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IMPACT OF NUTRIPEARLS ON GROWTH PARAMETERS AND ECONOMICS OF RICE

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ABSTRACT

The experiment was conducted at Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during kharif season 2022 to study the effect of nutripearls on growth and yield of transplanted rice. The experiment was conducted in randomized block design keeping a combination of nine treatments of nutripearls and fertilizer. There was significant difference among treatments in respect of growth parameters. The application of nutripearls @ 100 kg/ha with 100% RDF at tillering and panicle initiation stage proved superior in respect to plant height, number of tillers/hill, dry weight, leaf area index while application of nutripearls @ 50 kg/ha with 100% RDF at tillering and panicle initiation stage found more remunerative in term of net monetary returns (Rs 89835/ha) and B:C (2.93).

***Key words*:** Nutripearls, growth, transplanted, dry weight

Introduction

Rice (*Oryza sativa* L.), a member of the Gramineae family, serves as the primary staple for over two-thirds of India's population. It accounts for 40% of the nation's total food grain output, playing a central role in ensuring food security and livelihoods. The 2004 International Year of Rice theme, "Rice is Life," underscores its global significance. Approximately 90% of the world's rice production and consumption occurs in Asia. For many consumers, rice supplies 50-80% of their daily caloric needs (Choudhary *et al*., 2011).

Rice cultivation spans more than 162 million hectares worldwide. India leads with the largest cultivated area at 43.82 million hectares and ranks second globally in production, yielding ~112-120 million tonnes recently (projections: 152 Mt in 2025-26). In Madhya Pradesh, rice occupies 2.02 million hectares, producing 4.80-7.24 million tonnes overall, yet its productivity remains below the national average of ~2,929 kg/ha (Anonymous, 2021).

As a staple for billions worldwide, rice urgently requires productivity enhancements. This need intensifies amid rising food demands from population growth and shrinking arable land. To match projected population increases, rice demand nears 533 million tonnes (milled) by 2030—a target unattainable through Green Revolution methods alone, which falter due to overuse of chemical fertilizers and pesticides (Mishra *et al*., 2013). Key challenges include yield plateaus, soaring input costs, soil degradation, and environmental damage (Biswas *et al*., 2019). Thus, partial substitution or a full shift to modern biotechnological innovations—like CRISPR-edited varieties for higher yields and resilience—is essential.

Nutripearls is an organic fertilizer derived from naturally occurring organic acids. These fertilizers consist of carbon-based materials sourced from plants, animals, or human activities and are applied to soil to deliver essential plant nutrients (Anonymous, 2014). This certified organic granule employs advanced fermentation technology from nutrient-dense sources. As a crop nutrient supplement, Nutripearls contains lacto-gluconates that enhance nutrient uptake, leading to superior yield and quality without chemical residues while promoting early root development. It bolsters plant vigor, increases stress tolerance, and addresses nutrient deficiencies, helping crops resist pests, diseases, and drought.

Table 1: Effect of different treatments of nutripearls on plant population.

	Treatments	Plant Population (m^2)		Leaf Area Index	
		20 DAT	At harvest	30 DAT	60 DAT
T1	100% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	25.00	24.00	1.38	4.70
T2	100% RDF + Nutripearls 50 kg/ha at Tillering & PI stage	25.00	24.30	1.32	4.83
T3	100% RDF + Nutripearls 75 kg/ha at Tillering & PI stage	25.00	24.40	1.44	4.87
T4	100% RDF + Nutripearls 100 kg/ha at Tillering & PI stage	25.00	24.50	1.35	5.01
T5	75% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	25.00	23.80	1.4	4.47
T6	75% RDF+ Nutripearls 50 kg/ha at Tillering & PI stage	25.00	23.90	1.47	4.50
T7	75% RDF+ Nutripearls 75 kg/ha at Tillering & PI stage	25.00	24.00	1.5	4.52
T8	100% RDF	25.00	23.50	1.41	4.42
T9	Untreated control	25.00	21.00	1.00	3.02
	SEm±	0.00	0.60	0.08	0.04
	CD(P=0.05)	NS	NS	NS	0.12

