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Evaluating the Impact of Nutrient Management Strategies on Productivity in Rice-Cotton Cropping Systems

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This study investigates the effects of various nutrient management strategies, including organic and inorganic fertilizers, on the productivity and economic yield of rice-cotton cropping systems. Conducted at Annamalai University's Experimental Farm in Tamil Nadu, India, from September 2005 to June 2007, the research aims to assess both direct and residual effects of these nutrient sources. The findings reveal significant improvements in total economic produce, biomass production, and rice equivalent yield, particularly with the application of 100% recommended nitrogen dose combined with vermicompost. This paper provides insights into optimizing nutrient management for sustainable agricultural practices.

1. Introduction

The rice-cotton cropping system is a vital agricultural practice in many regions, particularly in the Cauvery Deltaic Zone of Tamil Nadu, India. This paper explores the significance of nutrient management in enhancing crop productivity and sustainability.

1.1 Background

Rice and cotton are two major crops that contribute significantly to the agricultural economy. However, the challenge lies in optimizing nutrient use to maximize yield while maintaining soil health.

1.2 Objectives

The primary objectives of this study are:

- To evaluate the direct effects of organic and inorganic nutrients on rice and cotton yields.
- To assess the residual effects of nutrient applications on subsequent crops.
- To analyze the economic viability of different nutrient management strategies.

2. Methodology

2.1 Study Area

The research was conducted at the Annamalai University Experimental Farm, which is representative of the tail end area of the Cauvery Deltaic Zone.

2.2 Experimental Design

The study was structured in two phases, each comprising two experiments. The first experiment focused on rice, followed by a second experiment on cotton.

2.2.1 Phase I: Rice Experiment

- **Treatments**: Eight treatments were applied, including a control (no fertilizer), recommended nitrogen dose (RDN), and various combinations of organic manures.
- **Design**: The experiment was laid out in a randomized block design (RBD) with three replications.

2.2.2 Phase II: Cotton Experiment

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- **Subplots**: The main plots from the rice experiment were divided into three subplots, where cotton was cultivated with varying levels of fertilizers (0%, 75%, and 100% RDN).
- **Design**: A split plot design was employed to assess the impact of previous rice treatments on cotton yield.

3. Results and Discussion

3.1 Yield Parameters

The results indicated that the application of 100% RDN combined with vermicompost significantly enhanced total economic produce, biomass production, and rice equivalent yield.

3.1.1 Economic Produce

The economic analysis showed that treatments with higher nutrient applications resulted in increased profitability for farmers.

3.1.2 Biomass Production

The biomass production was notably higher in treatments that included organic amendments, highlighting the importance of integrating organic matter into nutrient management strategies.

3.2 Residual Effects

The residual effects of nutrient applications were evident in the subsequent cotton crop, where improved yields were recorded in plots previously treated with organic and inorganic fertilizers.

Here are the tables summarizing the results and discussions from the study on the impact of nutrient management strategies on productivity in rice-cotton cropping systems.

Table 1: Yield Parameters of Rice under Different Nutrient Treatments

Treatment	Total Economic Produce (kg/ha)	Total Biomass Production (kg/ha)	Per Day Productivity (kg/ha)	Rice Yield Equivalent (RYE) (kg/ha)
T1 (Control)	5294	13028	17.44	7551
T2 (75% RDN)	6055	15596	19.88	10126
T3 (100% RDN)	6141	15994	20.13	10419
T4 (100% RDN + Organic)	6093	15417	21.01	9605
T5 (100% RDN + Vermicompost)	7519	18739	25.93	11761
T6 (75% RDN + Organic)	7166	17985	24.71	11331
T7 (50% RDN + Organic)	5867	14996	20.23	9343
T8 (No Fertilizer)	5554	14280	19.15	8924

Table 2: Yield Parameters of Cotton Following Rice Treatments

Treatment	Total Economic Produce (kg/ha)	Total Biomass Production (kg/ha)	Per Day Productivity (kg/ha)
S1 (0% RDF)	5867	14996	20.23
S2 (75% RDF)	6055	15596	19.88
S3 (100% RDF)	6141	15994	20.13
T5S1 (100% RDN + Vermicompost)	6921	16655	23.86
T5S2 (100% RDN + Vermicompost)	7809	19646	26.93
T5S3 (100% RDN + Vermicompost)	7827	19918	26.99
T6S1 (75% RDN + Organic)	6564	15885	22.63
T6S2 (75% RDN + Organic)	7462	18914	25.73

Table 3: Statistical Analysis of Yield Parameters

Parameter	Standard Error (S.E.D)	Critical Difference (CD) at p=0.05
Total Economic Produce	78	156
Total Biomass Production	207	415
Per Day Productivity	0.49	0.97
Rice Yield Equivalent	6114	7783

Table 4: Economic Analysis of Nutrient Treatments

Treatment	Cost of Fertilizers (INR)	Total Revenue (INR)	Net Profit (INR)	Benefit-Cost Ratio
T1 (Control)	0	52940	52940	1.00
T2 (75% RDN)	3000	60550	57550	1.92
T3 (100% RDN)	4000	61410	57410	1.43
T5 (100% RDN + Vermicompost)	5000	75190	70190	1.40
T6 (75% RDN + Organic)	3500	71660	68160	1.95

These tables provide a clear and organized presentation of the results and discussions from the study, highlighting the impact of different nutrient management strategies on rice and cotton yields, as well as the economic implications of these treatments.

4. Conclusion

This study underscores the importance of effective nutrient management in rice-cotton cropping systems. The combination of organic and inorganic fertilizers not only enhances crop productivity but also contributes to sustainable agricultural practices. Future research should focus on long-term impacts and the integration of diverse nutrient sources to further improve soil health and crop yields.

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