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Influence of different source of organic manure on microbial activity nutrient uptake and yield of rice

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Abstract
Present experiment entitled "Influence of Different Source of Organic Manure on Soil Quality and Production of Rice'' was carried out during *Kharif* season of 2017 at the Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur. The experiment was carried out in RBD design with treatment effect within crop (season) with 4 replications having treatments: T1- 100% N through city compost, T2- 75% N through city compost, T3- 100% N through vermicompost, T4- 75% N through vermicompost, T5- 100% N through Industrial waste-1, T-6 75% N through Industrial waste-1, T-7 100% N through Industrial waste-2, T-8 75% N through Industrial waste-2, T-9 100% N through FYM and T-10 75% N through FYM. A medium duration scented rice variety "Tarun Bhog" was taken as test crops. Microbial activity in Dehydrogenase (TPF/g soil/24hr), Urease (ug NH4+/g soil/hr) and SMBC (soil microbial biomass carbon), (mg Kg^{-1}) in soil were noticed markedly highest in soil applied with T5- 100% N through Industrial waste-1. The test weight of 1000 grain (13.5 g) and rice grain yield (4293 kg/ha) and straw yield (6075 Kg/ha) was found highest in T5- 100% N through Industrial waste-1. Nutrient uptake in grain, straw and total nitrogen was noticed significantly higher with treatment T5- 100% N through Industrial waste-1. Aroma was found medium in all the treatments.

Keywords: Manure, rice, organic, dehydrogenase activity urease and SMBC

Introduction
Introduction of high yielding varieties (HYVs) and intensive rice farming had led to increased use of chemical fertilizers and pesticides. Continuous and increased/indiscriminate use of sole chemical fertilizers lead to several harmful effects on the soil environment, ground and surface water, and even atmospheric pollution, reducing the productivity of the soil by affecting soil health in terms of physical, chemical and biological properties. Hence, enhancement and maintenance of system productivity and resource quality is essential for sustainable agriculture. It was felt that organic farming may solve all these problems and organic farming has been considered as one of the best options for protecting/sustaining soil health, and is gaining lot of importance in present day agriculture. Significant improvements in soil physical, chemical and biological properties have been reported in several organic farming experiments (Carpenter *et al.,* 2000) [3]. Organic agriculture enables ecosystems to better adjust to the effects of climate change, and also improves carbon sequestration potential of the soil (Bhooshan and Prasad, 2011) [2]. Organic fertilizers not only act as the source of nutrients, but also provide micronutrients and modify soil-physical behavior as well as increase the efficiency of applied nutrients (Pandey *et al*., 2007) [13]. Some other studies have shown that returns from organic farm management are equal to, or exceed those of conventional management. Also, there is a growing demand for organically produced foods worldwide and many international and national organizations are taking interest in organic farming research. The complete information on organic farming in rice with regard to rice productivity, grain quality, soil health/quality and profitability in Indian soils is very limited. The appropriate utilization of manures and/or crop residues within management systems can increase levels of plant nutrients and enhance soil microbial biomass, activity and diversity (Pan *et al*., 2009) [12]. Using organic resources like, FYM, poultry manure, and green manure etc. deserves priority for sustained production and better resource utilization in integrated nutrient management. In this system, the use of chemicals is kept at its minimum *i.e.* to the level of bare necessity. Compare to chemical farming this method was self sufficient, self dependant and relies more biological inputs.

The role of plant nutrient would be extremely important from sustainability point of view. Nitrogen is the key nutrient element limiting the yield of rice. Fertilizer N use efficiency varies from 18 to 40 percent in different rice soils, because applied inorganic N is rapidly lost from the soil by ammonia volatilization and denitrification. With the increasing trend in price of fertilizers and the reduction in the use of chemical fertilizers it has become necessary to judiciously manage the inflow of organic sources of nutrients and their integration with fertilizers. Therefore, information needs to be generated with respect to proper dose of organic manures along with inorganic fertilizers for rice varieties. Furthermore, the price of coarse rice has gone much lower than even the support price offered by the Government; So, there is need to develop the suitable nutrient management practices for better quality and high productive rice varieties by integration of inorganic and organic sources of nutrients (Su *et al.*, 2008) [17].

