the present trial.

3.1.2. Yellow stem borer

The data presented in table 1 revealed that the number of yellow stem borer varied from 1.67 to 9.33 for different levels of NPK fertilizers. The lowest number (1.67) of yellow stem borer was observed from T5 (NPK @ 70, 50, 60 kg/ha) treatment whereas the highest number (9.33) was found from T7 (NPK @ 95, 50, 40 kg/ha) treatment. Optimum doses of NPK fertilizers was more effective in controlling of yellow stem borer, whereas in excessive application of NPK fertilizers increased the incidence of yellow stem borer. Rangini *et al.* (2005) reported that yellow stem borer (YSB) infestation was extensively occurred early tillering to maximum tillering stage.

3.1.3. Leaf folder

In the present study, the number of leaf folder varied from 1.13 to 12.67 upon described treatments. Data revealed that the lowest number (1.13) of leaf folder was recorded from T5 (NPK @ 70, 50, 60 kg/ha) treatment, while the highest number (12.67) was observed from T7 (NPK @ 95, 50, 40 kg/ha) treatment. However, our result is not in conformity with the findings of de Kraker *et al.* (1996). He found that the average density of leaf folder larvae at the highest nitrogen level was eight times more than that at the zero-nitrogen level.

3.1.4. Rice hispa

The range of rice hispa was 1.13 to 3.27 for different levels of NPK fertilizers under the study. The lowest number (1.13) of rice hispa was recorded from T5 treatment (NPK @ 70, 50, 60 kg/ha) while the highest number (3.67) was observed from T7 treatment (NPK @ 95, 50, 40 kg/ha). Singh *et al*. (1990) in Punjab indicated that the NPK at 120:60:60 kg/ha increased the susceptibility of rice to infestation by rice hispa.

3.1.5. Brown plant hopper

The lowest number (1.93) of brown plant hopper was found from T5 (NPK @ 70, 50, 60 kg/ha) treatment, whereas the highest number (9.47) was recorded from T7 treatment (NPK @ 95, 50, 40 kg/ha). Madhuri (2016) reported that the lowest BPH population (2.87/hill) was found in control treatments which was devoid of all types of nutrients. Whereas, without micronutrients other treatments with only nitrogen produced higher incidence or in combination with boron, zinc etc caused lower incidence.

3.1.6. Green leaf hopper

In consideration of green leaf hopper, data revealed that the number of green leaf hopper in 5 selected hills vary from 2.47 to 11.67 for different levels of NPK fertilizers. The lowest number (2.47) of green leaf hopper was recorded from T5 treatment (NPK @ 70, 50, 60 kg/ha), while the highest number was observed from T7 (11.67) treatment (NPK @ 95, 50, 40 kg/ha). Dash *et al*. (2007) reported that the nutrient level 60:30:30 kg NPK with ZnSO4 recorded the lowest GLH population.

3.1.7. Rice bug

In case of rice bug, the numbers of rice bug differ from 1.73 to 8.60 per 5 selected hills due to different levels of NPK fertilizers. The lowest number (1.73) of rice bug was observed from T5 treatment (NPK @ 70, 50, 60 kg/ha), whereas the highest number (8.60) was found from T7 treatment (NPK @ 95, 50, 40 kg/ha). Mahadev *et al*. (1995) reported that the crop applied with N either alone or coupled with P exhibited a lower incidence of rice bug.

Table 1. Number of major insect pests during the growing period for different levels of NPK fertilizers

Treatment	Number of different insect pests in 5 selected hills						
	Yellow stem borer	Leaf folder	Rice hispa	Grasshopper	Brown plant hopper	Green leaf hopper	Rice bug
T0	7.67 b	10.27 b	3.27 b	11.13 b	7.27 b	9.27 b	6.33 b
T1	3.13 g	2.73 f	1.60 f	4.27 f	2.47 g	2.87 fg	2.60 f
T2	6.87 c	8.13 c	2.87 c	8.33 c	5.87 c	7.87 c	5.53 c
T3	6.33 d	7.33 d	2.47 d	6.33 d	5.33 d	6.13 d	4.80 d
T4	5.80 e	5.33 e	2.13 e	5.47 de	4.87 e	4.87 e	4.13 e
T5	1.67 h	1.13 g	1.13 g	3.33 g	1.93 h	2.47 g	1.73 g
T6	5.27 f	4.93 e	1.67 f	4.93 ef	4.27 f	3.07 f	3.80 e
T7	9.33 a	12.67 a	3.67 a	12.73 a	9.47 a	11.67 a	8.60 a
LSD(0.05)	0.470	0.751	0.293	0.899	0.467	0.522	0.495
CV(%)	4.65	6.52	7.07	7.26	5.13	4.95	6.04

