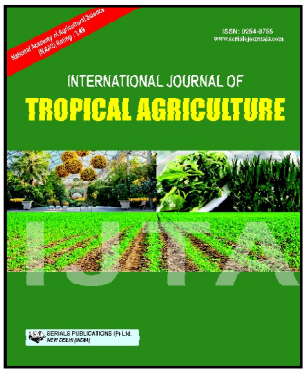

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Effect of Integrated Application of Inorganic Nitrogen Fertilizer in Combination with Organic Sources on Incidence of Rice Pests

S. K. Nayak* and A. Nayak

Regional Research and Technology Transfer Station (OUAT), Bhawanipatna, Kalahandi – 766001, Odisha, India
** College of Agriculture, Bhawanipatna*

Abstract: Field experiment was conducted at Regional Research and Technology Transfer Station, Bhawanipatna, Kalahandi, Odisha during *kharif* 2014-15 in randomized block design with three replications and seven treatments combination. Significant difference was recorded in different organic and inorganic treatments combination of N-fertilizer in the incidence of leaffolder, brown plant hopper and whorl maggot. The plots received the organic source of nutrients (FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5 kg ha^{-1}) recorded lowest incidence of leaffolder, brown plant hopper and whorl maggot compared to both purely inorganic and combination of organic and inorganic nitrogen fertilizer sourses. The percent increase of leaffolder, BPH and whorl maggot was 220.00, 326.76 and 147.72% in purely nitrogen fertilizer sourse treatment [Recommended Dose of Fertilizer, (RDF 120:60:60 N_2, P_2O_5, K_2O) with 1/3rd N at transplanting (Tp)+ 1/3rd at T (Tillering stage)] + 1/3rd at PI (Panicle initiation) compared to organic treatment plots. The nitrogen fertilizer curtail in T2 (50%) and T3 (25%) w.r.t RDF (T1) treated plots the % leaffolder, BPH and whorl maggot infestation was decrease. Application of 5t FYM along with N_2 fertilizer at recommended dose of fertilizer (RDF) with 1/4th at transplanting, 1/2 at tillering and 1/4th at panicle initiation stage is the best one with respect to low incidence of leaffolder, brown planthopper, whorl maggot with higher natural enemies and grain yield.

***Key words*:** Rice, FYM, N-fertilizer, leaf folder, BPH and Whorl Maggot

Rice is the staple food in Odisha. Leaf folder (*Cnephalocrosis medinalis)*, Brown plant hopper (*Nilaparvata lugens*) and Whorl maggot (*Hydrilla phillipina*) are major insect pests during *Kharif* rice in the western undulating zone of Odisha and one of the factor in grain yield loss. Nitrogen is an inevitable

nutrient for the rice plant growth and development. However, indiscriminate use of nitrogenous fertilizers leading to development of several problems like decline in soil organic matter, increase in salinity and severe attack of pest and diseases (Chakraborthi and Singh, 2004).

Judicious and integrated application of inorganic N_2 fertilizer in relation to paddy growth stage can suppress the pest incidence (Bhaskaran *et al.*, 2009). Balanced uses of nutrients through organic sources are the pre-requisites to sustain soil fertility and to produce the maximum crop yield with optimum input level (Dahiphale *et al.,* 2003). Therefore, optimization of management practices to increase field N efficiency in rice production with lower insect pests load is urgently required. Keeping this point in view the present study was under taken to study the effect of integrated application of inorganic N_2 fertilizer in combination with organic source of N_2 fertilizer at different stages of crop growth on incidence of rice leaf folder, brown plant hopper and whorl maggot.

MATERIALS AND METHODS

Field experiment was conducted at Regional Research and Technology Transfer Station, (RRTTS) Bhawanipatna, Kalahandi, Odisha during *kharif* 2014-15 in randomized block design with three replications and seven treatments combination *viz.* T1: Recommended Dose of Fertilizer, (RDF 120:60:60 N_2, P_2O_5, K_2O) with 1/3rd N at transplanting (Tp)+ 1/3rd at tillering (T) + 1/3rd at PI (Panicle initiation) , T2: 5t FYM + 50% RDF with 1/3rd N_2 at Tp+ 1/3rd N_2 at T +1/3rd N_2 at PI , T3: 5t FYM + 75% RDF with 1/3rd N_2 at Tp + 1/3rd N_2 at T + 1/3rd N_2 at PI, T4: 5t FYM + RDF with 1/3rd N_2 at Tp + 1/3rd N_2 at T +1/3rd N_2 at PI, T5: 5t FYM + RDF with 1/2 N_2 at Tp+ 1/4th N_2 at T +1/4th N_2 at PI, T6: 5t FYM+ RDF with 1/4th N_2 at Tp + 1/2 N_2 at T + 1/4th N_2 at PI, and T7: FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5 kg ha^{-1}.