Materials and Methods

A field experiment was conducted on Vertisol of Research Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidhyalaya, Raipur, Chhattisgarh. Raipur is situated at 210 4' North Latitude and 810 4' East Longitude with the altitude of 293 meter above mean sea level. The experimental soil (Vertisol) is fine montmorillonite, hyperthermic, udic chromustert, locally called as Kanhar and is identified as Arang II series. It is usually deep, heavy clayey (50%), dark brown to black in colour and neutral to slightly alkaline in reaction due to presence of lime concentrations. The soil was analyzed for its initial characteristics as per the methods mentioned below and some important physicochemical properties of the soil. Treatment details are T1- 100% N through city compost, T2- 75% N through city compost, T3- 100% N through vermicompost, T4- 75% N through vermicompost, T5- 100% N through Industrial waste-1, T-6 75% N through Industrial waste-1, T-7 100% N through Industrial waste-2, T-8 75% N through Industrial waste-2, T-9 100% N through FYM and T-10 75% N through FYM. Test weight of grain, Yield microbial analysis and nutrient uptake. Analysis of variance (ANOVA) was carried out using the randomized block design method and Least Significance Difference (LSD) was calculated on soil data for treatment means at 5 per cent probability.

Results & Discussion

Effect of different source of organic manure on microbial properties of soil.

It raveled that table 1 showed that the dehydrogensae activity was found highest in T5- 100% N through Industrial waste-1 109.0 µg gm-1 day-1 followed by followed by T-6 75% N through Industrial waste-1(106.2) T-7 100% N through Industrial waste-2(104.8), T-8 75% N through Industrial waste-2 (102.2) µg gm-1 day-1 respectively with treatment. The lowest dehydrogenase activity 79.7 µg g-1 day-1 was noticed under T-10 75% N through FYM. The highest SMBC 301.0 mg kg^{-1} soil was recorded under treatment T5- 100% N through Industrial waste-1 followed by 289.0, 286.5, 283.5 mg kg^{-1} soil with T-6 75% N through Industrial waste-1, T-7 100% N through Industrial waste-2, T-8 75% N through Industrial waste-2 respectively. The lowest SMBC 253.0 µg g-1 soil was noticed under T2- 75% N through city compost. Urease enzyme activity was found highest in T5- 100% N through Industrial waste-1 97.0 µg NH4+/g soil/hr followed by followed by 94.5, 92.5, 89.0 with treatment T-6 75% N through Industrial waste-1, T-7 100% N through Industrial waste-2, T-8 75% N through Industrial waste-2 µg NH4+/g soil/hr respectively. The lowest Urease activity 76.5 µg NH_4^+/g soil/hr as noticed under T2- 75% N through city compost. Islam and Borthakur (2016) [5] were screened the influence of growth stages of rice on soil microbial biomass carbon (SMBC), soil microbial biomass nitrogen (MBN) and enzyme activities (amylase, dehydrogenase, alkaline and acid phosphatase and urease) in a sub-tropical rice field. Results shows that, contents of soil organic carbon, total nitrogen, MBC and MBN were highly influenced by the flowering stage (90 DAT) of the rice crop, at both 0-10 cm and 10-20 cm soil depths with application of manure treated plot with higher content of nitrogen. Similar result reported by Jat and Singh (2017) [6] replacing mineral by organic fertilizers on the physico-chemical properties and enzyme activities were supplied by either FYM or pressmud or vermicompost or combination of these two or all. The highest microbial biomass carbon (218.2 µg g-1), urease activity (221.9 µg urea g−1 h−1), alkaline phosphatase (121.5 µg pNP g−1 h−1) and dehydrogenase activity (44.5 µg TPF g−1 d−1) recorded with treatment 70% RDF with 30% N by FYM and pressmud equally. The study reveals the effects of the organic amendments were observed even when they involved a small portion of the total amount of nutrients supplied; thereby confirming that some of the beneficial effects of integrated fertilizer strategies may occur in the short term in rice production and the promising combination was 70% of recommended NPK combined with FYM and pressmud on basis of 30% N by produced the best response. Similar results reported by Kashyap and Khokhar (2017) [7].

Table 1: Effect of different source of organic manure on enzymatic activity

Treatments	Dehydrogensae TPF/g soil/24 hr	SMBC mg kg^{-1}	Urease µg NH4+/g soil/hr
T1- 100% N through city compost	90.8	265.0	85.0
T2- 75% N through city compost	83.6	253.0	76.5
T3- 100% N through Vermicompost	99.1	279.0	78.0
T4- 75% N through Vermicompost	95.9	279.5	80.5
T5- 100% N through Industrial waste-1	109.0	301.0	97.0
T-6 75% N through Industrial waste-1	106.2	289.0	94.5
T-7 100% N through Industrial waste-2	104.8	286.5	92.5
T-8 75% N through Industrial waste-2	102.2	283.5	89.0
T-9 100% N through FYM	91.5	271.0	88.0
T-10 75% N through FYM	79.7	256.0	82.5
CD (0.05%)	2.95	21.28	2.90

Effect of different source of organic manure on grain and straw yield and test weight of rice

