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Effect of Organic Manures and Fertilizers on Incidence of Brown Planthopper (*Nilaparvata Lugens*), Predators and Grain Yield Of Rice (*Oryza Sativa* L.)

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Abstract: A field study was conducted during *kharif* and *rabi* seasons for five continuous years from 2006-07 to 2010-11 to evaluate the influence of different organic and inorganic nutrient management practices on brown planthopper (BPH) incidence and grain yield in rice. Treatments included untreated control, 100% recommended fertilizer dose (RDF), farmyard manure (FYM) @ 10 t ha^{-1}, green manuring, green manuring + 50% N as top dressing, and poultry manure @ 2 t ha^{-1}. Observations on BPH and predatory arthropods (spiders and mirid bugs) at 50 and 70 days after transplanting (DAT), and grain yield were recorded in both the seasons. High nitrogen treatments (100% RDF and green manuring + 50% N) supported higher BPH populations and mirid bug abundance, whereas organic manures reduced BPH incidence while maintaining moderate predator populations. Grain yield was highest under 100% RDF, followed by green manuring + 50% N; organic manures produced moderate but stable yields. Integrated nutrient management combining organic amendments with reduced chemical fertilization is recommended to sustain productivity while enhancing natural pest regulation.

Keywords: Rice, Organic manures, BPH, Predators, Grain yield, INM.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple food crops, feeding more than half of the global population and serving as a vital source of livelihood for millions of smallholder farmers (FAO, 2023). However, rice production is severely constrained by the infestation of various insect pests, particularly the brown planthopper (BPH), *Nilaparvata lugens* Stål and this pest alone causes a yield loss ranged from 20-80 per cent (Min *et al.*, 2014). The wide spread use of chemical fertilizers and pesticides, while initially enhancing yields, has led to ecological imbalances, pest resurgence, resistance development, and environmental degradation (Savary *et al.*, 2019).

In recent years, there has been a growing emphasis on organic nutrient management as part of sustainable and eco-friendly rice production systems. Organic manures such as farmyard manure, compost, vermicompost, and green manures not only improve soil fertility and microbial activity but also influence the population dynamics of insect pests and their natural enemies (Yadav *et al.*, 2020). Several studies have suggested that organically managed rice fields often

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experience lower pest incidence compared to conventionally fertilized systems, possibly due to improved soil health, balanced plant nutrition, and enhanced activity of natural enemies (Dutta *et al.*, 2019).

Despite increasing evidence on the ecological benefits of organic nutrient management, information on its specific influence on insect pest incidence in rice under field conditions remains limited and is location-specific. Therefore, the present investigation was undertaken to assess the influence of different nutrient management practices, including organic manures and chemical fertilizers, on BPH population dynamics and grain yield in Godavari delta of Andhra Pradesh over multiple seasons as it is the major pest of the region.

MATERIALS AND METHODS

The field experiments were conducted during *kharif* and *rabi* seasons for five continuous years from 2006-07 to 2010-11 except *rabi* 2009-10 at A.P. Rice Research Institute and Regional Agricultural Research Station, Maruteru. The soils of the Godavari delta are primarily alluvial soils, which are highly fertile. The experiment was laid out in a Randomized Block Design (RBD) with six treatments and four replications. The treatments consisted of different organic manures and chemical fertilizers applied individually or in combination, as follows:

Tr. No.	*Particulars of treatments*
1.	Untreated control without any fertilizers
2.	100% Recommended fertilizer dose (RDF) *Kharif*: 60:40:30 NPK kg ha^{-1} *Rabi*: 120:60:40 NPK kg ha^{-1}
3.	Farm yard manure (FYM) @ 10 t/ha
4.	Green manuring alone (*Calotropis gigantea* leaves)
5.	Green manuring + 50% N as top dressing in two splits
6.	Poultry manure @ 2 t/ha

