Effect of different nutrient management practices onkharif rice yield,nutrientuptake and soil properties in Telangana.

Abstract

The field experiment was conducted during kharif-2019, 2020 and 2021in RARS Warangal, located at 18^0 01.077 N latitude 79^0 36.197 E longitude and an altitude of 259 m above mean sea level to study the effect of different nutrient management practices on rice yield, nutrient uptake and soil properties in Telangana. The experiment was laid out in completely randomized block design with 5 treatments (T_1 = Organic Farming, T_2 = Chemical farming, T_3 = Integrated Nutrient Management (INM), T_4 = Control and T_5 = Natural farming) replicated in four times. Rice (WGL-32100) was sown during third week of July, transplanted in third week of August and harvested at 135 days after sowing. The results indicated that, significantly higher grain yield (5357 kg ha^{-1}) was recorded in INM over control (3632 kg ha^{-1}), natural farming (3986 kg ha^{-1}) and organic farming (4843 kg ha^{-1}) but at par with chemical farming (5164 kg ha^{-1}). Significantly higher straw yield (6428 kg ha^{-1}) was recorded in INM over control (4326 kg ha^{-1}), natural farming (5100 kg ha^{-1}), organic farming (5668 kg ha^{-1}) and chemical farming (5856 kg ha^{-1}).Significantly higher nitrogen uptake (87.42 kg ha^{-1}) was recorded in INM over control (56.58 kg ha^{-1}), natural farming (67.58 kg ha^{-1}) and organic farming (75.39 kg ha^{-1}) but at par with chemical farming (81.46 kg ha^{-1}). Significantly higher phosphorus uptake (27.34 kg ha^{-1}) was recorded in INM over control (17.80 kg ha^{-1}) and natural farming (19.76 kg ha^{-1}) but at par with organic farming (25.52 kg ha^{-1}) and chemical farming (25.86 kg ha^{-1}). Significantly higher potassium uptake (96.66 kg ha^{-1}) was recorded in INM over control (56.31 kg ha^{-1}), natural farming (68.20 kg ha^{-1}) and organic farming (81.27 kg ha^{-1}) but at par with chemical farming (89.29 kg ha^{-1}).The maximum increase in the OC, available N, P_2O_5 and K_2O were noted in INM (6.9 g kg^{-1}, 186, 45 and 296 kg ha^{-1}, respectively). The lowest value of OC, available N, P_2O_5 and K_2O were noted in control (4.1 g kg^{-1}, 58, 18 and 201 kg ha^{-1}, respectively).

Key Words: Organic farming, Chemical farming and Natural farming.

Introduction

Rice (Oryza sativa L.), a tropical plant is one of the major cereals that provide food security and livelihood to millions of people worldwide. Total rice production in 2021-22 is estimated at a record 127.93 million tonnes (Anonymous 2022). It is 11.49 million tonnes higher than the average production over the past five years of 116.44 million tonnes. It occupies an honourable position among the major cereals and other food crops due to its wider adaptability to edaphic, climatic and cultural conditions. More than 3 billion people eat rice every day. Rice with its diverse growing conditions in India, is grown between 8° to 25° latitudes at an altitude of 2500 meters above mean sea level. With an estimated increase in world population from 6.2 billion in 2000 to 8.2 billion in 2030, the global demand for rice will increase to approximately 765 million tons (FAO 2015). Proper and real time nutrient management in rice leads to higher productivity. Application of a single nutrient element or source of nutrient would not elevate the yield and productivity of rice. However, an integration of essential nutrient elements through organics and inorganics with proper soil reclamation focused under a balanced fertilization in rice is the key to sustainable yield augmentation under rice agroecosystem (Nath *et al.* 2015; Monica *et al.* 2020). It is believed that soil microbes are essential for preserving the soil's health, production, quality, and sustainability (Zhao *et al.* 2014). However, repeated and prolonged treatments may have an impact on the number of soil microorganisms and their viability, changing the structure and activities of the microbial community (Hartmann *et al.* 2018). Apart from soil microorganisms, soil enzyme activities also form a major microbial component in maintaining soil health as it acts as an index for soil fertility and microbial functional diversity. Dehydrogenases are the most significant enzymes among other enzymes in the soil environment and are employed as a general indication of soil microbial activity (Salazar *et al.* 2011). Urease activities in the soil ecosystem correlated the nitrogen dynamics with microbes and crop productivity (Zhao *et al.* 2009). Phosphatase enzymes, both acid and alkaline, are important for releasing accessible inorganic phosphorus (P) from organic forms of phosphorus in soil and for P cycling (Nannipieri*et al.* 2011). In this connectiona field experiment was conducted to assess the relative performance of different nutrient management practices on kharif rice yield, nutrients uptake and soil properties in Telangana as more number of farmers are cultivating paddy under organic farming in Telangana state.