Materials and Methods

The experiment was conducted at Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during kharif season 2022 which is located at 23°90 North latitude and 79°58' East longitude, with an elevation of 411.78 metres above sea level. The soil of the experimental field was clay loam in texture, medium in organic carbon (0.59 per cent), low in available nitrogen (236.1 kg/ha), medium in available phosphorus (17.35 kg/ha) and available potassium (306.80 kg/ha). Soil was neutral in reaction (7.1 pH) with electrical conductivity (0.25 ds m). During the crop season of 2022, the maximum temperature ranged from 26.2°C to 34.4°C and minimum temperature from 7.0°C to 25.6°C and relative humidity in the morning was lowest 78% and highest 93% respectively, while relative humidity in evening was 33% to 79%. The maximum rainfall was 208.1 mm and minimum 16.0 mm received in three and two rainy days in cropping season (Fig.1). The experiment was conducted in randomized block design with a combination of 9 treatments [T1:100% RDF + Nutripearls 25 kg/ha at Tillering & PI stage; T2:100% RDF + Nutripearls 50 kg/ha at Tillering & PI stage; T3:100% RDF + Nutripearls 75 kg/ha at Tillering & PI stage; T4:100% RDF + Nutripearls 100 kg/ha at Tillering & PI stage; T5:75% RDF + Nutripearls 25 kg/ha at Tillering & PI stage; T6:75% RDF+ Nutripearls 50 kg/ha at Tillering & PI stage; T7:75% RDF+ Nutripearls 75 kg/ha at Tillering & PI stage; T8:100% RDF; T9:Control]. Twenty-five days old Rice seedlings were transplanted manually in the field at a planting geometry of 20 cm × 20 cm in all the treatment plots on 22nd July, 2022 of variety JR 206. Two healthy seedlings/hill were transplanted uniformly. The plant population per m row length was recorded at 20 DAT and harvest by randomly from five randomly selected rows. The height of the plant was measured from the base of the plant (ground level) to the tip of the flag leaf stage and the height of the plant was measured from the base of the plant (ground level) to the lower node of the panicle at the commencement of the panicle. The number of tillers from the five randomly selected hills/plot was recorded at 30, 60 DAT and harvest. Then the average number of tillers was calculated. Out of the randomly selected hills in each plot, the number of leaves was recorded at 30 and 60 DAT. Then the average number of leaves/hill was calculated. Three samples from each plot were sun dried before being dried in an oven at 650°C until a constant weight was obtained. Studies on crop growth parameters.

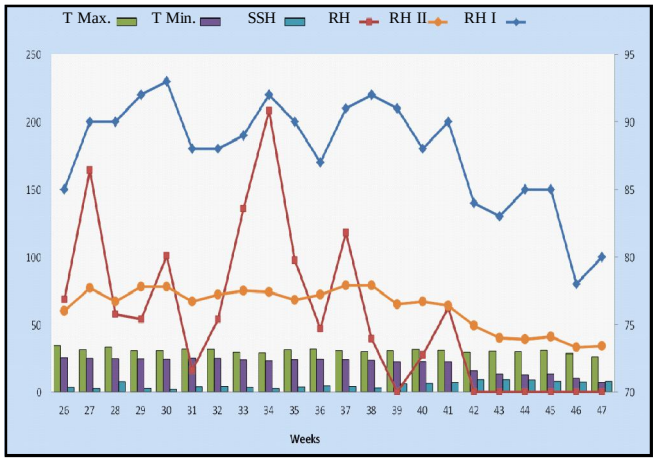

Fig. 1: Weekly meteorological week parameters during crop season (June to November, 2022).

Results and Discussion

Plant population

Data recorded on plant population of rice at 20 DAT and just before harvesting under different treatments of nutripearls are given in Table 1. Plant population of rice at 20 DAT and harvest was not affected due to nutripearls treatments and it was practically similar in all the treatments including untreated control and 100% RDF where nutripearls was not applied.

Table 2: Effect of various nutripearls treatments on plant height at different time intervals.

