Response of paddy to optimizing yield and reducing chemical cost through organic practices

Objective: To identify the most efficient and economically viable organic treatment for kharif paddy cultivation.

Introduction:

Rice (Oryza sativa L.) is the most important staple food crop of India, providing food security and livelihood to a major portion of the population. Kharif paddy occupies a significant area in the country and contributes substantially to national food production. However, the continuous and excessive use of chemical fertilizers over the years has resulted in deterioration of soil health, reduced nutrient-use efficiency, increased cost of cultivation, and environmental pollution. These challenges have emphasized the need for adopting sustainable and eco-friendly nutrient management practices for maintaining productivity of rice cultivation in the long run.

Organic farming has emerged as a promising alternative system that focuses on the use of natural nutrient sources to improve soil fertility, crop productivity, and ecological balance. The application of organic manures and biofertilizers enhances soil organic carbon, microbial activity, and nutrient availability, thereby improving crop growth and yield. Organic nutrient sources such as farmyard manure (FYM), vermicompost, castor cake and biofertilizer like azotobacter & PSB have gained importance due to their ability to supply macro- and micronutrients in a slow and sustained manner and improve soil physical and biological properties.

The integration of biofertilizers such as azotobacter and phosphorus-solubilizing bacteria (PSB) further supports nutrient availability by enhancing biological nitrogen fixation and increasing phosphorus solubility in soil. Vermicompost is known for improving soil structure and supplying readily available nutrients, while FYM and castor cake contributes to organic matter buildup and microbial diversity.

Experimental Details:

Crop	:	Rice
Variety	:	Ratnagiri-8
Experiment Layout	:	RBD
No. of Replications	:	Three
Spacing	:	20 cm x 15 cm
Plot size	:	3.60 m X 4.40 m
Date of TP	:	14/07/2024

T1- 100% RDN through FYM + 2 lit. Azotobacter + 2 lit. PSB

T2- 100% RDN through Vermicompost + 2 lit. Azotobacter + 2 lit. PSB

T3- 100% RDN through Castor cake + 2 lit. Azotobacter + 2 lit. PSB

T4- 50% RDN through FYM + 25% RDN through Vermicompost + 25% RDN through Castor cake

T5- 33% RDN through FYM + 33% RDN through Vermicompost + 33% RDN through Castor cake

T6- INM (40:20 NP kg/ha + 2 lit. Azotobacter + 2 lit. PSB)

T7- RDF through chemical fertilizers

Methodology:

The field experiment was conducted during the **Kharif season of 2024–25** at the **ASPEE Agricultural Research & Development Foundation Farm**, Village Nare, Taluka Wada, District Palghar, Maharashtra. The experimental area represents a **coastal agro-climatic zone** characterized by high rainfall during the monsoon period and moderately fertile soil conditions, which are suitable for lowland rice cultivation.

The experiment was laid out in a **Randomized Block Design (RBD)** with **three replications** to minimize the effect of soil heterogeneity and enhance the precision of treatment comparisons. A total of **seven treatments** comprising different organic nutrient sources were randomly allotted within each replication. Each individual plot measured **3.60 m × 4.40 m**, with appropriate bunds and irrigation channels maintained to avoid nutrient movement across plots.

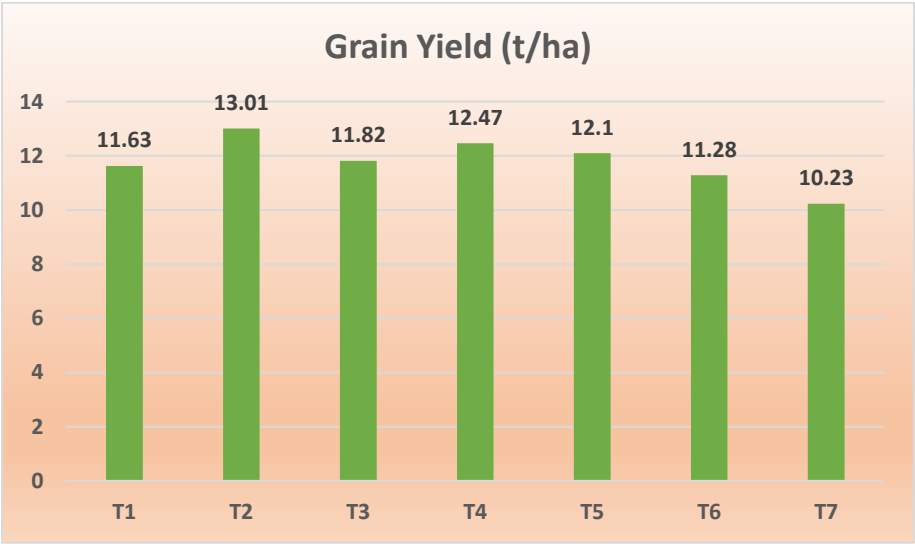
Seeds were treated with **Thiram @ 3 g kg^{-1} seed** to protect against seed-borne diseases. The treated seeds were sown in a raised nursery bed and maintained under standard nursery management practices. **Twenty-five day old healthy seedlings** were selected for transplanting into the main field. Transplanting was carried out on **14th July 2024** at a spacing of **20 cm × 15 cm**, ensuring uniformity across all treatments to avoid plant competition effects. **Two seedlings per hill** were transplanted manually in puddled conditions. All cultural practices such as manual weeding, pest management through organic methods, and other agronomic operations were carried out uniformly across all plots to ensure unbiased comparison of treatment effects. Observations were recorded on important growth, yield, and soil parameters. The recorded data were subjected to **Analysis of Variance (ANOVA)** as per the Randomized Block Design to test significance among treatment means. Critical difference (CD) at **5% probability level** was calculated to compare treatment effects where differences were statistically significant.

Layout:

Results:

The experiment showed clear variation among treatments in their effect on growth and yield of rice crop. Among all seven treatments, **T_2 – 100% RDN through vermicompost + Azotobacter @ 2 l/ha + PSB @ 2 l/ha** recorded the best performance and resulted in superior plant growth and yield compared to other organic combinations and chemical fertilizer treatment. It was observed and recorded that in treatment T_2 the higher number of tillers per plant (12.93), number of panicles per plant (10), length of panicle (25.12 cm), seeds per panicle (251.87), test weight (21.05g), grain (13.01 t/ha) and straw (19.39 t/ha) yield.

Graph:



Conclusion:

The study concluded that nutrient management practices significantly influenced the growth and yield of rice. Application of **100% RDN through vermicompost along with Azotobacter and PSB (T_2)** was found to be the most effective treatment and produced the highest crop performance. Hence,

vermicompost integrated with biofertilizers can be recommended as a sustainable and efficient nutrient management approach for rice cultivation under similar agro-climatic conditions.