The plot size of 20 m^2 with 30 cm bunds were maintained per each treatment per replication and separated from each other by one meter spacing so as to prevent water movement from one plot to another. A susceptible rice variety, Swarna (MTU 7029) and IR 64 was transplanted at a spacing of 20 × 15 cm and 15 × 15 cm in *kharif* and *rabi* seasons respectively with two seedlings per hill. Organic manures were applied 15 days before transplanting and incorporated into the soil. Chemical fertilizers were applied as per the recommendation. All the recommended agronomic practices for rice cultivation were followed, excluding nutrient and pest management. Observations on the population of both nymphs and adults of brown planthopper (BPH) were recorded from 20 randomly selected hills per plot twice at 50 and 70 days after transplanting (DAT). Similarly, the populations of spiders and mirid bugs were recorded and their peak incidence was reported in the results.

Grain yield was recorded from the net plot area and expressed as kg ha^{-1}. The data on brown planthoppers and predators were transformed to square root values. The collected data on pest, predator's incidence and yield were subjected to analysis of variance (ANOVA) (Gomez and Gomez, 1984). Treatment means were compared using LSD (Least Significant Difference) at 5% level of significance. The per cent increase in yield over control in various treatments was calculated by using the following formula.

$$\textit{Percent increase of yield in treatment over control} = \frac{\textit{Yield in treatment} - \textit{Yield in control}}{\textit{Yield in control}} \times 100$$

RESULTS AND DISCUSSION

Effect on BPH incidence

***Kharif*:** The population of brown planthopper in rice varied significantly among the nutrient management treatments during most of the *kharif* seasons (2006–2010) and at different crop growth stages (50 and 70 DAT) (Table 1). During 2006, the lowest BPH population (146.25 and 156.25 hoppers/20 hills at 50 and

70 DAT, respectively) was recorded in the untreated control without fertilizers, whereas green manuring alone and 100% RDF recorded relatively higher hopper populations (203.00 and 341.00 hoppers/20 hills at 50 and 70 DAT, respectively). In 2007, the BPH incidence increased markedly across treatments, with the maximum population recorded in the green manuring + 50% N top dressing treatment (1187.5 and 2856.0 hoppers/20 hills), followed by green manuring alone 100% RDF recorded relatively higher hopper populations (771.25 and 1416.25 hoppers/20 hills) at 50 and 70 DAT, respectively. Significantly lowest BPH populations were observed in the control (128.00 and 561.75 hoppers/20 hills at 50 and 70 DAT, respectively).

During 2008, the trend was similar, green manuring and its combination with inorganic nitrogen recorded higher BPH populations, while the control and poultry manure treatments recorded the lowest pest incidence. During 2009, although differences were not statistically significant at 50 DAT, significant variation was observed at 70 DAT, with the lowest population in untreated control without fertilizers, (470 hoppers/20 hills) and the highest in 100% RDF (701 hoppers/20 hills). During 2010, all treatments showed a general decline in BPH infestation compared to earlier years and the differences were not significant at 70 DAT. The untreated control without any fertilizers and poultry manure plots recorded the lowest pest numbers (65 and 88 hoppers/20 hills at 50 DAT respectively), whereas the 100% RDF treatment recorded significantly higher populations (350 hoppers/ 20 hills).

***Rabi*:** Compared with *kharif* seasons the BPH populations were lower during *rabi* seasons. The population of BPH in rice varied significantly among the nutrient management treatments during most of the *rabi* seasons (2006–2010) and at different crop growth stages (50 and 70 DAT) (Table 2). During *Rabi* 2006–07, the significantly lowest BPH population was recorded in the untreated control without fertilizers with 19.75 and 39.25 hoppers/20 hills at 50 and 70 DAT, respectively, followed by farmyard manure and poultry manure treatments. Significantly highest BPH incidence was recorded in plots that received 100% RDF with 42.75 and 228.25 hoppers/hill at 50 and 70 DAT, respectively. In *Rabi* 2007–08, the untreated control without fertilizers again recorded the least BPH incidence (14.25 and 9.75 hoppers/ 20 hills at 50 and 70 DAT), whereas the 100% RDF (75 No. s/20 hills) and green manuring + 50% N top dressing recorded a significantly higher population (741.75 hoppers/ 20 hills) at 50 and 70 DAT respectively.