T0 = Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2 = NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2. Infestation of rice by different insects and pests in different stages

3.2.1. Dead heart incidence by yellow stem borer at 25, 45 and 60 Days after transplanting

In case of incidence of dead heart, at 25 DAT, data recorded from each plot revealed that the lowest incidence of dead heart was observed from T5 (3.64%), while the highest incidence of dead heart was found from T7 (10.37%) treatment. At 45 DAT, from each plot it was revealed that the lowest incidence of dead heart was observed from T5 (4.23%), while the highest incidence of dead heart from T7 (13.56%) treatment. At 65 DAT, data recorded from each plot revealed that the lowest incidence of dead heart was observed from T5 (4.47%), while the highest incidence of dead heart was found from T7 (14.73%) treatment. In case of incidence of dead heart decrease/increase over control, the highest decrease was observed in T5 at 25, 45 and 60 DAT as -61.36, -59.17 and -59.58 respectively. On the other hand, the increase of dead heart incidence was found from T7 at 25,45 and 60 DAT as +10.08, +30.89 and +33.18 respectively. Ramzan *et al*. (1992) reported that high infestation of yellow stem borer is correlated with the high use of nitrogenous fertilizers in rice field.

Table 2. Incidence of rice yellow stem borer (dead heart) infestation for different levels of NPK fertilizers

Treatments	Incidence of rice yellow stem borer infestation (dead heart/plot) at different days after transplanting (DAT)					
	1st observation (25 DAT)		2nd observation (45 DAT)		3rd observation (65 DAT)	
	Dead heart (%)	Decrease/increase over control (%)	Dead heart (%)	Decrease/increase over control (%)	Dead heart (%)	Decrease/increase over control (%)
T0	9.42 b	--	10.36 b	--	11.06 b	--
T1	4.24 e	-54.99	5.16 e	-50.19	5.66 d	-48.82

T2	7.27 c	-22.82	8.47 c	-18.24	9.08 c	-17.90
T3	6.08 d	-35.46	6.24 d	-39.77	6.57 d	-40.60
T4	5.77 d	-38.75	5.96 de	-42.47	6.41 d	-42.04
T5	3.64 f	-61.36	4.23 f	-59.17	4.47 e	-59.58
T6	4.66 e	-50.53	5.48 de	-47.10	6.10 d	-44.85
T7	10.37 a	+10.08	13.56 a	+30.89	14.73 a	+33.18
LSD(0.05)	0.517	--	0.810	--	1.124	--
CV(%)	4.59	--	6.22	--	8.01	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2.2. White head incidence by yellow stem borer at 60, 70 and 80 DAT

In terms of white head incidence, at 60 DAT, 70 DAT and 80 DAT, data recorded from each plot revealed that the lowest incidence of white head was found from T5 (2.35%, 2.66% and 3.12% @ 95, 50 and 40 kg/ha), while the highest incidence of white head was observed from T7 (7.57%, 8.26% and 8.64% respectively) treatment. In case of incidence of white head decrease/increase over control, the highest decrease was observed in T5 at 60, 70 and 80 DAT as -54.19, -54.45 and -47.56 respectively. Whereas, the increase of white head incidence was found from T7 treatment at 60,70 and 80 DAT as +47.56, +41.44 and +45.21respectively. Chakraborty (2011) observed that incidence of white head (WH) was 206.72% higher than the control field when the field was fertilized by 140 kg N/ha.