Rice hybrid Ajaya of twenty one days old seedlings were transplanted during 2nd week of August, 2014 in plot size of 10m x 7m with a spacing of 25 cm X 25 cm. FYM, Vermicompost, Azospirillum and PSB were applied before transplanting of rice crop as per treatments. Full doses of phosphorous and potassium were applied as basal before transplanting (TP) and nitrogen as per treatments. Normal agronomic practices were followed to raise the crop and without any insecticidal treatment. The populations of hoppers (adults and nymphs) and natural enemies (spiders, *Epilachana* beetles, ground beetles and rove beetles) were recorded by sampling 10 randomly selected hills from each plot at 10 days interval. The data on percentage leaf damage due to leaf folder and whorl maggot were assessed by counting the total number and infested leaves on 10 randomly selected hills in each plot. The grain yield per plot was recorded and computed on hectare basis. Finally the data generated were subjected to statistical analysis after necessary transformation for comparison study.

RESULTS AND DISCUSSION

Leaf folder: The leaf folder incidence in different organic and inorganic treatment combination of N-fertilizer revealed a significant difference between treatments and the leaf infestation ranged from 0.65 to 4.37% (Table 1). The plot which received the organic source of nutrients (T7: FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5 kg ha^{-1}) recorded lowest incidence (1.0%) of leaf folder followed by the combination treatments of organic and inorganic viz., T2 (5t FYM + 50% RDF with 1/3rd N_2 at Tp+ 1/3rd N_2 at T +1/3rd N_2 at PI) (1.70 %/hill) i.e, 1.79%. The % leaf infestation rcorded was highest (3.20%) in T1(Recommended Dose of Fertilizer, (RDF 120:60:60 N_2, P2O5, K2O) with 1/3rd N_2 at transplanting (Tp)+ 1/3rd at T (Tillering stage) + 1/3rd at PI (Panicle initiation)) followed by T4 (5t FYM + RDF with1/3rd N_2 at Tp + 1/3rd N_2 at T +1/3rd

Table 1
Effect of integrated application of inorganic N_2 fertilizer in combination with organic source on incidence of leaf folder during *Kharif* 2014.

Treatments	*Leaf damage (%)*						*% Increase infestation over organic treatment*
	40 DAT	*50 DAT*	*60 DAT*	*70 DAT*	*80 DAT*	*Mean*	
T1: Recommended Dose of Fertilizer, (RDF 120:60:60 N_2, P_2O_5, K_2O) with 1/3rd N at transplanting (Tp)+ 1/3rd at T (Tillering stage) + 1/3rd at PI (Panicle initiation)	3.74 (11.14)	3.45 (10.69)	4.37 (12.06)	2.51 (9.11)	1.94 (7.97)	3.20	220.00
T2: 5t FYM + 50% RDF with 1/3rd N_2 at Tp+ 1/3rd N_2 at T +1/3rd N_2 at PI	2.40 (8.93)	2.25 (8.62)	1.39 (6.76)	2.02 (8.17)	0.90 (5.42)	1.79	79.00
T3: 5t FYM + 75% RDF with 1/3rd N_2 at Tp + 1/3rd N_2 at T + 1/3rd N_2 at PI	2.71 (9.46)	1.22 (6.33)	1.70 (7.47)	2.62 (9.26)	2.30 (8.71)	2.11	111.00
T4: 5t FYM + RDF with1/3rd N_2 at Tp + 1/3rd N_2 at T +1/3rd N_2 at PI	3.83 (11.30)	1.92 (7.95)	2.36 (8.81)	2.61 (9.26)	2.91 (9.71)	2.73	173.00
T5: 5t FYM + RDF with1/2 N_2 at Tp+ 1/4th N_2 at T +1/4th N_2 at PI	3.58 (10.90)	1.90 (7.89)	2.93 (9.76)	1.78 (7.60)	2.05 (8.18)	2.45	145.00
T6: 5t FYM+ RDF with1/4th N_2 at Tp + 1/2 N_2 at T + 1/4th N_2 at PI	2.19 (8.49)	2.17 (8.32)	2.02 (7.73)	1.82 (7.68)	1.33 (6.52)	1.91	91.00
T7: FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5kg ha^{-1}	1.72 (7.53)	0.65 (4.61)	1.02 (5.77)	0.90 (5.44)	0.73 (4.91)	1.00	
Mean	2.84	1.93	2.33	1.90	1.61		
CD (0.05%)	0.700	1.165	1.743	0.897	2.126		

