EFFECT OF ORGANIC NPK GRANULES AND INORGANIC FERTILIZERSON GROWTH, YIELD AND ECONOMICS OF RICE

ABSTRACT

A field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Annamalai Nagar, CuddaloreDistrict of Tamil Nadu from June to September 2023 to study the effect of combined application of graded levels of inorganic fertilizers along with organic NPK granules on growth, yield and economics of rice. The experiment was laid out in randomized block design with seven treatments, comprised of different levels of inorganic fertilizersand organic NPK granules. Among the treatments evaluated, application of 70% NPK through inorganic fertilizers and 30% NPK through organic NPK granules registered highergrowth, yield attributes and yieldof rice.However the net income and benefit cost ratio was observed under application of 100% NPK through inorganic fertilizers which was comparable with application of 70% NPK through inorganic fertilizers and 30% NPK through organic granules. Therefore it can be concluded that combined application of 70% NPK through inorganic fertilizers and 30% NPK through organic granules is an environmental safe and economically viable nutrient management practice for getting higher yield and income from riceand it can be recommended to the rice growers.

Keywords: Organic NPK granules, inorganic fertilizers, Rice, growth, yield, economics.

INTRODUCTION

Rice is one of the most important food crops and more than half of the world's population depends on rice for their daily calories. It is cultivated over an area of 160.59 million hectares in 114 countries, producing 742.54 million tonnes of rice annually with an average yield of 4.62 t ha^{-1} (USDA, 2022). In Asia and the Pacific, rice is the primary staple food and supplies 21% of dietary energy per person (Depar*et al*., 2011) and more than 90% of the Asian consumes rice.Rice is a significant component of Indian agriculture. The tagline "rice is life" is the most fitting for India because this crop is essential to the country's food security and provides a living for millions of people. Most Indian farmers get their living on

the paddy crop. India is the country that produces the most rice, with an area under cultivation of 46.37 million hectares, generating an estimated 130.29 million tonnes of rice annually, with a productivity of 2.8 t ha¹ (MAFW, 2022). In Tamilnadu, Rice is grown on 2.2 million hectares with an average productivity of roughly 3.93 t ha¹ and a production of 8.65 million tonnes,

About 14.29 Mt of India's total rice production is derived from dry-season (rabi) rice, with the remainder coming from wet-season (kharif) rice. Deteriorating soil health, inadequate fertilizer application, a lack of suitable rice types, pest infestation, and frequent floods and droughts are the contributing factors to the decline in rice yields (Dhariwal*et al*., 2017). Among these, a lack of macronutrients and micronutrients has an impact on rice productivity and growth. In India, after green revolution, rice cultivation is mainly depends on inorganic fertilizers. Continues use of inorganic fertilizers larger quantity in the same field year after years affects soil health and crop productivity. Hence there is a shift for organic farming. However organic farming yields somewhat lesser produces when compare to use of inorganic fertilizers and it not enough to meet out the demand of the growing population. Moreover, the availability organic sources are limited for crop production. Therefore, alternate organic sources of nutrients are needed. To solve all the above issues, integrated uses of organic and inorganic fertilizers are more imperative.

The recommended approach for creating a long-lasting integrated plant nutrient system (IPNS) is integrated nutrient management, or INM. The INM is a practice that sustains soil fertility and productivity because it increases the availability of both native and applied soil nutrients during the crop-growing season, synchronizing the plants' time and space-dependent nutrient demands with the availability of nutrients from the labile soil and applied nutrient pools. It also improves and maintains the soil's chemical, biological, and physical health and stops the deterioration of the soil, water, and environment by encouraging carbon sequestration and reducing the amount of fertilizer nutrients that would otherwise leak into water bodies and the atmosphere.

Organic NPK granules are newly developed organic sources of nutrients which contains adequate amount of major nutrients. It releases minerals that are beneficial to the plant, stimulates soil life and also provides a good amount of macronutrients. It increases the minerals' high availability and duration of activity. Using organic NPK granules has two primary benefits: it raises the resilience to pests and diseases and increases the amount of organic carbon in the soil, which improves plant growth quality and production.Higher

leaching losses are seen and nutrients are supplied more quickly using inorganic fertilizers. Conversely, leaching losses are significantly reduced and nutrients are supplied throughout time by the organic NPK granules. Sustained nutrition delivery improves nutrient utilization efficiency and promotes healthier growth and development. Keeping the above facts in mind, the present investigation was programmed to study effect of organic NPK granules and inorganic fertilizers on productivity and profitability of low land rice.