Materials and methods:

The field experiment was conducted during kharif-2019, 2020 and 2021in RARS Warangal, located at 18^0 01.077 N latitude 79^0 36.197 E longitude and an altitude of 259 m above mean sea level to study theeffect of different nutrient management practices on rice yield, nutrient uptake and soil properties in Telangana. During the study a composite soil sample was collected from 0-20 cm depth, processed and tested in soil science laboratory for soil texture, pH, EC, Organic Carbon (OC%), available nitrogen, phosphorus, potassium, Zinc, Iron, soil enzymes and microbial status following standard procedures.The experiment was laid in completely randomized block design with 5 treatments replicated in four times.The treatments were; T_1 = Organic Farming, T_2 = Chemical Farming, T_3 = Integrated Nutrient Management (INM), T_4 = Control T_5 = Natural Farming. Rice (WGL-32100) was sown during third week of July, transplanted in third week of August. Farm yard manure was applied in organic farming treatment on the nitrogen equivalent basis before transplanting(T_1). The Recommended Dose of Fertilizers (RDF) were applied in chemical farming as per the schedule (T_2).Half of the nitrogen through farm yard manure and remaining half in the form of urea, recommended dose of phosphorus and potassium was applied in the form of DAP and MOP, respectively as per the schedule in INM(T_3). Neither FYM nor chemical fertilizers were applied in control(T_4).The bio enhancers were used as per the standard procedure in the natural farming (T_5). The other cultural practices were carried out according to the standard practices in the rice fields and harvested at 135 days after sowing. The grain and straw samples were collected at harvest, oven dried at 70^0C processed and estimated for total content of N, P and K following standard procedures.

Results and discussion:

The experimental soil was sandy loam in texture, slightly alkaline in reaction (pH: 8.12) and nonsaline in nature (EC: 0.46 dSm^{-1}). Organic carbon (0.59%) and available nitrogen (116 kg ha^{-1}) were low, medium in available phosphorus (34 kg ha^{-1}) and potassium (278 kg ha^{-1}), sufficient in available Zn(0.82 mg kg^{-1}) and Fe(5.51mg kg^{-1}), bacteria, fungus, actinomycetes population were $37x10^6$, $0.6x10^5$, $2x10^5$CFU/gm soil, respectively. Urease, dehydrogenase and phosphatase activities were 7.41 μg of NH_4^+-N g^{-1} soil $2h^{-1}$, 0.012 μg TPF g^{-1} soil day^{-1} and 31.25 μg P-nitrophenol g^{-1} soil h^{-1}, respectively.

Grain yield:

Grain yield was significantly influenced due to different nutrient management practices in all three years and pooled study. However, significantly higher grain yield (5830 kg ha^{-1}) was recorded in INM over control (4612 kg ha^{-1}) and natural farming (4784 kg ha^{-1}) but at par with chemical farming (5600 kg ha^{-1}) and organic farming (5312 kg ha^{-1}) in 2019. Significantly higher grain yield (5937 kg ha^{-1}) was recorded in INM over natural farming (4075 kg ha^{-1}), chemical farming (4727 kg ha^{-1}), control (3530 kg ha^{-1}) and organic farming (4077 kg ha^{-1}) in 2020 and significantly higher grain yield (4935 kg ha^{-1}) was found in INM over control (2755 kg ha^{-1}) and natural farming (3099kg ha^{-1}) but at par with organic farming (4821kg ha^{-1}) and chemical farming (4855 kg ha^{-1}) in 2021 and significantly higher grain yield (5357 kg ha^{-1}) was recorded in INM over control (3632 kg ha^{-1}), natural farming (3986 kg ha^{-1}) and organic farming (4843 kg ha^{-1}) but at par with chemical farming (5164 kg ha^{-1}) in pooled study. Improvement in yield due to combined application of inorganic fertilizer and organic manure might be attributed to controlled release of nutrients in the soil through mineralization of organic manure which might have facilitated better crop growth (Saha *et al.* 2008) and also these results were supported with results reported by Harish(2019) revealed that rice grain yield was significantly higher in INM practice (4.18 tha^{-1}) followed by inorganic (4.02 t ha^{-1}) and organic practice (3.74 t ha^{-1}) and least in control treatment (2.26 t ha^{-1}).