	Treatments	Plant height (cm)			
		30 DAT	60 DAT	90 DAT	At harvest
T1	100% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	45.81	67.47	83.46	82.90
T2	100% RDF + Nutripearls 50 kg/ha at Tillering & PI stage	46.10	69.09	84.10	83.30
T3	100% RDF + Nutripearls 75 kg/ha at Tillering & PI stage	46.18	70.73	85.00	84.40
T4	100% RDF + Nutripearls 100 kg/ha at Tillering & PI stage	46.25	72.58	87.60	86.36
T5	75% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	45.86	68.10	80.83	79.36
T6	75% RDF+ Nutripearls 50 kg/ha at Tillering & PI stage	46.42	64.23	81.00	80.51
T7	75% RDF+ Nutripearls 75 kg/ha at Tillering & PI stage	45.73	65.30	81.90	80.93
T8	100% RDF	45.40	61.93	79.66	78.16
T9	Untreated control	40.27	56.19	72.16	71.41
	SEm±	0.42	0.53	0.75	0.64
	CD(P=0.05)	NS	1.60	2.25	1.93

Plant Height

Data on plant height recorded at 30, 60, 90 DAT and at harvest stages under different doses of nutripearls are presented in Table 2. Plant height is a genetically controlled character, but several studies indicated that the plant height is influenced by the application of organic fertilizers. There was significance difference between treatments for the plant height at 60 DAT, 90 DAT and at the harvest stage of rice crop but was no significant at 30 DAT. At harvest stage of crop, the crop attained its maximum height by application 100% RDF + nutripearls 100 kg/ha at tillering and panicle initiation stage and least plant height was recorded under untreated control (Table 2). This increase might be due to the existence of organic constituents of sea weed extract, humic acid, vitamins etc. which elicit strong physiological responses in lower doses (Pramanick *et al.*, 2013). Plant height might be increased due to greater availability of nutrients which is stated by Sivakumar *et al.*, (2007). Such results are in similar line with those obtained by Arun *et al.,* (2019), Devi *et al.*, (2015), Baradhan *et al.*, (2019) and Deepana *et al.,* (2021). Application of humic acid increases nutrient availability, resulted into increased conversion of carbohydrates into protein which in turn elaborated into protoplasm and cell wall material increased the size of the cell, which expressed morphologically in terms of plant height and number of tillers. These results are in accordance with Nardi *et al.,* (2002).

Number of tillers

Data pertaining to number of tillers per hill at 30, 60 DAT and harvest stages have been presented in Table 3. There was significance difference between the treatments for the number of tillers/hill of rice crop at 60 DAT, 90 DAT and at the harvest stage of rice crop but was no significant at 30 DAT. Maximum number of tillers were recorded under 100% RDF + nutripearls 100 kg/ha at tillering and panicle initiation stage and least number of tillers under untreated control (Table 3). Saha *et al.*, (2013) reported that, for rice crop application of humic acid @ 3 litre/ha produced significantly the highest number of effective tillers/hill and the lowest was produced in the treatment with no application of humic acid. Arun *et al.,* (2019) reported that, application of bio-stimulant i.e. LBS6-S has produced significantly more number of tillers/ m^2. Similar findings were reported by Mirza and Sahu (2010) and Venkateshprasath *et al.*, (2017) who reported that increase in number of tillers in rice plants is due to the balanced nutrition to plants especially micro nutrients which activated the tillering in plants with the application of biostimulants along with RDF.

Dry weight

Data pertaining to dry weight at successive growth stages including 30, 60, 90 DAT and at harvest as affected by different dose of nutripearls are presented in Table 4. The dry weight of rice was minimum at 30 DAT, which increased with time being the maximum at harvest stage. However, the rate of increase in dry weight was more between 60 and 90 DAT. There was significance

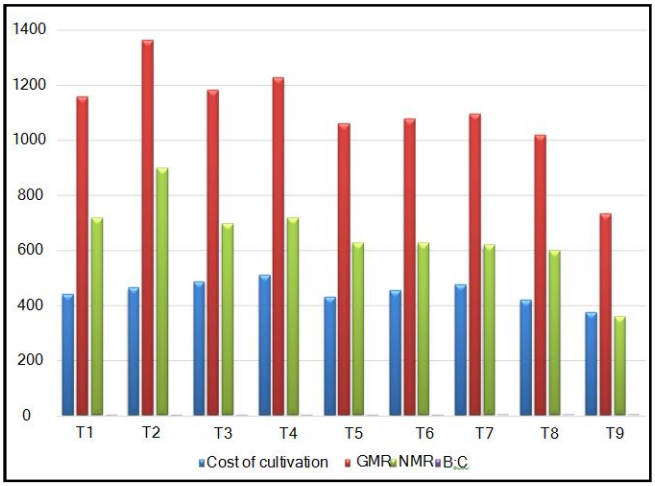

Fig. 2: Economic analysis of treatments.