Table 3. Incidence of rice yellow stem borer (white head) infestation for different levels of NPK fertilizers

Treatments	Incidence of rice yellow stem borer infestation (white head/plot) at different days after transplanting (DAT)					
	1st observation (60 DAT)		2nd observation (70 DAT)		3rd observation (80 DAT)	
	White head (%)	Reduction over control (%)	White head (%)	Reduction over control (%)	White head (%)	Reduction over control (%)
T0	5.13 b	--	5.84 b	--	5.95 b	--
T1	3.08 d	-39.96	2.97 e	-49.14	3.45 de	-42.02
T2	4.69 b	-8.58	5.16 b	-11.64	5.67 b	-4.71

T3	3.96 c	-22.81	4.06 c	-30.48	4.38 c	-26.39
T4	3.66 c	-28.65	3.83 cd	-34.42	4.08 c	-31.43
T5	2.35 e	-54.19	2.66 e	-54.45	3.12 e	-47.56
T6	3.19 d	-37.82	3.24 de	-44.52	3.99 cd	-32.94
T7	7.57 a	+47.56	8.26 a	+41.44	8.64 a	+45.21
LSD(0.05)	0.436	--	0.731	--	0.559	--
CV(%)	5.92	--	9.25	--	6.49	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2.3. Leaf folder incidence in leaf at 30, 45 and 60 DAT

In consideration of leaf folder incidence, at 30 DAT, 45 DAT and 60 DAT data recorded from each plot revealed that the lowest incidence of leaf folder was found from T5 (3.47%, 3.94% and 4.04% respectively), while the highest incidence of leaf folder was observed from T7 (8.05%, 8.56% and 9.18% respectively) treatment. In case of incidence of leaf folder decrease/increase over control, the highest decrease was observed in T5 at 30, 45 and 60 DAT as -43.30, -40.66 and -41.79 respectively. Whereas, the highest increase of leaf folder incidence was found from T7 treatment at 30, 45 and 60 DAT as +31.54, +28.92 and +32.28 respectively. Mahadev *et al*. (1995) reported that the crop applied with N either alone or coupled with P exhibited a lowered the incidence of leaf folder in rice field at vegetative stage.

Table 4. Incidence of leaf folder infestation for different levels of NPK fertilizers

Treatments	Incidence of leaf folder at different days after transplanting (DAT)					
	1st observation (30 DAT)		2nd observation (45 DAT)		3rd observation (60 DAT)	
	Leaf infestation (%)	Reduction over control (%)	Leaf infestation (%)	Reduction over control (%)	Leaf infestation (%)	Reduction over control (%)
T0	6.12 b	--	6.64 b	--	6.94 b	--
T1	3.84 ef	-37.25	4.56 e	-31.33	4.72 e	-31.99
T2	5.47 c	-10.62	5.93 c	-10.69	6.12 c	-11.82
T3	4.92 d	-19.61	5.34 d	-19.58	5.64 cd	-18.73

T4	4.57 d	-25.33	4.91 de	-26.05	5.23 de	-24.64
T5	3.47 f	-43.30	3.94 f	-40.66	4.04 f	-41.79
T6	4.05 e	-33.82	4.67 e	-29.67	4.91 e	-29.25
T7	8.05 a	+31.54	8.56 a	+28.92	9.18 a	+32.28
LSD(0.05)	0.403	--	0.502	--	0.643	--
CV(%)	4.57	--	5.15	--	6.29	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2.4. Brown plant hopper incidence at 35, 50 and 65 DAT

In consideration of brown plant hopper incidence, at 35 DAT, 50 DAT and 65 DAT data recorded from each plot revealed that the lowest incidence of brown plant hopper was found from T5 (4.23%, 4.55% and 4.78% respectively), while the highest incidence of brown plant hopper was observed from T7 (7.88%, 7.12% and 7.95% respectively) treatment. In case of incidence of BPH decrease/increase over control, the highest decrease was observed in T5 at 35, 50 and 65 DAT as -33.28, -26.14 and -29.50 respectively. Whereas, the highest increase of BPH incidence was found from T7 treatment at 35, 50 and 65 DAT as +24.29, +15.58 and +17.26 respectively. Similar findings also reported by Sarwar (2012) earlier.