Straw yield:

Straw yield was significantly influenced by different nutrient management practices in kharif rice in all three years under study. However, significantly higher straw yield (7732 kg ha^{-1}) was recorded in INM over control (5666 kg ha^{-1}) and natural farming (5976 kg ha^{-1}) but on par with organic farming (7008 kg ha^{-1}) and chemical farming (7052 kg ha^{-1}) in 2019. Significantly higher straw yield (6531 kg ha^{-1}) was recorded in INM over organic farming (4483 kg ha^{-1}), chemical farming (5200 kg ha^{-1}), control (3883 kg ha^{-1}) and natural farming (4484 kg ha^{-1}) in 2020. Significantly higher straw yield (5829 kg ha^{-1}) was found in INM over control (3430 kg ha^{-1}) and natural farming (3809 kg ha^{-1}) but at par with organic farming (5703 kg ha^{-1}) and chemical farming (5741 kg ha^{-1}) in 2021 and significantly higher straw yield (6428 kg ha^{-1}) was recorded in INM over control (4326 kg ha^{-1}), natural farming (5100 kg ha^{-1}), organic farming (5668 kg ha^{-1}) and chemical farming (5856 kg ha^{-1}) in pooled data. "Generally, neither sole use of organic manures nor sole use of chemical fertilizers can achieve the crop yield sustainability, thus, their integrated use might have maintained the higher yield levels by supplying primary, secondary and micronutrients, and might have enhanced the efficiency of applied nutrients by maintaining favourable soil physico–chemical and microbiological parameters" (Choudhary and Suri 2009, 2014; Paul *et al*. 2014, Choudhary and Rahi 2018). The INM practice exhibited higher grain and straw yield over their respective counter parts. These results were supported by Harish (2019)revealed that rice straw yield was significantly higher in INM practice (6.36 t ha^{-1}) followed by inorganic (6.29 t ha^{-1}) and organic practice (6.05 t ha^{-1}) and least in control treatment (3.90 t ha^{-1}).

Table-1: Grain and straw yield of kharif rice as influenced by different nutrient management practices.

Treatments	Grain yield (kg ha^{-1})				Straw yield (kg ha^{-1})			Pooled
	2019	**2020**	**2021**	**Pooled**	**2019**	**2020**	**2021**	
Organic farming	5312	4077	4821	4843	7008	4483	5703	5668

Chemical farming	5600	4727	4855	5164	7052	5200	5741	5856
INM	5830	5937	4935	5357	7732	6531	5829	6428
Control	4612	3530	2755	3632	5666	3883	3430	4326
Natural farming	4784	4075	3099	3986	5976	4484	3809	5100
SEm±	**279**	**347**	**207**	**122.28**	**346**	**382**	**131**	**174.96**
CD(P=0.05)	**842**	**1050**	**626**	**369.76**	**1045**	**1155**	**395**	**529.04**
CV(%)	**11.92**	**17.38**	**11.31**	**5.95**	**11.91**	**18.21**	**5.96**	**7.15**

Nitrogen uptake:

Nitrogen uptake was significantly influenced by different nutrient management practices in kharif rice in 2019, 2020 and 2021. However, significantly higher nitrogen uptake (111 kg ha^{-1}) was recorded in INM over control (89 kg ha^{-1}) but at par with natural farming (99 kg ha^{-1}), organic farming (106 kg ha^{-1}) and chemical farming (106 kg ha^{-1}) in 2019. Significantly higher nitrogen uptake (87.91 kg ha^{-1}) was recorded in INM over organic farming (50.67 kg ha^{-1}), chemical farming (62.27 kg ha^{-1}), control (44.07 kg ha^{-1}) and natural farming (45 kg ha^{-1}).Significantly higher nitrogen uptake (76.29 kg ha^{-1}) was found in INM over control (36.33 kg ha^{-1}), natural farming (58.27kg ha^{-1}) and organic farming (64.24 kg ha^{-1}) but at par with chemical farming (68.30 kg ha^{-1}) in 2021 and significantly higher nitrogen uptake (87.42 kg ha^{-1}) was recorded in INM over control (56.58 kg ha^{-1}), natural farming (67.58 kg ha^{-1}) and organic farming (75.39 kg ha^{-1}) but at par with chemical farming (81.46 kg ha^{-1}) in pooled study.The higher nitrogen uptake with organic manure might be attributed to solubilization of native nutrients, chelation of complex intermediate organic molecules produced during decomposition of added organic manures, their mobilization and accumulation of different nutrients in different plant parts. These confirming the results reported by Sharma *etal*. (2015). He stated that integrated nutrient management (INM) treatments increased N uptake by rice and it ranged from 40.20 to75.60 kg ha^{-1}

Table-2:Nitrogen uptake by kharif rice as influenced by different nutrient management practices.

