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Incidence of insect pests of rice as affected by organic and inorganic fertilizers

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Abstract

A field study was conducted to assess the effect of organic manures on the incidence of insect pest on rice. Recommended dose of chemical fertilizers were applied as a check. The experiment was set out in a randomized block design (RBD) with seven treatments comprising 15 t/ha of FYM, 7.5 t/ha of vermicompost, 2 t/ha of neemcake, 4 t/ha of poultry manure, 12 t/ha of pressmud, 3 t/ha of karanj cake and Recommended Dose of Fertilizers (RDF). Each treatment was replicated four times. Organically manured plots showed significant ($P < 0.05$) decrease in gallmidge and leaf folder incidence compared with the check. The gallmidge incidence was ranged from 6.61 to 9.25% with the organic treatments and 12.94% with the check. The leaf folder incidence was ranged from 11.75 to 13.46% with the organic treatments and 22.70 with the check. The natural enemy populations significantly ($P < 0.01$) increased with organic treatments compared with the check. The natural enemy population was ranged from 21.5 to 23.5 per hill with the organic treatments and 14.75 per hill with the check. Gross yield was also significantly highest in karanj cake and FYM amended plots (7119 and 6651 kg/ha, respectively) compared with RDF amended plots (6485).

Keywords: Insect pest, rice, FYM, neem cake, poultry manure, karanj cake

Introduction

In developing countries where the population is on the increase, improved technologies including the rational use of fertilizers employed to meet the food requirement of the people [1]. However, in long-term cropping systems extensive use of inorganic fertilizers leads to increased soil erosion, soil compaction, environmental pollution, public health risk, reduced crop yields, nutrient imbalance, and increase in the incidence of insect pests [2]. Excessive nitrogen applications can also lead to pest problems by increasing the reproductive rate, longevity and overall fitness to certain agricultural pests [3]. However, with organic fertilizers, soil fertility is usually maintained and there is also improvement in the physical and biological properties of the soil [4]. We also have know that the capacity of a resistant plant to insect pests and diseases is strictly related to optimal physical, chemical and mainly biological characteristics of soils. Soil fertility practices can impact the physiological susceptibility of crop plants to insect pests by either affecting the resistance of individual plant to attack or by altering plant acceptability to certain herbivores. Some studies have also documented how the shift from organic soil management to chemical fertilizers has increased the potential of certain insects and diseases to cause economic losses.

The understanding of these interactions between organic fertilizers and insect pests becomes the basis for design of the sustainable rice production system. Therefore the study was conducted to evaluate the effect of different organic manures in comparison with NKP fertilizers on insect pest attack on rice under pesticide-free conditions.

Materials and Methods

The study was carried out in an irrigated rice field ecosystem at Agricultural Research Station, Nellore, Andhra Pradesh during kharif season for two years (2014–2015 to 2015–2016) to compare the influence of organic fertilizers and chemical fertilizers on the incidence of insect pests, natural enemies and yield. The experiment was laid out in a randomized block design with seven treatments each with four replications having a single plot area of 25 m² and a total plot size of 700 m². The test variety was BPT 5204. The treatments included: Farm Yard Manure (FYM), Vermicompost, Neem cake, Poultry manure, Pressmud, Karanj cake and Recommended Dose of Fertilizers (RDF) at 100-60-40 kg N, P₂O₅ and K₂O/ha through urea,

single super phosphate and muriate of potash, respectively. Nitrogen was given in three equal splits at basal, maximum tillering and panicle initiation stages. P as basal while K at basal and at panicle initiation stage. The doses of organic amendments were adjusted to give recommended levels of nitrogen on dry weight basis, while the phosphorous and potassium levels were kept constant. Organic manures were incorporated one day before transplanting rice. There was no application of insecticides in the experimental plots, need based application plant protection sprays were given with 5% Neem Seed Kernel Extract (NSKE). All other cultural practices were as per standard recommendations. The same set of seven treatments were repeated in the permanent laid out plots over five years, from 2011-12 to 2015-16. And in this paper I have presented two years data i.e. 2014-15 and 2015-16.