Table 5. Incidence of brown plant hopper infestation for different levels of NPK fertilizers

Treatments	Incidence of brown plant hopper at different days after transplanting (DAT)					
	1st observation (35 DAT)		2nd observation (50 DAT)		3rd observation (65 DAT)	
	Tillers infestation (%)	Reduction over control (%)	Tillers infestation (%)	Reduction over control (%)	Tillers infestation (%)	Reduction over control (%)
T0	6.34 b	--	6.16 b	--	6.78 b	--
T1	4.78 cd	-24.61	4.94 de	-19.81	5.03 de	-25.81
T2	6.12 b	-3.47	5.78 bc	-6.17	6.14 bc	-9.44
T3	5.86 b	-7.57	5.56 bcd	-9.74	5.94 c	-12.39
T4	5.22 c	-17.67	5.34 cd	-13.31	5.78 c	-14.75
T5	4.23 d	-33.28	4.55 e	-26.14	4.78 e	-29.50

T6	4.93 c	-22.24	5.23 cde	-15.10	5.55 cd	-18.14
T7	7.88 a	+24.29	7.12 a	+15.58	7.95 a	+17.26
LSD(0.05)	0.578	--	0.726	--	0.667	--
CV(%)	5.69	--	7.26	--	6.22	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2.5. Green leaf hopper incidence at 35, 50 and 65 DAT

For green leaf hopper incidence, at 35 DAT, 50 DAT and 65 DAT, data recorded from each plot revealed that the lowest incidence of green leaf hopper was found from T5 (1.12%, 1.34% and1.56% respectively), whereas the highest incidence of green leaf hopper was observed from T7 (3.96%, 4.18% and4.34% respectively) treatment. In case of incidence of Green leaf hopper decrease/increase over control, the highest decrease was observed in T5 at 35, 50 and 65 DAT as -59.71, -54.73 and -50.16 respectively. Whereas, the highest increase of Green leaf hopper incidence was found from T7 treatment at 35, 50 and 65 DAT as +42.45, +41.22 and +38.66 respectively. Mahadev *et al*. (1995) reported that the crop applied with N either alone or coupled with P exhibited a higher degree of incidence of green leaf hopper.

Table 6. Incidence of green leaf hopper infestation for different levels of NPK fertilizers

Treatments	Incidence of green leaf hopper at different days after transplanting (DAT)					
	1st observation (35 DAT)		2nd observation (50 DAT)		3rd observation (65 DAT)	
	Leaf infestation (%)	Reduction over control (%)	Leaf infestation (%)	Reduction over control (%)	Leaf infestation (%)	Reduction over control (%)
T0	2.78 b	--	2.96 b	--	3.13 b	--
T1	1.58 f	-43.17	1.88 e	-36.49	1.94 d	-38.02
T2	2.59 bc	-6.83	2.78 bc	-6.08	2.97 b	-5.11
T3	2.24 cd	-19.42	2.46 cd	-16.89	2.81 b	-10.22
T4	2.03 de	-26.98	2.14 de	-27.70	2.45 c	-21.73
T5	1.12 g	-59.71	1.34 f	-54.73	1.56 e	-50.16
T6	1.84 ef	-33.81	1.94 e	-34.46	2.12 cd	-32.27

T7	3.96 a	+42.45	4.18 a	+41.22	4.34 a	+38.66
LSD(0.05)	0.380	--	0.367	--	0.332	--
CV(%)	9.51	--	8.53	--	6.94	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2.6. Rice hispa incidence in leaf at 25, 40 and 55 DAT

For rice hispa incidence, at 25 DAT, 40 DAT and 55 DAT data recorded from each plot revealed that the lowest incidence of rice hispa was found from T5 (1.15%, 1.46% and1.66% respectively), whereas the highest incidence of rice hispa was observed from T7 (4.86%, 5.14% and 5.83% respectively) treatment. In case of incidence of Rice hispa decrease/increase over control, the highest decrease was observed in T5 at 25, 40 and 55 DAT as -63.72, -58.87 and -56.08 respectively. Whereas, the highest increase of Rice hispa incidence was found from T7 treatment at 25, 40 and 55 DAT as +53.31, +44.79 and +54.23 respectively. Pathak and Ram (1999) reported that minimum rice hispa incidence in control plots and enhanced doses of N resulted in significant increase in rice hispa incidence in rice field.