MATERIALS AND METHODS

A field experiment was carried out during *Kuruvai* season (June – September) of 2023 at Annamalai University, Experimental Farm, Cuddalore District in Tamil Nadu to study the combined effect of organic NPK granules and inorganic fertilizers on the productivity and profitability of lowland rice. The experimental field area comes under the North Eastern Agro-Climatic Zone of Tamil Nadu. The experimental farm is geographically located at 11.38□ North latitude and 79.72□ east longitude with an altitude of + 5.79 m above MSL. The climate of the experimental site is moderately hot. The maximum temperature ranged from 28.2□C to 40.1□C with a mean of 34.15□C, the minimum temperature ranged from 16.8□C to 25.6□C with a mean of 21.2□C and the relative humidity ranged from 77 to 96 per cent. The mean annual rainfall was 1500 mm with a distribution of 80% during the North – East monsoon, 15% during the South – West monsoon, and the remaining 5% as summer showers. During the cropping period, a total rainfall of 327.6 mm was recorded in 19 days. The mean daily sunshine of 4.8 hrs day^{-1} was also recorded during the cropping period. The soil is low in available nitrogen (200 kg ha^{-1}), medium in available phosphorus (21 kg ha^{-1}), and high in available potassium (228 kg ha^{-1}).

The experiment was laid put in randomized block design with seven treatments and three replications. The treatments comprised of T_1 – No NPK, T_2 – 100% NPK through inorganic fertilizers, T_3 –100% NPK through organic NPK granules, T_4 – 100% NPK through organic N rich, P rich and K rich Granules, T_5 –70% NPK through inorganic fertilizers and 30% NPK through organic granules, T_6 –30% NPK through inorganic fertilizers and70%NPKthrough organic granules, T_7 – 50% NPK through inorganic fertilizers and50%NPKthrough organic granules. Short duration rice variety of ADT 43 was chosen for this study. The recommended seed rate of 60 kg $ha^{-1}$and fertilizer schedule of 120:40:40 kg NPK $ha^{-1}$was used in this experiment. Organic granules such as Organic NPK granules (5:5:5), N rich(7-1-1), P rich (0.5-15-1), and K rich(0.5-0.5-15) were obtained as a gift

samples from Privi Life Sciences Pvt.Ltd. Navi Mumbai. The quantitative assessment of growth, yield parameters and yield were recorded at respective stages of crop growth. Gross income was calculated using grain and straw yield of rice based on prevailing market price and expressed in rupees ha^{-1}. Net income was calculated by deducting the cost of cultivation from gross income as given below and expressed in rupees ha^{-1}. The BCR was calculated treatment wise by dividing the gross income by total cost of cultivation.The different growth and yield components observed during the course of the investigation were analyzed statistically as per the procedure suggested by Gomez and Gomez (1984). Whenever the results were found significant ('F' test), the critical difference (CD) were arrived at a 5% probability level (P=0.05). Treatment differences that are not significant were denoted by 'NS'.

RESULTS AND DISCUSSION

Application oforganic NPK granules and inorganic fertilizers significantly influenced the growth, yield and economics of lowland rice. Among the various treatments tried, application of 70% NPK through inorganic fertilizers and 30% NPK through organic granules gave significantly highest plant height (105.4 cm), number of tillers $hill^{-1}$ (17.96), root length (25.47 cm), root volume (26.54 cc), leaf area index (7.65) and dry matter production (11520 $kgha^{-1}$) of rice (Table 1). Increased plant height might be due to the application of mineral fertilizers along with organic manures increased larger concentration of nutrients in the cell – sap which promotes rapid cell division, a differentiation that performed better nutrient mobilization which resulted in maximum stem elongation, faster growth and the cumulative effect of photosynthesis due to increased availability of nutrients that led to increased plant height, number of tiller m^{-2} and dry matter production (Senthilvalavan and Ravichandran *et al*., 2019).The nutrients N, P and K makes the soil more fertile because nitrogen has benefits for plants, namely stimulating the growth of leaves and tillers, as well as the formation of roots. Similar results were also obtained by Sutardi*et al*., (2022). Organic manures have a complex structure which had undergone chemical and enzymatic degradation in lowland soils which became a hormone that together enhanced the root respiration, formation, development and its proliferation (Devi *et al*., 2022). The combination of organic and inorganic fertilizers may facilitate its greater availability and increased uptake of macro and micro nutrients and active participation in carbohydrate assimilation, photosynthesis, and starch formation, translocation of protein and sugar and source to sink activity ended in increased leaf area. This was followed by the application of 50% NPK through synthetic fertilizers

and50%NPKthrough organic granules and recorded the values of higher plant height (102.71 cm), number of tillers hill^{-1} (17.24), root length (24.28 cm), root volume (25.35 cc), leaf area index (7.31) and dry matter production (11195 kgha^{-1})of rice. This was comparable with the application of 100% NPK through synthetic fertilizers. The least values on growth attributes were recorded in absolute control (No NPK).

