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EFFECTS OF ORGANIC AND INORGANIC NUTRIENT MANAGEMENT PRACTICES ON NUTRIENT STATUS OF SOIL AT MATURITY STAGE OF PADDY UNDER VARIOUS GROWING PRACTICES

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ABSTRACT
A field study was conducted during the kharif season of 2018–19 in Parseoni Tahsil of Nagpur district to assess the effect of different organic and inorganic nutrient management practices on the nutrient status of soil at the maturity stage of paddy. Five different paddy-growing practices, namely conventional lowland, organic lowland, INM lowland, conventional upland and INM upland, were evaluated under farmers' field conditions. Thirty soil samples from 0–20 cm depth were collected randomly at the maturity stage of the paddy crop from selected farmers' fields. The available nitrogen (N), phosphorus (P) and potassium (K) status of soil was determined under different nutrient management practices. The results showed considerable variation in available N, P and K among the paddy-growing practices. Available N ranged from 162.16 to 221.49 kg ha^{-1}, available P from 18.67 to 36.22 kg ha^{-1}, and available K from 314 to 387 kg ha^{-1}. The highest available N and P were recorded under organic lowland practice (221.49 and 36.22 kg ha^{-1}, respectively), whereas the highest available K was observed under INM lowland practice (387 kg ha^{-1}). The lowest available N was recorded under conventional lowland, while the lowest available P and K were recorded under INM upland and conventional lowland practices, respectively. The differences in available N were significant at the 5% level, whereas available P and K showed non-significant differences. The findings indicate that organic and integrated nutrient management practices can maintain comparatively higher levels of available nutrients in paddy soils.

KEYWORDS: Paddy, organic farming, integrated nutrient management, available nitrogen, available phosphorus, available potassium, soil nutrient status.

INTRODUCTION
Rice (Oryza sativa L.) is one of the major cereal crops cultivated under diverse soil and water-management conditions. Maintaining adequate soil nutrient availability is essential for sustaining paddy productivity and soil fertility. Continuous use of inorganic fertilizers without adequate organic inputs may not adequately maintain soil quality in the long term, whereas the incorporation of organic manures, crop residues and biofertilizers can contribute to nutrient cycling and improvement of soil fertility. Integrated nutrient management (INM), which combines organic and inorganic sources of plant nutrients, provides an approach for maintaining a balanced supply of nutrients while sustaining soil productivity(Kamboj et al., 2024; Walia et al. 2024).Organic materials such as farmyard manure, crop residues and green manure contribute nutrients gradually and improve soil biological activity, while inorganic fertilizers provide readily available nutrients to the growing crop. The availability of nitrogen, phosphorus and potassium is influenced by nutrient management practices, soil properties, crop uptake and nutrient recycling. Differences in nutrient management between upland and lowland paddy systems may therefore result in differences in residual nutrient availability at crop maturity. Long-term research has demonstrated that balanced fertilization and integrated nutrient management can improve soil health and nutrient transformations in rice-based cropping systems. Therefore, evaluation of available N, P and K under different organic, inorganic and integrated nutrient management practices is important for understanding their effects on soil fertility and developing sustainable nutrient management strategies for paddy cultivation.(Krishna et al., 2025; Rajni et al., 2025and Bhat et al., 2026)

MATERIAL AND METHODS

The study was conducted in Parseoni Tahsil of Nagpur district during the kharif season of 2018–19. Four locations, namely Nayakund, Chargaon, Aawleghat and Parseoni, were selected, and a total of 30 farmer's fields representing five different paddy-growing practices were studied. The five practices consisted of conventional lowland, organic lowland, INM lowland, conventional upland and INM upland paddy production systems (Table- 1). Soil samples were collected randomly from the 0–20 cm soil depth at the maturity stage of the paddy crop. Soil samples collected from the different paddy-growing practices were analysed for available nitrogen, available phosphorus and available potassium, their analytical methods are given in Table-2. The results were expressed in kg ha^{-1}. The standard statistical parameters, namely standard error of mean (SE ±) and critical difference (CD) at 5% probability level, were used to compare the nutrient status among the different paddy-growing practices.