Treatments	N-uptake (kg ha^{-1})			
	2019	**2020**	**2021**	**Pooled**
Organic farming	106	50.67	64.24	75.39
Chemical farming	106	62.27	68.30	81.46
INM	111	87.91	76.29	87.42
Control	89	44.07	36.33	56.58
Natural farming	99	45.00	58.27	67.58
SEm±	**4.54**	**5.44**	**2.83**	**2.34**
CD (P=0.05)	**13.73**	**16.44**	**8.55**	**7.08**
CV (%)	**9.92**	**20.97**	**10.42**	**7.10**

Phosphorus uptake:

Phosphorus uptake was significantly influenced by different nutrient management practices in kharif rice during 2019, 2020 and 2021. However, significantly higher phosphorus uptake (42.69 kg ha^{-1}) was recorded in INM over control (34.39 kg ha^{-1}) but at par with natural farming (37.94 kg ha^{-1}), organic farming (40.66 kg ha^{-1}) and chemical farming (41.10 kg ha^{-1}) in 2019. Significantly higher phosphorus uptake (17.20 kg ha^{-1}) was recorded in INM over control (10.18 kg ha^{-1}) and natural farming (8.56 kg ha^{-1}) but at par with chemical farming (14.24 kg ha^{-1}) and organic farming (13.74 kg ha^{-1}) in 2020. Significantly higher phosphorus uptake (25.11 kg ha^{-1}) was found in INM over control (8.82 kg ha^{-1}), natural farming (12.79 kg ha^{-1}) and organic farming (18.71 kg ha^{-1}) but at par with chemical farming (22.74kg ha^{-1}) in 2021 and significantly higher phosphorus uptake (27.34 kg ha^{-1}) was recorded in INM over control (17.80 kg ha^{-1}) and natural farming (19.76 kg ha^{-1}) but at par with organic farming (25.52 kg ha^{-1}) and chemical farming (25.86 kg ha^{-1}) in pooled data.The solubilizing action of organic acids produced during decomposition of organic manures or green manure might have increased the release of native P, stimulated microbial growth in soil, and favoured root growth which had finally led to increased P uptake by rice. Sharma *etal.* (2015) reported that almost all the INM treatments except 50%NPK+FYM recorded significantly higher P uptake by rice compared to 50% NPK during both the years and in pooled data also and the magnitude of increase was about 54% over that with 75% NPK.

Table-3: Phosphorus uptake by kharif rice as influenced by different nutrient management practices.

Treatments	**P-uptake (kg ha^{-1})**			
	2019	**2020**	**2021**	**Pooled**
Organic farming	40.66	13.74	18.71	25.52
Chemical farming	41.10	14.24	22.74	25.86
INM	42.69	17.20	25.11	27.34
Control	34.39	10.18	8.82	17.80
Natural farming	37.94	8.56	12.79	19.76
SEm±	**1.77**	**1.66**	**1.53**	**0.92**
CD (P=0.05)	**5.35**	**5.03**	**4.62**	**2.79**
CV (%)	**10.05**	**27.08**	**19.39**	**8.86**

Potassium uptake:

Potassium uptake was significantly influenced by different nutrient management practices in kharif rice in 2019, 2020 and 2021. However, significantly higher potassium uptake (95.84 kg ha^{-1}) was recorded in INM over control (75.11 kg ha^{-1}) and natural farming (83.08 kg ha^{-1}) but at par with organic farming (89.22 kg ha^{-1}) and chemical farming (91.77 kg ha^{-1}) in 2019. In 2020 significantly higher potassium uptake (61.25 kg ha^{-1}) was recorded in INM over control (39.65 kg ha^{-1}), natural farming (42.65 kg ha^{-1}) and organic farming (51.62kg ha^{-1}) but at par with chemical farming (55.65 kg ha^{-1}) and significantly higher potassium uptake (97.06 kg ha^{-1}) was found in INM over control (46.92 kg ha^{-1}), natural farming (57.69 kg ha^{-1}) and organic farming (76.02 kg ha^{-1}) but at par with chemical farming (92.39kg ha^{-1}) in 2021 and significantly higher potassium uptake (96.66 kg ha^{-1}) was recorded in INM over control (56.31 kg ha^{-1}), natural farming (68.20 kg ha^{-1}) and organic farming (81.27 kg ha^{-1}) but at par with chemical farming (89.29 kg ha^{-1}) in pooled study. The increased uptake of K by rice may be ascribed to the release of K from the K-bearing minerals by complexing agents and organic acids produced during decomposition of organic resources. Potassium uptake was found significantly higher in almost all the INM treatments as compared to 50% NPK in both the years and in the pooled data alsoSharma *etal.* (2015).