Regarding grain and straw, addition of 70% NPK through inorganic fertilizers and 30% NPK through organic NPK granules recorded the highest grain yield of 5382 kgha^{-1}which was 19.10%, 22.33 % and 51.7 per cent higher over T_3, T_4 and control (Table 2). Similarly, the same treatment recorded the higher straw yield of 8657 kg/ha which was 8.13%, 22.51%, 24.64% and 45.70 per cent higher over T_2, T_3, T_4 and control. This was followed by application of 50% NPK through synthetic fertilizers and50%NPKthrough organic granules which was on par with application of 100% NPK through synthetic fertilizers, which was on par with application of 100% NPK through synthetic fertilizers. The least grain and straw yield was recorded with no NPK treatment. Increase in grain straw yield at 70% NPK through inorganic fertilizers and 30% NPK through organic granules might be due to the fact that adequate levels of nitrogen, phosphorus and potassium in organic NPK granules might have improved respiration, energy transfer, cell division, efficient physiological and metabolic processes resulting in luxuriant vegetative and reproductive growth. The synergistic effect of micronutrients on root development, vegetative and reproductive growth positively impacted the dry matter of the crops. A balanced NPK fertilization boosted nutrient uptake in rice which might have stimulated more enzymes for carbohydrate and protein metabolism that caused a rise in the photosynthetic activity which in turn reflected in the reproductive growth (Kumar *et al*., 2019). Besides nutrient contribution from the soil for realizing better crop growth and development, physiological progressions like higher chlorophyll content, soluble protein, nitrate reductase activity thus enhancing the source-sink relationship and formation of yield attributes ultimately increasing the seed and straw yield in lowland rice (Luo *et al*.,2023). Improved vegetative growth due to the application of organic NPK granules and inorganic fertilizers throughout the crop period helps in better translocation of the source to the reproductive sink which showed an increment in the yield attributing characters thus increasing the yield of the crop (Kumar *et al*.,2019).

With respect to economics, Application of 100% synthetic fertilizers recorded the highestnet income of Rs.51,462ha^{-1} and benefit cost ratio of 2.12 (Table 3). The higher grain

yield and higher market value of the produce enhanced the net income and BCR of rice(Sutardi*et al*., 2022 and Ismael *et al*., 2021). However, this was comparable with application of 70% NPK through synthetic fertilizers and 30% NPK through organic NPK granules and recorded the net income of Rs.50,798 ha^{-1} and benefit cost ratio of 1.93.

Conclusion

The experimental results showed that there was a marked variation in the growth and yield of rice due to application of organic NPK granules and graded levels of inorganic fertilizers. In light of the above-mentioned facts, it can be concluded that combined application of 70% NPK through synthetic fertilizers and 30% NPK through organic granules (T_5) was the optimal nutrient management strategy to enhance the productivity and profitability of rice and it can be recommended to the farming community, especially under lowland conditions.

Table 1. Effect of organic NPK granules and inorganic fertilizers on growth attributes ofrice

Treatments	Plant height (cm) at harvest	Number of tillers hill^{-1}	Root length (cm)at flowering	Root volume (cm)at flowering	LAIat flowering	DMP (kg ha^{-1}) at harvest
T_1 – No NPK	89.97	13.98	20.70	19.56	5.77	9548
T_2 – 100% NPK through inorganic fertilizers	100.86	16.70	24.28	24.34	7.07	10898
T_3 –100% NPK through organic NPK granules	94.99	15.24	22.89	21.89	6.38	10215
T_4 – 100% NPK through organic N rich, P rich and K rich Granules	92.98	14.71	22.05	20.90	6.16	9920
T_5 –70% NPK through inorganic fertilizers and 30% NPK through organic granules	105.4	17.96	25.47	26.54	7.65	11520
T_6 –30% NPK through inorganic fertilizers and70%NPKthrough organic granules	98.00	15.92	23.07	23.13	6.75	10564
T_7 – 50% NPK through inorganic fertilizers and50%NPKthrough organic granules	102.71	17.24	24.28	25.35	7.31	11195
S.Ed	1.06	0.28	0.42	0.46	0.13	152.65
C.D (p=0.05)	2.32	0.61	1.14	1.14	0.29	310.00

Table 2. Effect of organic NPK granules and inorganic fertilizers on grain and straw yield of rice

Treatments	Grain Yield ($kgha^{-1}$)	Straw Yield ($kgha^{-1}$)
T_1 – No NPK	2600	4700
T_2 – 100% NPK through inorganic fertilizers	4974	7953
T_3 –100% NPK through organic NPK granules	4354	6708
T_4 – 100% NPK through organic N rich, P rich and K rich Granules	4180	6524
T_5 –70% NPK through inorganic fertilizers and 30% NPK through organic granules	5382	8657
T_6 –30% NPK through inorganic fertilizers and70%NPK through organic granules	4664	7395
T_7 – 50% NPK through inorganic fertilizers and50%NPK through organic granules	5152	8273
S.Ed	88	137
C.D (p=0.05)	187	290

Table 3. Effect of organic NPK granulesand inorganic fertilizers on economics ofrice

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	BCR
T_1 – No NPK	31,495	51,500	20,005	1.63
T_2 – 100% NPK through inorganic fertilizers	46,023	97,485	51,462	2.12
T_3 –100% NPK through organic NPK granules	82,920	85,080	2,160	1.02
T_4 – 100% NPK through organic N rich, P rich and K rich Granules	86,670	81,764	-4,906	0.94
T_5 –70% NPK through inorganic fertilizers and 30% NPK through organic granules	54,735	1,05,533	50,798	1.93
T_6 –30% NPK through inorganic fertilizers and 70%NPKthrough organic granules	76,012	91,347	15,335	1.20
T_7 – 50% NPK through inorganic fertilizers and 50%NPKthrough organic granules	62,255	1,01,009	38,754	1.62

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