Table 1. Inputs used by the farmers and different paddy growing practices

Practices/ Input Used	Conventional practice of growing low land Paddy	Organic farming of growing low land paddy	INM practice of growing Lowland paddy	Conventional Upland Paddy	INM practice of Upland paddy
Manure	Rare and low use(2-3 t ha-1)	Regular and high use (10 t ha-1)	Regular (5 t ha-1)	Rare and low use(2-3 t ha-1)	Regular (5 t ha--1)
Sowing	Transplanting	Transplanting	Transplanting	Drilling	Drilling
Fertilizer (Soil application)	Low dose	No dose	Optimum dose	Low dose	Optimum dose
Fertilizer Spray)	(Spray)	Manurial liquid (500L-1 ha)	Spraying of 2% Urea solution	No Spray	Spraying of 2% Urea solution
Residue addition	Low residue in the form of root stubles	Straw 5 t ha-1	Straw 2-3 t ha-1	Low residue in the form of root stubbles	Low residue in the form of root stubbles
Biofertilizer used	No Use	Biola (Azola)	Blue green algea	No Use	Azotobacter

Table 2: Methods employed for soil analysis at 0-15 cm depth

S. No.	Determination	Procedure	References
1.	Available nitrogen	By alkaline permanganate method	Subbiah and Asija (1956)
2.	Available phosphorus	Extraction of soil with 0.5 M NaHCO3 at pH 8.5 and development of blue colour with SnCl2. and measurement through colorimetrically	Olsen et al. (1954)
3.	Available potassium	Extraction was done with 1 N neutral ammonium acetate at pH 7.0 and determined by flame photometer	Merwin and Peech (1951)

RESULTS AND DISCUSSION

The available nutrient status of soil varied among the different paddy-growing practices. The available N, P and K contents ranged from 162.16–221.49, 18.67–36.22 and 314–387 kg ha^{-1}, respectively. The highest available N and P were recorded under organic lowland practice, whereas available K was highest under INM lowland practice as given in data in Table 3; Figure 1.

Available Nitrogen

Available nitrogen content varied from 162.16 to 221.49 kg ha^{-1} among the different paddy-growing practices (Table 3; Figure 1). The highest available N was recorded under organic lowland (221.49 kg ha^{-1}), followed by INM upland (185.75 kg ha^{-1}), conventional upland (177.90 kg ha^{-1}), INM lowland (176.74 kg ha^{-1}) and conventional lowland (162.16 kg ha^{-1}). Thus, the treatment ranking for available nitrogen was organic lowland > INM upland > conventional upland > INM lowland > conventional lowland. The available N under organic lowland was 36.59% higher than conventional lowland, indicating a considerable improvement in soil N status under the organic system. The higher N availability under organic lowland may be associated with the regular application of a higher quantity of manure, straw incorporation and the use of Azolla, which provided additional sources of organic nitrogen and promoted nutrient recycling. Organic inputs increase the supply of organic substrates and stimulate microbial processes responsible for N mineralization. Similar improvements in soil N under organic and integrated nutrient management have been reported in long-term rice-based systems, where combined use of organic manures and fertilizers enhanced soil N and improved nutrient cycling (Dhawan et al., 2021; Bhattacharyya et al., 2024). The lowest available N under conventional lowland may be related to the comparatively low application of organic manure and greater dependence on conventional nutrient inputs. The CD at 5% for available N was 25.732 kg ha^{-1}, indicating that the differences among the paddy-growing practices were statistically significant.

Available Phosphorus

Available phosphorus ranged from 18.67 to 36.22 kg ha^{-1} across the paddy-growing practices (Table 3; Figure 1). The maximum available P was recorded under organic lowland (36.22 kg ha^{-1}), followed by INM lowland (31.64 kg ha^{-1}), conventional upland (25.39 kg ha^{-1}), conventional lowland (25.27 kg ha^{-1}) and INM upland (18.67 kg ha^{-1}). The ranking was therefore organic lowland > INM lowland > conventional upland > conventional lowland > INM upland. Organic lowland recorded 94.00% higher available P than INM upland, representing the largest numerical difference among the practices for phosphorus. The comparatively higher P status under organic lowland may be associated with the regular addition of organic manure and crop residues, which can contribute phosphorus to the soil and enhance nutrient cycling. Organic amendments can also promote P availability through decomposition and the release of organic compounds that modify P fixation and solubility. Long-term studies in rice-based systems have similarly reported improved soil P pools where organic amendments were combined with mineral fertilizers, compared with mineral fertilization alone (Bhattacharyya et al., 2024; Penget al., 2023). However, despite the numerical differences, the CD at 5% was non-significant, indicating that the observed differences in available phosphorus among the practices were not statistically significant.

Available Potassium

Available potassium content varied from 314 to 387 kg ha^{-1} among the different paddy-growing practices (Table 3; Figure 1). The highest available K was recorded under INM lowland (387 kg ha^{-1}), followed by INM upland (368 kg ha^{-1}), organic lowland (354 kg ha^{-1}), conventional upland (353 kg ha^{-1}) and conventional lowland (314 kg ha^{-1}). Thus, the ranking was INM lowland > INM upland > organic lowland > conventional upland > conventional lowland. The available K under INM lowland was 23.25% higher than conventional lowland. The higher K availability under INM lowland may be associated with the combined use of organic manure, crop residues and inorganic fertilizers, which may have contributed to the maintenance and recycling of soil potassium. Organic materials can return K to the soil during decomposition, while integrated nutrient management can maintain a more continuous supply of plant-available K. Recent long-term research in rice-based systems has demonstrated that organic and INM practices can sustain higher available K and improve soil K buffering and K reserves. Similarly, long-term rice–wheat research has shown that treatments receiving organic manures together with fertilizers improved exchangeable and non-exchangeable K pools and other indicators of soil fertility. Conventional lowland recorded the lowest available K, corresponding with its relatively low manure and residue inputs. However, the CD at 5% for available K was non-significant, indicating that the numerical differences among the paddy-growing practices were not statistically significant.