During *Rabi* 2008–09, the BPH population was significantly lower in untreated control without any fertilizers and green manuring treatments (67.0 and 90.88 hoppers/20hills; 66.50 and 132.65 hoppers/20 hills at 50 and 70 DAT, respectively), while the 100% RDF again showed the highest incidence (158.25 and 383.25 hoppers/20 hills). In *Rabi* 2010–11, the differences among treatments were not significant at 50 DAT, but significant differences were observed at 70 DAT. The untreated control without fertilizers recorded the lowest incidence (32.0 hoppers/ 20 hills), while the 100% RDF recorded the highest (660.0 hoppers/20 hills).

Overall, the results clearly revealed that the application of organic manures such as FYM, green manure, and poultry manure resulted in significantly lower BPH incidence compared to inorganic fertilizer application.

Effect on incidence of predators (spiders and mirid bugs)

***Kharif*:** The population of natural enemies such as spiders and mirid bugs was influenced by different organic manurial treatments across the *Kharif* seasons from 2006 to 2010 (Table 3). During *Kharif* 2006, variations among treatments were not significant for either spiders or mirid bugs. The mean spider population ranged from 18.75 to 26.25 per 20 hills, with the highest numbers recorded in poultry manure @ 2 t/ha. Mirid bug populations varied between 82.5 and 113.25 per 20 hills, being numerically higher in FYM and 100% recommended fertilizer dose treatments. In *Kharif* 2007, significant differences were observed among treatments for both spiders and mirid bugs. The highest spider population was recorded in green manuring + 50% N as top dressing (23.50 per 20 hills) followed closely by poultry manure (20.25). Mirid bugs were most abundant in green manuring + 50% N as top dressing (414.25 per 20 hills) and 100% recommended fertilizer dose (343.25 per 20 hills), while the untreated control without fertilizers showed the lowest (176.0 per 20 hills).

During *Kharif* 2008, the spider population did not differ significantly among treatments, though slightly higher values were recorded in FYM and poultry manure plots. However, mirid bug incidence differed significantly, being highest in green manuring + 50% N top dressing (105.25 per 20 hills), and lowest in poultry manure (56.50 per 20 hills). In *Kharif* 2009, both spider and mirid bug populations varied significantly among treatments. The highest spider numbers were found in 100% RDF (16.75 per 20 hills) and poultry manure (14.50 per 20 hills). Mirid bugs were again more abundant in 100% recommended fertilizer (180.75 per 20 hills), whereas green manuring + 50% N as top dressing recorded the lowest population (78.25 per 20 hills). During *Kharif* 2010, treatment effects were non-significant for mirid bugs. Spider populations ranged from 9.75 to 21.25 per 20 hills, and highest numbers were observed in green manuring alone (21.25 per 20 hills) and 100% RDF (21.0 per 20 hills).

***Rabi*:** The population of natural enemies such as spiders and mirid bugs varied among the different organic manurial treatments during the Rabi seasons from 2006–07 to 2010–11 (Table 4). During *Rabi* 2006–07, the population of spiders was not significantly affected by treatments. In contrast, mirid bug incidence differed significantly among treatments, being highest in 100% RDF (132.75 per 20 hills) and lowest in poultry manure (44.50 per 20 hills). In *Rabi* 2007–08, both spider and mirid bug populations showed significant differences. The highest spider population was recorded in green manuring + 50% N as top dressing (17.75 per 20 hills), followed by 100% RDF (14.75 per 20 hills). Similarly, mirid bugs were most abundant in green manuring + 50% N as top dressing (66.75 per 20 hills), whereas untreated control without fertilizers and FYM treatments maintained negligible numbers (1.25 and 1.00 per 20 hills, respectively).