The data were recorded for the incidence of insect pests like stem borer, gall midge, rice hispa, leaf folder and predator populations of spiders, coccinellids, and mirid bugs. The stem borer incidence was assessed by counting total number of tillers and number of dead hearts on 20 hills per plot and also total panicle bearing tillers and white ears prior to harvest to assess percent white ears. The extent damage by gall midge was assessed by counting the total number of tillers and number of galls per 20 plants per plot. The leaf damage by leaf folder and whorl maggot was assessed by counting the total number of leaves and number of damaged leaves on 20 hills per plot.

The data collected were subjected to analysis of variance (ANOVA) using SPSS 13.0 and treatment means were separated by Least Significant Difference test (LSD) at 5% level of probability.

Results and Discussion

Insect pests

Gall midge

The study revealed that the Gall midge was the key pest observed in all treatments followed by leaf folder, stem borer and rice hispa. Gall midge, *Orseolia oryzae* Wood-Mason incidence was significantly differed among the seven treatments (Table) where the per cent gall midge incidence was ranged from 6.61% - 12.94%. Lowest per cent gall midge incidence was observed in vermicompost treated plots (6.61%) and highest was with recommended dose of fertilizers. Gall midge incidence was reduced by 50% in plots applied vermicompost, Neem cake, Poultry manure and pressmud when compared with RDF. The gall midge incidence was reduced by 38% and 29% in plots applied karanj cake and FYM respectively, as compared to RDF.

Leaf folder

Leaf folder incidence was significantly differed among organic treated plots and RDF. Percent leaf folder incidence was ranged from 11.75 – 22.70% where the lowest per cent leaf folder incidence was recorded with vermicompost (11.75%) and highest percent leaf folder incidence was recorded with RDF (22.7%). Leaf folder incidence was reduced by 48% in plots treated with vermicompost and pressmud when compared to RDF. Plots treated with FYM, Neem cake and poultry manure recorded 46% less leaf folder incidence compared with RDF. Leaf folder incidence reduced by 41% in plots applied karanj cake as compared to RDF. Highest incidence of gall midge and leaf folder in RDF plots could be attributed to inorganic fertilization resulting in fast

rate of release of nitrogen creating an imbalance which decreases the plants ability to resist insect pest infestation and attack. This agrees with the report of ^[5] that chemical fertilizers could dramatically influence the balance of nutritional elements in plants and it is likely that excess use would create nutrient imbalance which in turn could reduce resistance to insect pests. Van Embden ^[6] and Mattson ^[7] also reported that many of the factors influencing plants susceptibility to pests and diseases do so through their effect on plant nitrogen metabolism and that growth and fecundity of insects are commonly stimulated by high levels of free amino acids and insufficient potassium predisposing them to attack. In contrast, organic practices promote and increase of soil organic matter and microbial activity and slower/gradual release of plant nutrients which does not lead to enhanced N levels in plant tissues. This is supported by the findings of ^[8, 9, 10]. Organic practices can also provide supplies of secondary and trace elements, which can stimulate resistance to insect attack ^[11, 12] stated that organic crops have shown more tolerance to insect attacks and organic rice is reported to have thicker cell wall and lower levels of free amino acids than conventional rice.

Stem borer and Rice hispa

Stem borer incidence was not significantly differed among treatments, however the dead heart incidence was ranged from 4.24 – 5.16%. Lowest per cent dead hearts were observed with RDF (4.24%) which was on par with the FYM, vermicompost and karanj cake treated plots.

Rice hispa incidence was differed significantly among treatments. Lowest per cent hispa incidence (3.44%) was noticed in plots treated with RDF which was at par with the neem cake treated plots (3.83%). Chitra Shanker ^[13] also reported lowest per cent dead hearts in Neem cake treated plots which were at par with the RDF plots. In contrast, lowest incidence of stem borer in organics compared to inorganics was reported by several workers ^[14]. Reported that the white ears and dead hearts in rice were slightly more in Inorganic treatment compared to organics. Out breaks of stem borer in rice crop was reported to be low with organics compared to synthetic inorganic fertilizers ^[15]. However, in this study as the incidence of stem borer and rice hispa is very low concrete conclusions could not be drawn.