Data in parenthesis are the angular transformed value

N_2 at PI) and T5 (5t FYM + RDF with1/2 N_2 at Tp+ 1/4th N at T +1/4th N at PI) *i.e,* 2.73 and 2.45% respectively. Prsesnt study also indicated that the the mean leaf folder % damage was highest (2.84%) at 40 DAT compared to fag end of the crop *i.e* 80 DAT (1.61%).

The per cent increase infestation of leaf in the inorganic treatment (T1) is 220%, where as in the combination of organic and inorganic treatment it varied from 79 to 173%, compared to organic treatment (T7). The per cent increase of leaffolder incidence was recorded lowest (79%) inT2 (5t FYM + 50% RDF with 1/3rd N_2 at Tp+ 1/3rd N_2 at T +1/3rd N_2 at PI) and followed by T_6 (91.0%) which received 5t FYM+ RDF with1/4th N_2 at Tp + 1/2 N_2 at T + 1/4th N at PI. The % decrease of leaf folder infestation in T2 (50%) RDF and T3 (75% RDF) was 44% and 34% respectively w.r.t. T1 (100 RDF).

Brown planthopper: Brown plant hopper differs significantly in different treatments and the BPH population varies from 0.53 to 4.40 Nos/ hill

during the study period (Table 2). The organic treatment T7 (FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5kg ha^{-1}) recorded lowest number (0.71 nos/hill) of BPH followed by T2 (5t FYM + 50% RDF with $1/3^{rd}$ N_2 at Tp+ $1/3^{rd}$ N_2 at T +$1/3^{rd}$ N_2 at PI) and T3 (5t FYM + 75% RDF with $1/3^{rd}$ N_2 at Tp + $1/3^{rd}$ N_2 at T + $1/3^{rd}$ N_2 at PI) i.e, 1.52 and 1.89 nos/hill respectively. Lowest number of BPH population was recorded in organic treated plot (0.71 nos/hill) compared to inorganic treated plot T1 (3.03 nos/hill) which is 326.76% increase of BPH population. The % decrease of BPH population was 50% (T2) and 38% (T3) where there was cut off 50 and 25% nitrogenous fertilizer respectively compared to T1 (100% RDF). BPH population was low in organic plots compared to inorganic plots and also combination of organic and inorganic sources N-treated plots. Present investigation also indicates that the mean BPH population recorded was more at mid crop growth period *i.e*, 70 DAT (2.61 nos/hill).

Whorl maggot: Presesnt study revealed a significant difference in % whorl maggot damaged

Table 2
Effect of integrated application of inorganic N fertilizer in combination with organic source of N_2 fertilizer on incidence of BPH and grain yield during *Kharif* 2014.

Treatments	*Nos. of BPH/hill*			*Mean*	*%Increase of BPH over organic treatment (%)*	*Grain yield (q/ha)*	*Increase in grain yield over organic treatment (%)*
	60 DAT	*70 DAT*	*80 DAT*				
T1: Recommended Dose of Fertilizer, (RDF 120:60:60 N_2, P_2O_5, K_2O) with $1/3^{rd}$ N at transplanting (Tp)+ $1/3^{rd}$ at T (Tillering stage) + $1/3^{rd}$ at PI (Panicle initiation)	1.50 (1.58)	4.40 (2.32)	3.20 (2.04)	3.03	326.76	47.40	13.49
T2: 5t FYM + 50% RDF with $1/3^{rd}$ N_2 at Tp+ $1/3^{rd}$ N_2 at T +$1/3^{rd}$ N_2 at PI	1.00 (1.41)	1.90 (1.97)	1.67 (1.63)	1.52	114.08	51.70	26.32
T3: 5t FYM + 75% RDF with $1/3^{rd}$ N_2 at Tp + $1/3^{rd}$ N_2 at T + $1/3^{rd}$ N_2 at PI	1.90 (1.70)	2.00 (1.10)	1.77 (1.66)	1.89	166.19	60.40	49.60
T4: 5t FYM + RDF with$1/3^{rd}$ N_2 at Tp + $1/3^{rd}$ N_2 at T +$1/3^{rd}$ N_2 at PI	2.00 (1.73)	3.9 (2.43)	2.00 (1.73)	2.63	270.42	69.00	69.84
T5: 5t FYM + RDF with$1/2$ N_2 at Tp+ $1/4^{th}$ N_2 at T +$1/4^{th}$ N_2 at PI	1.60 (1.61)	3.83 (2.19)	2.50 (1.87)	2.64	271.83	67.50	65.16
T6: 5t FYM+ RDF with$1/4^{th}$ N_2 at Tp + $1/2$ N_2 at T + $1/4^{th}$ N_2 at PI	1.80 (1.67)	2.93 (2.22)	2.47 (1.85)	2.40	238.03	75.40	82.19
T7: FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5kg ha^{-1}	0.80 (1.34)	0.80 (1.67)	0.53 (1.24)	0.71		41.80	
Mean	1.48	2.61	1.98				
CD (0.05%)	0.161	0.224	0.277			4.00	