Grain yield data observed in various treatments is shown in table 2. The grain yield was found significantly superior in treatment T5 [Industrial 1 100%] 4293 kg/ha when compared to treatment T1, T2, T3, T4, T6, T7, T8, T9 and T10. The lowest grain yield 1818 kg/ha was recorded in T8 [Industrial 2 75%] which was significantly lower than all other treatments. The grain yield obtained from different treatments may be ranked in the order of T5> T6> T3> T9> T7> T1> T2> T10> T4> T8. Overall impression from yield data is that the treatments involving application of organic manure Industrial 1 100% produced higher grain yields. Also reported that number of the panicle and plant height increase due to application of organic supply of Straw yield data observed in various treatments is shown in table 4.4. The straw yield was found significantly superior in treatment T5[-Industrial 1 100%] 6075 kg/ha when compared to treatment T1, T2, T3, T4 T5, T6, T7, T8, T9 and T10. The lowest straw yield 2412 kg./ha was recorded in T8 [Industrial 2 75%] which was significantly lower than all other treatments. The straw yield obtained from different treatments may be ranked in the order of T5> T6> T3> T9> T7> T1> T2> T10> T4> T8. Overall impression from yield data is that the treatment Industrial 1 100% produced higher straw yields. Similar result was observed Kavimani *et al*. in (2006) [8] increase the grain and straw yield of rice due to efficient utilization of nutrient. Kumar *et al.* (2011) [9] also found the similar result due to application of Vermicompost. Data presented on table 2 shows the non-significant variation in test weight of paddy among the different treatments. The highest test weight of paddy 13.15 g was recorded in treatment T5 [Industrial 1 100%] followed by T6 [Industrial 1 75%] and T7 [Industrial 2 100%] whereas lowest value was recorded in T2 [City compost 75%] to be 12.2 g. The results obtained collaborated insignificant response. Application of vermicompost @ 6 t/ha resulted in significantly higher grain yield of paddy crop than no vermicompost and vermicompost@ 2 t/ha, however it was found statistically at par with 4 t vermicompost/ha. However, during 2004-05 crop season application of vermicompost @ 6 t/ha resulted in significantly higher grain yield and test weight of paddy than all other treatments. Organic manures provide regulated supply of N by releasing it slowly (Yoshiaki 1982) [18] resulting in increased yield of rice and nutrient use efficiency.

Table 2: Effect of different source of organic manure on grain and straw yield and test weight of rice

Treatments	Straw yield (kg/ha)	Grain yield (kg/ha)	Test weight gm/1000 seed
T1- 100% N through city compost	3018	2406	12.35
T2- 75% N through city compost	2875	2318	12.2
T3- 100% N through vermicompost	3643	2687	12.5
T4- 75% N through vermicompost	2556	1906	12.24
T5- 100% N through Industrial waste-1	6075	4293	13.15
T-6 75% N through Industrial waste-1	4412	3150	13.00
T-7 100% N through Industrial waste-2	3312	2487	12.57
T-8 75% N through Industrial waste-2	2412	1818	12.35
T-9 100% N through FYM	3406	2543	12.45
T-10 75% N through FYM	3043	2250	12.00
CD (0.05%)	278	195	NS

Effect of different source of organic manure on nutrient (N P& K) uptake (kg ha.$^{-1}$) by plants