Natural enemies

The population of natural enemies viz., spiders, coccinellids and mirid bugs ranged from 14.75 to 23.5 per hill. Highest (23.5) natural enemy population was recorded in plots treated with karanj cake followed by plots treated with poultry manure (23.0). The lowest (14.75) natural enemy population was recorded in plots treated with Recommended dose of Fertilizers. The present study revealed that organic manures have a positive impact on predatory diversity in rice fields and is beneficial to the restoration of natural enemies and improvement of the ecological environment ^[14]. Also reported more natural enemies population in organic treatments compared to Inorganics ^[16]. Reported higher natural enemies in the naturally grown rice than conventional rice.

Yield

Yield under various organic treatments and RDF differ significantly, and the highest yield (7119 kg/ha) was recorded in plots applied with Karanj cake which was at par with the FYM (6651 Kg/ha) amended plots. Yield from vermicompost,

Neem cake, Poultry manure, press mud and RDF amended plots on par with each other.

Lower yields in plots treated with organic amendments (except with karanj cake) compared to RDF was also

explained by [17, 18] who reported that 20-30% less yield of crops in organic farming. However, yield reduction have been recorded in organically manured plots by previous workers.

Table 1: Incidence of insect pest on organic manured rice

Treatments	Gall midge (% DT)	Stem borer (% Dead hearts)	Rice hispa (%DL)	Leaf folder (% DL)	No.of natural enemies/hill	Yield (Kg/ha)
T1: FYM	9.25 ^c	14.40	4.68 ^b	12.27 ^a	21.75 ^b	6651 ^{ab}
T2: Vermicompost	6.61 ^a	13.57	5.34 ^d	11.75 ^a	22.75 ^b	6271 ^a
T3: Neem cake	6.71 ^a	14.50	3.83 ^a	12.32 ^a	22.00 ^b	6180 ^a
T4: Poultry manure	7.30 ^a	15.17	5.51 ^d	12.06 ^a	23.00 ^b	6520 ^a
T5: Pressmud	6.73 ^a	14.60	5.46 ^d	11.82 ^a	21.50 ^b	6222 ^a
T6: Karanj cake	7.93 ^b	15.93	4.92 ^c	13.46 ^a	23.50 ^b	7119 ^b
T7: Rec. Dose of Fertilizers	12.94 ^d	16.40	3.44 ^a	22.70 ^b	14.75 ^a	6485 ^a
Sig.	*	NS	*	**	**	*
P-value	.012	.606	.024	.000	.000	.018

NS: Not significant, *Significant at p=0.05

Numbers followed by different letter in superscript are significantly different at p=0.05

Table 2: Fertilizer doses amended in soil

Treatments	% N	Amount applied (tones ha ⁻¹)
FYM	0.75	15
Vermicompost	1.5	7.5
Neem cake	6.5	2
Poultry manure	3	4
Pressmud	1	12
Karanj cake	4	3.0
Rec. Dose of Fertilizers	46	0.16

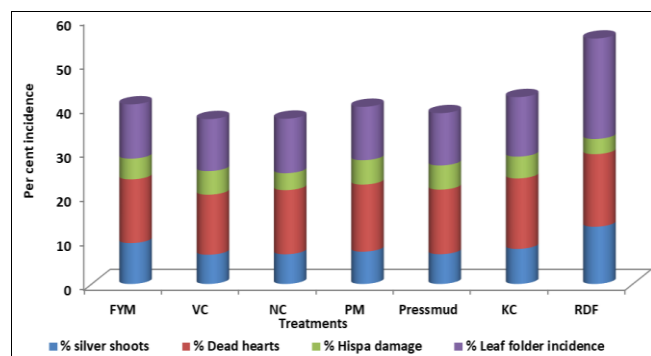


Fig 1: Incidence of insect pests of rice grown on organic manures and chemical fertilizer amended soils

Conclusion

Organic manures are essential for establishing and maintaining optimum soil physical and nutrient status which are important for plant growth. Organic manures are relatively cheap, effective and good source of nitrogen for sustainable crop production. It has also been shown that adding various organic manures to soil can suppress insect pest populations and damage to plants growing in amended soils. Therefore organic manures can be said to be the best management system for increasing soil fertility, vigorous rice growth and reduced insect pest incidence. Further application of organic manures has sound effect to protect natural enemies under field conditions. With organic fertilizers obtained the same yield as compared to chemical fertilizers by lowering unfilled grains and increasing weight of grains.

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