During *Rabi* 2008–09, spider populations did not differ significantly among treatments. However, mirid bugs showed significant variation, being highest in green manuring + 50% N as top dressing (92.25 per 20 hills), followed by 100% RDF (84.25 per 25 hills), while the lowest incidence was in poultry manure (54.25 per 20 hills). In *Rabi* 2010–11, significant differences were observed for both spiders and mirid bugs. The maximum spider population was recorded in green manuring + 50% N as top dressing (19.3 per 20 hills), followed by 100% RDF (18.8 per 20 hills). The lowest spider count was in the untreated control without fertilizers (6.5 per 20 hills). Mirid bug incidence was highest in 100% RDF (189.8 per 20 hills), while FYM and poultry manure recorded relatively lower numbers (25.3 and 25.5 per 20 hills, respectively).

Overall, organically manured plots (FYM, green manure, poultry manure) generally supported moderate spider populations and lower mirid bug abundance, while inorganic fertilizer treatments tended to increase mirid bug incidence. This indicates that organic nutrient management helps maintain a more balanced predator–prey relationship, contributing to the natural regulation of pest populations in the rice ecosystem.

Effect on grain yield

The grain yield of rice was significantly influenced by the different organic and inorganic nutrient management practices during all the five cropping seasons (2006–07 to 2010–11) under both *kharif* and *rabi* conditions (Table 5). Compared to *rabi* season the grain yields in different organic manure plots were higher in *kharif* season. During 2006–07, the highest grain yield was recorded in plots supplied with FYM @ 10 t ha^{-1} (4561 kg ha^{-1}) in *kharif* and 100% RDF (5405 kg ha^{-1}) in *rabi*, while the lowest yields were observed in the 100% recommended fertilizer dose and untreated control without fertilizers (3753 and 2551 kg ha^{-1} in *kharif* and *rabi*, respectively).

In 2007–08, highest grain yield was observed in untreated control without fertilizers (6238 kg ha^{-1}) during *kharif* and in green manuring + 50% N as top dressing and 100% RDF (4843 and 4657 kg ha^{-1}) during *rabi*. During *kharif* 2008–09, the yield advantage of 100% RDF was again evident (7196 kg ha^{-1}), significantly surpassing all organic manure treatments. Among the organic sources, green manuring (6673 kg ha^{-1}), FYM (6429 kg ha^{-1}) and poultry manure (6128 kg ha^{-1}) recorded significantly higher grain yields than the untreated control without any fertilizers (5293 kg ha^{-1}). During *rabi* 2008–09, green manuring + 50% N as top dressing and (4960 kg ha^{-1}) recorded significantly highest yield.

During *kharif* 2009–10, all the organic and inorganic treatments except untreated control without any fertilizers (3499 kg ha^{-1}) recorded at par yields. During 2010–11, the highest *kharif* yield was obtained from 100% RDF (5627 kg ha^{-1}), followed closely by green manuring + 50% N (5532 kg ha^{-1}), while the untreated control produced the least (4739 kg ha^{-1}). In *rabi*, green manuring + 50% N and 100% RDF again recorded significantly highest yields (5536 and 5039 kg ha^{-1}, respectively).

Overall mean grain yield trends across years (table 6) indicated that during *kharif* seasons there was no significant differences between organic manures and chemical fertilizers. However, 100% RDF recorded 11% yield increase over untreated control without fertilizers, followed by FYM. During *rabi*, the overall mean grain yields indicated that the differences among the treatments were significant. Green manuring + 50% N (4987 kg ha^{-1}) and 100% RDF (4842 kg ha^{-1}) applied plots recorded significantly highest grain yields with 96 and 90 per cent yield increase over untreated control without any fertilizers. The overall mean grain yields in both the seasons also indicate the same. Whereas the lowest yields were recorded in the untreated control. However, among the organic manures, poultry manure @ 2 t ha^{-1} and FYM @ 10 t ha^{-1} showed moderate but stable yields across years, reflecting their potential for sustaining productivity under organic management.