Table-4: Potassium uptake by kharif rice as influenced by different nutrient management practices.

Treatments	K-uptake (kg ha^{-1})			
	2019	**2020**	**2021**	**Pooled**
Organic farming	89.22	51.62	76.02	81.27
Chemical farming	91.77	55.65	92.39	89.29
INM	95.84	61.25	97.06	96.66
Control	75.11	39.65	46.92	56.31
Natural farming	83.08	42.65	57.69	68.20
SEm±	**4.05**	**2.61**	**5.31**	**4.03**
CD(P=0.05)	**12.25**	**7.25**	**16.06**	**12.17**
CV(%)	**10.41**	**7.89**	**16.05**	**11.49**

"Regarding plant nutrient acquisition, the INM practice exhibited highest NPK concentrations in rice grains and straw followed by inorganic, organic practice, natural farming and control treatmentowing to better crop nutrition" (Choudhary and Suri 2009, 2014, Paul *et al.* 2014). "The N uptake in rice grains, straw and total N uptake were significantly higher in INM practice followed by inorganic, organic and control treatment. This may be attributed to balanced and continuous N supply to rice crop under INM" (Choudhary and Suri 2009, 2014). "In case of P and K uptake in rice grains, straw and total uptake, the INM practice again exhibited significantly higher values, and it was followed by organic practice, inorganic practice, natural farming and control treatments. Under INM and organic practice, the added organic matter on decomposition and mineralization releasesP. Likewise, the proton generated and phosphatases produced by the action of P solubilizing organisms also mobilized the soil–P leading to higher P uptake in present study under INM or organic practice" (Choudhary and Suri 2009, Kumar *et al.* 2014). "Again, the added organic matter under INM and organic practice is responsible for higher K supplies besides holding positively charged potassium (K+) ions" (Olk*et al.* 1996, Choudhary and Suri 2009); "leading to higher K acquisition and uptake in the study (Table 4). Overall, the NPK acquisition behaviour again proved that better plant nutrition leads to higher crop productivity which resulted in higher NPK uptake in rice grains, straw and total uptake in current study" (Choudhary and Suri 2014)

Soil fertility:

"The organic carbon(OC), available N, P_2O_5 and K_2O contents of the experimental soil was found increased over the initial value in all the INM treatments (Table 5).The maximum increase in the OC, available N, P_2O_5 and K_2O were noted in INM (6.9 g kg^{-1}, 186, 45 and 296 kg ha^{-1}, respectively).The lowest value of OC, available N, P_2O_5 and K_2O were noted in control (4.1 g kg^{-1}, 58, 18 and 201 kg ha^{-1}, respectively).This increase may be attributed to higher microbial activity in the INM treatments which favoured the conversion of the organically bound nitrogen to inorganic form" (Panwar 2008). "Similar increase in available N in soil due to addition of organics was observed in rice" (Singh *et al*. 2006). "Organic manures, on decomposition, solubilize insoluble organic P fractions through release of various organic acids, thus resulting into a significant improvement in available P status of the soil" (Mondal *et al.* 2008). Maitra *et al.* (2008) "also found similar improvement in soil available P status in a Typic Ustochrept of Uttar Pradesh due to integrated nutrient managementin sunnhemp".

Soil microbial biomass changes:

It was observed that 46%,19%,11% and 22% higher bacterial count was recorded in INM, Natural farming,Chemical farming and Organic farming, respectively over initial status ($37x10^6$ CFU/gm soil) and there is slight decrease was observed in control treatment over initial status(Table 5). The soil fungus count was increased by 50% over initial status due to INM, Natural farming and Organic farming and there is no variation was observed due to chemical farming and control treatments over initial status. Actinomycetes population was increased about four times due to INM, Natural farmingand Organic farming over initial status."For sustainable crop production and maintaining soil quality, the input of organic manure, such as FYM is of major importance andshould be advocated in the nutrient management of intensive cropping systems for improving soil fertility and biological properties of soils" (Moharana*et al.* 2012).