Table 3: Effect of different nutripearls treatments on number of tillers on different time intervals.

	Treatments	No. of tillers/hill		
		30 DAT	60 DAT	At harvest
T1	100% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	11.00	18.31	14.99
T2	100% RDF + Nutripearls 50 kg/ha at Tillering & PI stage	11.18	19.07	15.33
T3	100% RDF + Nutripearls 75 kg/ha at Tillering & PI stage	10.68	19.16	15.93
T4	100% RDF + Nutripearls 100 kg/ha at Tillering & PI stage	10.82	19.68	16.88
T5	75% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	11.10	16.40	13.57
T6	75% RDF+ Nutripearls 50 kg/ha at Tillering & PI stage	11.00	16.80	13.61
T7	75% RDF+ Nutripearls 75 kg/ha at Tillering & PI stage	10.91	17.20	13.94
T8	100% RDF	10.70	15.71	13.39
T9	Untreated control	6.60	10.90	9.47
	SEm±	0.22	0.31	0.28
	CD(0.05)	NS	0.93	0.86

difference between the treatments for the dry weight (g) at 60 DAT, 90 DAT and at the harvest stage of rice crop but was no significant difference between treatments at 30 DAT. Highest plant dry weight was recorded under application of 100% RDF + nutripearls 100 kg/ha at tillering and panicle initiation stage and least under untreated control treatment (Table 4). Deepana *et al.*, (2021) also reported that in rice crop higher values of dry matter production with the application of sea weed extract gel soil application 12.5 kg/ha along with foliar spraying of sea weed extract liquid 0.5 per cent at tillering and panicle initiation stage of rice crop. The increase in assimilatory surface area due to recommended dose of fertilizers (NPK) could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthesis through increased leaf area thereby increase in dry matter production. The humic acid is known to increase uptake of certain elements and stimulate the dry matter production of shoots. Humic acid acts as natural chelator for metal ions and promote their uptake by the roots. It retains water soluble inorganic fertilizers in the root zones and reduces leaching, possesses extremely high cation-exchange capacities, promotes the conversion of nutrient elements (N, P, K, Fe, Zn and other trace elements) into forms available to plants, enhances the uptake of nitrogen by plants, reduces the reaction of phosphorus with Ca, Fe, Mg and Al and liberates it into a form that is available and beneficial to plants. The productivity of particular mineral fertilizers is increased considerably and liberates carbon dioxide from soil calcium carbonate and enables its use in photosynthesis which in turn resulted in higher dry matter production. The results consequently leading to higher AGR (g/day), CGR (g/m^2/day) and RGR (g/g/day). The results confirm the findings of Kundu *et al.*, (2020) who reported that significantly higher dry matter accumulation/hill produced under application of humic acid based biostimulant @ 20 kg/ha. Similar findings on effect of organic fertilizers on growth parameters were reported by Govindasamy and Chandrasekaran (2002), Baskar *et al.*, (2005).

Leaf Area Index

Leaf area index represents the photosynthetic efficiency of plant which have a significant effect on growth and production of photosynthates. Data pertaining to leaf area index (LAI) at successive growth stage as

Table 4: Effect of different nutripearls treatments on dry weight at different time intervals.

	Treatments	Dry weight (g/hill)			
		30 DAT	60 DAT	90 DAT	At harvest
T1	100% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	8.4	41.1	79.9	80.8
T2	100% RDF + Nutripearls 50 kg/ha at Tillering & PI stage	8.5	42.9	80.7	81.2
T3	100% RDF + Nutripearls 75 kg/ha at Tillering & PI stage	8.6	47.8	82.1	83.7
T4	100% RDF + Nutripearls 100 kg/ha at Tillering & PI stage	8.4	48.3	84.7	89.1
T5	75% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	8.7	34.4	75.1	78.6
T6	75% RDF+ Nutripearls 50 kg/ha at Tillering & PI stage	8.6	38.2	76.3	79.0
T7	75% RDF+ Nutripearls 75 kg/ha at Tillering & PI stage	8.7	40.8	77.4	79.1
T8	100% RDF	8.5	32.1	74.0	76.6
T9	Untreated control	5.3	27.1	69.5	71.3
	SEm±	0.18	0.53	0.67	0.54
	CD(P=0.05)	NS	1.59	2.02	1.63

Table 4: Economic analysis of different treatments.