The findings clearly demonstrate that nutrient management practices significantly influence both BPH population dynamics and grain yield in rice. Continuous use of 100% recommended fertilizer dose (T-) or green manuring + 50% N as top dressing in two splits (T-) favoured higher BPH buildup, possibly due to increased nitrogen availability and succulent plant growth. In contrast, balanced organic nutrient management (T-, T-, T-) supported a more stable ecosystem with reduced pest pressure. High nitrogen application has long been associated with increased BPH abundance, as it enhances plant succulence and amino acid content, favouring planthopper multiplication (Sogawa *et al*., 2015 and Singh *et al*., 2017). In contrast, organic nutrient sources such as FYM and poultry manure release nitrogen slowly, maintain balanced plant growth, and produce tougher plant tissues with lower soluble nitrogen content, reducing planthopper survival and fecundity (Yamasaki *et al*., 2003). The relatively lower BPH incidence under poultry manure and FYM treatments may also be attributed to improved soil microbial activity

Table 1: Effect of organic manuring and nutrient management on incidence of brown planthoppers in rice (*Kharif* 2006 to 2010)

Tr. No.	2006		2007		2008		2009		2010	
	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	**50 DAT**	**70 DAT**
1.	146.25 (12.06)	156.25 (12.31)	128.00 (11.27)	561.75 (23.66)	104.0 (10.19)	81.25 (8.96)	372.0 (19.2)	470.0 (21.7)	65.0 (8.0)	29.0 (5.4)
2.	189.00 (13.72)	341.00 (18.28)	462.00 (21.48)	1416.25 (37.59)	351.00 (18.72)	102.00 (10.09)	744.0 (26.9)	701.0 (26.4)	350.0 (18.6)	36.0 (6.0)
3.	182.75 (13.51)	276.50 (16.54)	590.00 (24.24)	1014.0 (31.81)	204.00 (14.22)	68.50 (8.25)	493.0 (21.9)	577.0 (23.7)	111.0 (10.5)	47.0 (6.8)
4.	203.00 (14.20)	225.75 (14.92)	771.25 (27.76)	1090.0 (33.00)	283.25 (16.81)	63.75 (7.97)	548.0 (23.4)	500.0 (22.3)	204.0 (14.2)	40.0 (6.3)
5.	132.00 (11.44)	194.25 (13.92)	1187.5 (34.43)	2856.0 (53.39)	473.00 (21.74)	91.00 (9.50)	534.0 (23.0)	452.0 (21.3)	77.0 (8.7)	31.0 (5.5)
6.	158.25 (12.56)	194.50 (13.64)	823.50 (28.65)	953.25 (30.84)	189.00 (13.71)	68.25 (8.25)	538.0 (23.0)	681.0 (26.0)	88.0 (8.7)	35.0 (5.9)
F test	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig	Sig	NS
CD	1.85	4.07	7.18	2.73	1.67	1.0	-	3.99	2.60	--
CV (%)	8.23	15.64	20.13	5.17	6.99	7.53	12.99	9.72	12.92	--

Values in parentheses are square root transformed

Table 2: Effect of organic manuring on incidence of brown planthoppers during *Rabi* 2006-07 to 2010-11

Tr. No.	2006-07		2007-08		2008-09		2010-11	
	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT	50 DAT	70 DAT
1.	19.75 (4.44)	39.25 (6.12)	14.25 (3.76)	9.75 (3.09)	67.0 (8.12)	90.88 (9.53)	10.0 (3.2)	32.0 (5.6)
2.	42.75 (6.47)	228.25 (14.62)	75.00 (8.62)	397.50 (19.88)	158.25 (12.51)	383.25 (19.56)	12.0 (2.8)	660.0 (24.0)
3.	26.75 (5.12)	71.25 (8.39)	17.50 (4.15)	11.00 (3.30)	66.50 (8.15)	132.65 (11.51)	14.0 (3.3)	68.0 (7.9)
4.	24.5 (4.91)	55.25 (7.37)	28.50 (5.33)	26.08 (5.08)	109.25 (10.44)	226.50 (15.04)	22.0 (4.5)	496.0 (22.2)
5.	34.5 (5.87)	107.00 (10.14)	58.25 (7.61)	741.75 (27.18)	137.0 (11.62)	333.38 (18.25)	33.0 (5.7)	455.0 (20.9)
6.	28.75 (5.35)	70.50 (8.25)	12.25 (3.50)	4.50 (2.03)	69.75 (8.32)	158.75 (12.59)	21.0 (4.5)	44.0 (6.6)
F test	Sig	Sig	Sig	Sig	Sig	Sig	NS	Sig
CD	1.15	3.95	0.82	1.80	1.81	0.87	-	1.61
CV (%)	12.30	24.82	9.94	11.85	12.18	12.99	3.47	36.37