Table 7. Incidence of rice hispa infestation for different levels of NPK fertilizers

Treatments	Incidence of rice hispa at different days after transplanting (DAT)					
	1st observation (25 DAT)		2nd observation (40 DAT)		3rd observation (55 DAT)	
	Leaf infestation (%)	Reduction over control (%)	Leaf infestation (%)	Reduction over control (%)	Leaf infestation (%)	Reduction over control (%)
T0	3.17 b	--	3.55 b	--	3.78 b	--
T1	1.90 e	-40.06	1.67 g	-52.96	1.86 f	-50.79
T2	2.89 bc	-8.83	3.03 c	-14.65	3.25 c	-14.02
T3	2.56 cd	-19.24	2.74 d	-22.82	2.85 d	-24.60
T4	2.34 d	-26.18	2.43 e	-31.55	2.67 d	-29.37
T5	1.15 f	-63.72	1.46 g	-58.87	1.66 f	-56.08
T6	1.85 e	-41.64	2.05 f	-42.25	2.24 e	-40.74
T7	4.86 a	+53.31	5.14 a	+44.79	5.83 a	+54.23
LSD(0.05)	0.443	--	0.254	--	0.355	--
CV(%)	9.80	--	5.26	--	6.69	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

3.2.7. Rice bug incidence at 45, 55 and 65 DAT

In case of rice bug incidence, at 45 DAT, 55 DAT and 65 DAT data recorded from each plot revealed that the lowest incidence of rice bug was found from T5 (1.78%,1.96% and 2.04% respectively), while the highest incidence of rice bug was observed from T7 (4.22%,4.75% and 5.08% respectively) treatment. In case of incidence of Rice bug decrease/increase over control, the highest decrease was observed in T5 at 45, 55 and 65 DAT as -48.85, -46.30 and -46.60 respectively. Whereas, the highest increase of Rice bug incidence was found from T7 treatment at 45, 55 and 65 DAT as +21.26, +30.14 and +32.98 respectively. Mahadev *et al*. (1995) reported that NPK @ 80,40,40 exhibited a lower incidence of rice bug than control absolute treatment.

Table 8. Incidence of rice bug infestation for different levels of NPK fertilizers

Treatments	Incidence of rice bug at different days after transplanting (DAT)					
	1st observation (45 DAT)		2nd observation (55 DAT)		3rd observation (65 DAT)	
	Panicle infestation (%)	Reduction over control (%)	Panicle infestation (%)	Reduction over control (%)	Panicle infestation (%)	Reduction over control (%)
T0	3.48 b	--	3.65 b	--	3.82 b	--
T1	2.15 e	-38.22	2.22 ef	-39.18	2.45 e	-35.86
T2	3.14 bc	-9.77	3.42 bc	-6.30	3.68 bc	-3.66
T3	2.95 cd	-15.23	3.13 bcd	-14.25	3.34 cd	-12.57
T4	2.84 cd	-18.39	2.97 cd	-18.63	3.12 d	-18.32
T5	1.78 e	-48.85	1.96 f	-46.30	2.04 f	-46.60
T6	2.56 d	-26.44	2.64 de	-27.67	2.67 e	-30.10
T7	4.22 a	+21.26	4.75 a	+30.14	5.08 a	+32.98
LSD(0.05)	0.403	--	0.514	--	0.367	--
CV(%)	7.66	--	9.14	--	6.19	--

In a column, numeric data represents the mean value of 3 replications; each replication is derived from each plot of each treatment

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

T0= Untreated control, no NPK fertilizers
T1 = NPK @ 45, 50, 40 kg/ha
T2= NPK @ 70, 25, 40 kg/ha
T3 = NPK @ 70, 50, 20 kg/ha
T4 = NPK @ 70, 50, 40 kg/ha
T5 = NPK @ 70, 50, 60 kg/ha
T6 = NPK @ 70, 75, 40 kg/ha
T7 = NPK @ 95, 50, 40 kg/ha

4. CONCLUSION

Considering the above finding it is revealed that if the nitrogen dose increases, the incidence of insect pest also increased. In the term of percent of infestation, NPK @ 70, 50, 60 kg/ha (T5) was the better for the incidence of insect pest. However, imbalanced nutrition like 95 kg nitrogen, 50 kg phosphorus and 40 kg potassium incited more insect incidence, whereas balanced nutrients resulted in lower incidence of insect pests. Moreover, it is seen that increased dose of potassium has experienced less insect infestation. Among the different levels of NPK fertilizers, NPK @ 70, 50, 60 kg/ha was the better for the rice cultivation. Considering the situation of the present experiment, further studies in the following areas may be suggested: Different pest management practices and rice variety may be use in future study. This experiment should be carried out in different agro-ecological zones AEZ) of Bangladesh for confirmation of the results.

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