CONCLUSION

The results demonstrate that nutrient availability differed according to the type of nutrient management and paddy-growing system. Organic lowland practice was particularly effective in maintaining available N and P, while INM lowland recorded the highest available K. The higher nutrient status observed under organic and integrated practices can be associated with the regular addition of organic materials, crop residues, biofertilizers and balanced inorganic fertilizers. Organic inputs provide nutrients through decomposition and mineralization and can support nutrient recycling within the soil–plant system. In contrast, conventional practices involving relatively low organic inputs showed comparatively lower nutrient availability, particularly for N and K. However, the statistical analysis indicates that only available N showed a significant treatment effect, while the differences in available P and K were non-significant.

Table 3. Effects of Organic and Inorganic Nutrient Management Practices on nutrient status of soil at maturity stage of Paddy in various growing Practices

Paddy Growing Practice	Available		
	N	P	K
	kg ha-1		
T1: Conventional Lowland	162.16	25.27	314

T2: Organic Lowland	221.49	36.22	354
T3: INM Lowland	176.74	31.64	387
T4: Conventional Upland	177.90	25.39	353
T5: INM Upland	185.75	18.67	368
SE (m)+-	8.72	4.16	36.1
CD at 5%	25.732	NS	NS

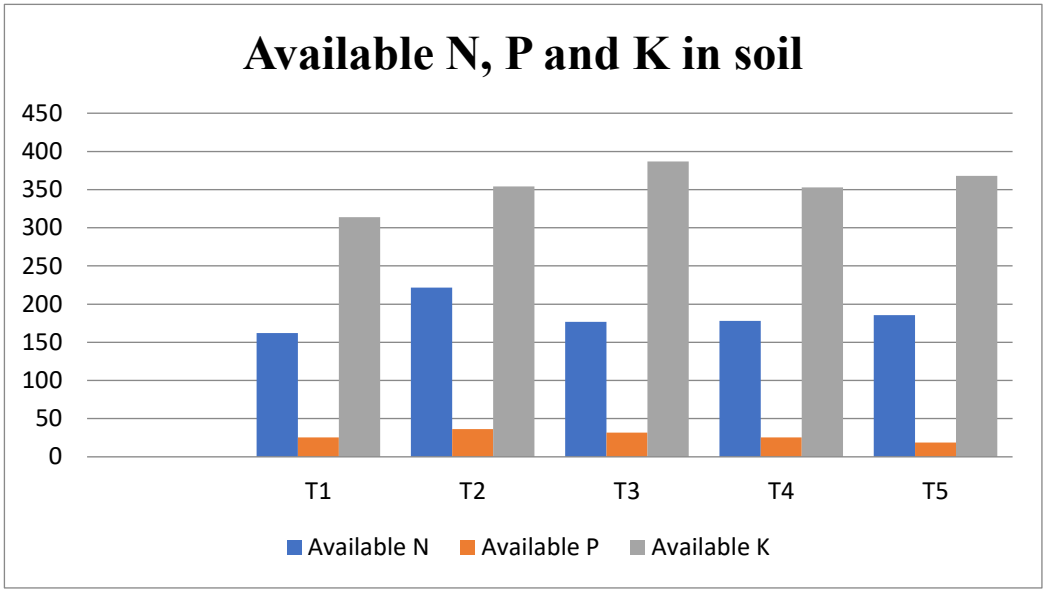


Figure 1. Effects of Organic and Inorganic Nutrient Management Practices on nutrient status of soil at maturity stage of Paddy in various growing Practices

CONCLUSION

The study revealed considerable variation in the available nutrient status of soil under different paddy-growing practices. Organic lowland recorded the highest available nitrogen (221.49 kg ha^{-1}) and phosphorus (36.22 kg ha^{-1}), while INM lowland recorded the highest available potassium (387 kg ha^{-1}). The lowest available N and K were observed under conventional lowland, whereas available P was lowest under INM upland. Available nitrogen showed a significant difference among the practices, while available phosphorus and potassium differences were non-significant at the 5% level. Overall, the results indicate that organic and integrated nutrient management practices, particularly those involving regular manure and residue application, can help maintain comparatively better soil nutrient status in paddy-growing systems.

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