Data in parenthesis are the square root transformed value

leaves between the treatments. The % leaf damage by whorl maggot range from 0.18 - 1.78/hill during the study period (Table-3).The mean % whorl maggot damaged leaves was highest (1.09/hill) in purely inorganic treated plot T1 (Recommended Dose of Fertilizer, (RDF 120:60:60 N_2, P_2O_5, K_2O) with 1/3rd N at transplanting (Tp)+ 1/3rd at T (Tillering stage) + 1/3rd at PI) and was lowest (0.44/ hill) in organic treated plots T7 (FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5kg ha^{-1}). Lowest % increase of whorl maggot was recorded in T3 (40.90%) followed by T2 (56.81%), the treatments where there was cut off 25 and 50% nitrogenous fertilizer compared to Organic treatment (T1). The mean % leaf damage by whorl maggot also indicated the damage was more in the early crop growth period of rice indicating whorl maggot is an early pest of rice.

Natural enemies: The number of natural enemies (spiders, *Epilachana* beetles, ground beetles and rove beetles) recorded was highest (2.50 nos/ hill) in organic treatment, T7 (FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5 kg ha^{-1}) followed by T6, 5t FYM+ RDF with 1/4th N_2 at Tp + 1/2 N_2 at T + 1/4th N_2 at PI (2.10 nos/hill) and T4, 5t FYM + RDF with1/3rd N_2 at Tp + 1/3rd N_2 at T +1/3rd N_2 at PI (1.90 nos/hill) (Table 3). However only inorganic fertilizer applied treatment T1 (RDF 120:60:60 N_2, P_2O_5, K_2O) with 1/3rd N_2 (Tp)+ 1/3rd at T + 1/3rd at PI) the natural enemies population was lowest (0.70 nos/ hill) followed by combination of inorganic and organic treatment plots *i.e*, T3, 5t FYM + 75% RDF with 1/ 3rd N_2 at Tp + 1/3rd N_2 at T + 1/3rd N_2 at PI (0.85 no/hill).

Grain Yield: The grain yield (75.4q/ha) was significantly higher in T_6 receiving combination of organic and inorganic treatment (Table 2). The lowest grain yield (41.8 q/ha) was recorded in plot receiving the organic source of nutrients (T_7). The % increase of yield in T6 (5t FYM+ RDF with 1/4th N_2 at Tp + 1/2 N_2 at T + 1/4th N_2 at PI) was highest (82.19%) compared to organic treatment (FYM 5 t ha^{-1} + vermicompost 2.5 kg ha^{-1} + Azospirillum 5 kg ha^{-1} + PSB 5 kg ha^{-1}). Additional higher nitrogen supply by fertilization during maximum growth period of crop plants might have favored the higher nitrogen uptake by crop plants for higher yield and was agreement with Patel and Thakur, 1997 and Kaushal *et. al*, 2010.

Present study clearly indicates that the application of 5t FYM along with N_2-fertilizer at recommended dose of fertilizer (RDF) with 1/4th at transplanting, ½ at tillering and 1/4th at panicle initiation stage is the best one with respect to lower incidence of leaf folder, brown plant hopper, whorl maggot and higher grain yield. Chau and Heong (2005) also found that manure and organic fertilizers are more effective than chemical fertilizer to induce rice plant growth and tolerance to insect pests and diseases. This might be due to application of ½ RDF N_2-fertilizer at tillering by which the root proliferation of plant is more for maximum utilization of N-fertilizer and the plants becomes more hardy for herbivores attack and was aggregement with Qiao-gang et al., 2013, that key period for nitrogen absorption by rice plants is from tillering to flowering, during this period the absorption of soil nitrogen is at its maximum rate.

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