Values in parentheses are square root transformed

Table 3: Effect of organic manuring on incidence of natural enemies during *Kharif* 2006 to 2010

Tr. No.	2006		2007		2008		2009		2010	
	Spiders	Mirid bugs	Spiders	Mirid bugs	Spiders	Mirid bugs	Spiders	Mirid bugs	Spiders	Mirid bugs
1.	21.00 (4.53)	82.50 (8.99)	12.25 (3.45)	176.0 (13.22)	9.75 (3.12)	70.75 (8.41)	9.50 (3.08)	140.75 (11.86)	10.00 (3.15)	8.50 (2.91)
2.	22.25 (4.70)	112.25 (10.59)	17.50 (4.18)	343.25 (18.46)	8.50 (2.92)	82.0 (9.04)	16.75 (4.09)	180.75 (13.44)	21.00 (4.58)	12.25 (3.49)
3.	23.00 (4.79)	113.25 (10.63)	17.00 (4.08)	213.25 (14.26)	13.25 (3.64)	71.75 (8.46)	12.75 (3.57)	122.25 (11.05)	13.00 (3.60)	12.50 (3.53)
4.	22.50 (4.72)	101.00 (10.04)	16.50 (4.03)	246.0 (15.60)	11.00 (3.32)	80.00 (8.93)	10.75 (3.28)	114.75 (10.71)	21.25 (4.60)	11.25 (3.33)
5.	18.75 (4.32)	95.50 (9.77)	23.50 (4.84)	414.25 (20.30)	12.00 (3.46)	105.25 (10.26)	12.00 (3.46)	78.25 (8.83)	9.75 (3.11)	10.75 (3.27)
6.	26.25 (5.07)	95.00 (9.62)	20.25 (4.48)	221.75 (14.69)	12.25 (3.50)	56.50 (7.50)	14.50 (3.81)	157.50 (12.55)	12.00 (3.44)	11.25 (3.35)
F test	NS	NS	Sig	Sig	NS	Sig	Sig	Sig	Sig	NS
CD	-	-	0.81	3.06	-	0.76	0.30	0.70	0.46	-
CV (%)	12.27	10.71	12.90	12.62	14.2	5.72	4.82	3.54	7.07	9.38

Values in parentheses are square root transformed

Table 4: Effect of organic manuring on incidence of natural enemies during *Rabi* 2006-07 to 2010-11

Tr. No.	*2006-07*		*2007-08*		*2008-09*		*2010-11*	
	Spiders	*Mirid bugs*	*Spiders*	*Mirid bugs*	*Spiders*	*Mirid bugs*	*Spiders*	*Mirid bugs*
1.	19.00 (4.35)	53.25 (7.29)	7.0 (2.62)	1.25 (1.10)	19.25 (4.38)	48.25 (6.93)	6.5 (4.3)	18.8 (4.3)
2.	22.25 (4.72)	132.75 (11.52)	14.75 (3.83)	30.0 (5.47)	19.5 (4.41)	84.25 (9.16)	18.8 (2.7)	189.8 (13.1)
3.	21.50 (4.63)	78.5 (8.83)	7.0 (2.59)	1.0 (0.85)	18.75 (4.32)	51.75 (7.19)	7.3 (4.0)	25.3 (5.0)
4.	18.25 (4.26)	62.00 (7.84)	5.5 (2.33)	4.0 (1.97)	20.50 (4.53)	70.75 (8.4)	16.0 (4.3)	130.5 (11.4)
5.	21.75 (4.66)	115.25 (10.63)	17.75 (4.21)	66.75 (8.17)	20.50 (4.51)	92.25 (9.58)	19.3 (3.3)	115.5 (10.7)
6.	19.00 (4.36)	44.50 (6.66)	8.0 (2.80)	0.0 (0.0)	18.25 (4.26)	54.25 (7.35)	11.0 (8.9)	25.5 (5.0)
F test	NS	Sig	Sig	Sig	NS	Sig	Sig	Sig
CD	-	1.72	0.53	0.67	-	0.98	0.81	3.43
CV (%)	5.46	11.23	10.03	13.19	5.91	8.0	10.20	23.87