	Treatments	Cost of cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	B:C Ratio
T1	100% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	44200	115824	71624	2.62
T2	100% RDF + Nutripearls 50 kg/ha at Tillering & PI stage	46450	136285	89835	2.93
T3	100% RDF + Nutripearls 75 kg/ha at Tillering & PI stage	48700	118236	69536	2.43
T4	100% RDF + Nutripearls 100 kg/ha at Tillering & PI stage	50950	122692	71742	2.41
T5	75% RDF + Nutripearls 25 kg/ha at Tillering & PI stage	43160	105895	62735	2.45
T6	75% RDF+ Nutripearls 50 kg/ha at Tillering & PI stage	45410	107875	62465	2.38
T7	75% RDF+ Nutripearls 75 kg/ha at Tillering & PI stage	47660	109317.	61657	2.29
T8	100% RDF	41950	101740	59790	2.43
T9	Untreated control	37590	73410	35820	1.95

influenced by different nutripearls treatments are given in Table 1. In general, the assimilation per unit of ground area was minimum at 30 DAT, which attained the maximum value at 60 DAT under all the treatments. At 30 DAT, the leaf area index was not affected significantly under different treatments. But at 60 DAT, significant difference in leaf area index was recorded. The leaf area index was minimum (2.99) under untreated control followed by 100% RDF. Application of nutripearls between 25 to 75 kg/ha at 75% RDF slightly increased the LAI being the higher when it was applied at 100% RDF and nutripearls at 25 to 100 kg/ha. The treatment with 100% RDF and nutripearls 100 kg/ha proved superior over all the treatments.

Economics

Cost of cultivation:

Cost of cultivation was determined treatment wise on the basis of market price of various common and variable agro-inputs used (Appendix-I). As a result, the obtained data are given in Table 5. Data indicates that the cost of cultivation was minimum (Rs. 37590/ha) under untreated control followed by plot with 100% RDF only (Rs. 41950/ha), which increased from Rs.43160 to 48700/ ha with the increasing doses of nutripearls @ 25 kg, 50 kg, 75 kg/ha at different stage of rice according to different treatments, whereas the highest cost of cultivation was obtained under the plot receiving nutripearls @100 kg/ha and 100% RDF at tillering and panicle initiation stage (Rs. 50950/ha).

Gross monetary returns:

The gross monetary return (GMR) was calculated with the amount received from produce (grain + straw), as per the current market prices was taken into consideration (Table 5). The GMR was minimum (Rs 73410/ha) in untreated control followed by plot receiving 100% RDF only (Rs 101740/ha) which increased remarkably under all the plots receiving nutripearls. Application of nutripearls @ 25 kg/ha to 100 kg/ha according to different treatments fetched higher gross monetary returns amongst which the best treatment was nutripearls @ 50 kg/ha with 100% RDF at tillering and panicle initiation stage (Rs 136285/ha).

Net monetary returns:

The net monetary return (NMR) for each treatment was calculated by subtracting the cost of produce from the gross monetary return (GMR) of the individual treatment. Thus, treatment wise values computed are presented in Table 5. It is evident from the data that NMR was lowest under the untreated control (Rs. 35820/ha) followed by the plot where only 100% RDF had been given. However, it increased with the application of variable doses of nutripearls. Maximum NMR of Rs. 89835/ha with T_2 in which nutripearls was applied @ 50 kg/ha along with 100% RDF at two stages i.e., tillering and panicle initiation stage.

Benefit-cost ratio:

It refers to the net monetary gain under a particular treatment with each rupee of investment. The different treatments of nutripearls influenced the Benefit-cost ratio. Data given in Table 5 reveal that the lowest benefit-cost ratio 1.95 was recorded in untreated control plot while it was highest in the treatment T_2 application of nutripearls @ 50 kg/ha with 100% RDF and proved more remunerative as it fetched 2.93 B:C ratio.

Conclusion

Based on the results of investigation it was concluded that application of 100% RDF along with nutripearls @ 50 kg/ha at tillering and panicle initiation stage was found suitable for getting higher yield of transplanted rice (5937.3 kg/ha) followed by nutripearls @ 100 kg/ha and 100% RDF at tillering and panicle initiation stage (5322.6 kg/ ha) with net returns (Rs 89835/ha) and B:C Ratio (2.93).

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