Soil enzyme activities:

It was observed that urease activity (Table 5) was maximum in INM followed by chemical farming, organic farming and least was found in control. Mohapatra *etal.* (2024)reported that the application of100% NPK + lime @1 t ha^{-1} + FYM @ 10t ha^{-1} where lime is integrated along with NPK and FYM, higher urease activities were recorded (Liang *et al.* 2014), in kharif rice.Because FYM improves soil quality by increasing soils'capacity for nitrogen cycling and transformation as reflected by hydrolytic enzyme activities (Meshram *et al.* 2016). Dehydrogenase activity was higher in INM followed by organic farming and natural farmingand least was found in control. As organic sources are the only sources of carbon and energy for heterotrophs, dehydrogenase enzyme activity increases when FYM is integrated with NPK fertilizers (Meshram *et al.* 2016). These results were confirming the results reported by Mohapatra *etal.* 2024 reported that dehydrogenase activity was maximum in 100% NPK+FYM+ lime (72.6 µg of TPF kg^{-1} of soil 24 hr^{-1}), which was followed by 100% NPK+ FYM (61.2 µg of TPF kg^{-1} of soil 24 hr^{-1}) and 150% NPK (53.0 µg of TPF kg^{-1} of soil 24 hr^{-1}) in kharif rice. The lowest dehydrogenase activity was found in unfertilized control (12.5 µg of TPF kg^{-1} of soil 24 hr^{-1}).Alkaline phosphatase activity was higher in INM followed by natural farming, organic farming and least was found in control. Soil phosphatase enzyme acts upon the organic form of P and releases the end product of plant available phosphate through the process of mineralization. Mohapatra *etal.*(2024) reported that the highest phosphatase activity was found in the treatment 100% NPK + FYM+ lime and the lowest in control in kharif rice. In the treatment 100% NPK + FYM, FYM is perhaps responsible for the highest phosphatase activity.

Table-5: Physico-chemical and biological properties of the initial and postharvest

surface soil samples.

S.No	Soil parameter	Initial soil fertility	Post harvest soil fertility				
			Organic farming	Chemical farming	INM	Natural farming	Control
1	pH	8.46	8.35	8.36	8.35	8.34	8.46
2	Ec (dS m^{-1})	0.46	0.45	0.47	0.46	0.45	0.46
3	Soil Texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
4	Bulk density (g cm^{-3})	1.82	1.70	1.82	1.72	1.71	1.82
5	Particle density (g cm^{-3})	2.01	2.01	2.01	2.01	2.01	2.01
6	OC (%)	0.59	0.69	0.60	0.69	0.55	0.41
7	Available N (kg ha^{-1})	116	139	181	186	87	58
8	Available P_2O_5 (kg ha^{-1})	34	28	42	45	26	18
9	Available K_2O (kg ha^{-1})	278	221	226	296	203	201
10	Available–Zn (mg kg^{-1})	0.82	0.55	0.62	0.68	0.49	0.52
11	Available–Fe (mg kg^{-1})	5.51	4.67	4.96	4.32	5.36	4.57
12	Bacteria (CFU/gm soil)	$37x10^6$	$45\ x10^6$	$41x10^6$	$54x10^6$	$44x10^6$	$35x10^6$
13	Fungus (CFU/gm soil)	$1x10^5$	$2x10^5$	$1x10^5$	$2x10^5$	$2x10^5$	$1x10^5$
14	Actinomycetes (CFU/gm soil)	$2x10^5$	$8x10^5$	$6x10^5$	$9\ x10^5$	$7x10^5$	$2\ x10^5$
15	Urease (µg ofNH_4^+-N g^{-1} soil $2h^{-1}$)	7.41	15.40	16.80	22.75	6.63	6.10
16	Dehydrogenase(µg TPF g^{-1} soil day^{-1})	0.012	0.044	0.033	0.054	0.037	0.016
17	Alkaline Phosphatase (µg P-nitrophenol g^{-1} soil h^{-1})	21.44	31.25	25.90	34.81	27.52	12.27

Conclusion:

The study assesses the relative performance of different nutrient management practices on kharif rice yield, nutrients uptake and soil properties in Telangana as more number of farmers are cultivating paddy under organic farming in Telangana state. It may be concluded that the integrated use of NPK fertilizers along with FYM sustains rice production, improves the soil fertility status and microbial status of Vertisols.

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