Values in parentheses are square root transformed

Table 5: Effect of organic manuring grain yield during *Kharif* and *Rabi*, 2006 to 2010

Tr. No.	*2006-07*		*2007-08*		*2008-09*		*2009-10*	*2010-11*	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Kharif*	*Rabi*
1.	4211	2551	6238	2474	5293	1924	3499	4739	3230
2.	3753	5405	5565	4657	7196	4268	4488	5627	5039
3.	4561	3494	5353	3565	6429	2934	3958	5258	3653
4.	3872	3921	4837	3203	6673	3962	3992	5074	3726
5.	4406	4608	4525	4843	5309	4960	4020	5532	5536
6.	3955	2883	5672	2753	6128	3282	4070	5407	4053
F test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
CD	314	328	492	317	357	371	623	505	1148
CV (%)	4.38	4.95	6.08	5.85	3.78	6.93	8.95	5.51	15.69

Table 6: Overall mean effect of organic manuring on grain yield during *Kharif* and *Rabi* seasons

Tr. No.	*Kharif (2006-10)*		*Rabi (2006-07 to 10-11)*		*Overall*	
	Mean	*% IOC*	*Mean*	*% IOC*	*Mean*	*% IOC*
1.	4796	---	2545	---	3671	---
2.	5326	11	4842	90	5084	38.51
3.	5112	7	3412	34	4262	16.11
4.	4890	2	3703	46	4297	17.05
5.	4758	-1	4987	96	4873	32.75
6.	5046	5	3243	27	4145	12.91
F test	NS	---	Sig	---	---	---
CD	---	---	655	---	---	---
CV (%)	10.17	---	9.93	---	---	---

IOC: Increase over control

and enhanced natural enemy abundance, both of which are promoted by organic management (Settle *et al*., 1996; Gurr *et al*., 2004; Gurr *et al*., 2011). Organic manures also improve silicon availability, which strengthens plant cell walls and imparts resistance against sap-sucking pests (Han *et al*., 2004).

Year-to-year variation in BPH population can be attributed to changes in climatic factors, natural enemy abundance, and soil nutrient status. However, the consistent pattern across years suggests that integrating organic nutrient sources, particularly poultry manure or FYM, can significantly reduce BPH incidence compared to nitrogen-rich inorganic fertilization. These results emphasize that integrated nutrient management (INM), combining organic and inorganic sources judiciously, can help optimize yield while minimizing pest risk. Long-term adoption of organic amendments such as poultry manure and FYM contributes not only to sustained productivity but also to the natural regulation of BPH populations, supporting the goals of sustainable and eco-friendly rice cultivation.

CONCLUSIONS

The study demonstrates that nutrient management practices strongly influence both brown planthopper (BPH) incidence and grain yield in rice. High nitrogen inputs, such as 100% RDF and green manuring + 50% N top dressing, consistently enhanced grain yield but also promoted higher BPH populations. Conversely, organic manures, particularly poultry manure @ 2 t ha^{-1} and FYM @ 10 t ha^{-1}maintained moderate yet stable yields while significantly suppressing BPH incidence. These findings highlight a clear trade-off between maximizing yield and minimizing pest incidence. Adoption of integrated nutrient management (INM), combining organic amendments with reduced chemical fertilization, can optimize productivity, enhance ecological balance, and reduce pest pressure, contributing to sustainable rice production.

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