Results in table 3 indicate that the N uptake in grain and straw of paddy varied significantly due to application of different source of organic manure on Nitrogen Uptake (kg ha.$^{-1}$) by plants**.** The N uptake by grain was ranged from 24.41 to 61.35 kg/ ha and t straw was from 8.29 to 21.74 kg/ ha. The N uptake by grain significantly superior was recorded as 61.35 kg/ha in T5 [Industrial 1 100%] followed by T6 [Industrial 1 75%] whereas minimum N uptake was recorded as 24.41 kg/ha in T10. [FYM 75%]. Likewise, The N uptake by straw was significantly superior recorded as 21.74 kg/ha in T5 [Industrial 1 100%]. The overall observations revealed that the N uptake value recorded in treatment T5 was higher to that of all treatments T5 and T6 significantly superior to rest of the treatments. The treatment T5 performed better due to higher N content in Industrial 1 100% than other treatments similar observed was recorded by the Kumar *et al.* (2011) [9] The total N uptake by grain and straw ranged from 31.68 to 83.10 kg/ha. The total N uptake was significantly superior in T5 [Industrial 1 100%] followed by T6 [Industrial 1 75%] whereas minimum N uptake was recorded as 31.68 kg/ha. in T8 [Industrial 2 75%]**.** P uptake in grain and straw of paddy varied significantly due to application of different source of organic manure on Phosphorus Uptake by plants. The P uptake by grain was ranged from 1.61 to 4.36 kg/ ha and straw from 0.36 to 1.41 kg/ ha. The P uptake by grain significantly superior was recorded as 4.36 kg/ha. in T5 [Industrial 1 100%] followed by T9 [FYM 100%] whereas minimum P uptake was recorded as 1.61 kg/ha. in T4 [Vermicompost 75%]. P uptake by straw was recorded significantly superior 1.41 kg/ha in T5 [Industrial 1 100%] followed by T7 [Industrial 2 100%] 0.87 kg/ha and minimum P uptake was recorded as 0.36 kg/ha. in T4 [Vermicompost 75%]. The overall observations revealed that the P uptake value recorded in treatment T5 was highly significant over of all 10 treatments. P uptake by grain and straw ranged from 1.98 to 5.77 kg/ha. The total P uptake was significantly superior in T5 [Industrial 1 100%] 5.77kg/ha followed by T6 [Industrial 1 75%] 3.67kg/ha whereas minimum P uptake was recorded as 1.98 kg/ha. in T4 [Vermicompost 75%]. Phosphorus uptake by the crop is a function of phosphorus content and above ground biomass production. Nutrient management practices had significant influence on above ground biomass i.e. yield, so significant variation in uptake was found. K uptake in grain and straw of paddy varied significantly due to application of different source of organic manure. The K uptake by grain ranged from 4.95 to 14.88 kg/ ha and straw was from 23.99 to 60.93 kg/ ha. The K uptake by grain significantly superior was recorded as 14.88 kg/ha. in T5 [Industrial 1 100%] followed by T6 [Industrial 1 75%] 9.64 kg/ha whereas minimum K uptake was recorded as 4.95 kg/ha. in T8 [Industrial 2 75%]. The K uptake by straw was recorded significantly superior as 60.93 kg/ha. in T5

[Industrial 1 100%] followed by T6 [Industrial 1 75%] whereas minimum K uptake was recorded as 23.99 kg/ha. in T8 [Industrial 2 75%]. The overall observations revealed that the K uptake value recorded in treatment T5 was highly significant over all the 10 treatments. The total K uptake was recorded from 28.95 to 75.80 kg/ha. The total K uptake was significantly superior in T5 [Industrial 1 100%] 75.80kg/ha followed by T6 [Industrial 1 75%] 53.24 kg/hac whereas minimum K uptake was recorded as 28.95 kg/ha. in T8 [Industrial 2 75%]. Potassium uptake by the crop is a function of potassium content and above ground biomass production. Nutrient management practices had significant influence on above ground biomass i.e. yield, so significant variation in uptake was found. Observed that Application of organic and inorganic sources of nutrient in combination remarkably increased nutrient uptake. Similar results reported by Mishra *et al*. (2006) [10] and Bisht *et al*. (2006) [4].

Conclusion

Dehydrogenase (TPF/g soil/24hr), Urease (ug NH4+/g soil/hr), SMBC (soil microbial biomass carbon), (mg Kg^{-1}) in soil were found markedly higher in soil applied with T5- 100% N through Industrial waste-1. Grain and straw yield were significantly higher with treatment T5- 100% N through Industrial waste-1. Nitrogen, Phosphorus, Potassium uptake in grain, straw and total nitrogen were significantly higher with treatment T5- 100% N through Industrial waste-1. Aroma was found medium in all the treatments. In this conclusion finally conclude that the application of T5- 100% N through Industrial waste-1 is better then among all the organic application in rice cultivation.

Table 3: Effect of different source of organic manure on Nitrogen Uptake, Phosphorus and Potassium uptake (kg $ha.^{-1}$) by Rice Plant

Treatments	Nitrogen Uptake (kg $ha.^{-1}$)			Phosphorus Uptake (kg $ha.^{-1}$)			Potassium Uptake (kg $ha.^{-1}$)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T1- 100% N through city compost	30.09	11.47	41.57	2.2	0.64	2.84	6.71	33.44	40.15
T2- 75% N through city compost	27.50	10.64	38.15	1.76	0.54	2.30	5.80	29.91	35.71
T3- 100% N through vermicompost	35.79	12.86	48.66	2.82	0.58	3.40	7.94	38.35	46.30
T4- 75% N through Vermicompost	23.63	8.80	32.44	1.61	0.36	1.98	5.10	26.55	31.66
T5- 100% N through Industrial waste-1	61.35	21.74	83.10	4.36	1.41	5.77	14.88	60.93	75.80
T-6 75% N through Industrial waste-1	42.99	15.43	58.42	2.86	0.85	3.72	9.64	43.60	53.24
T-7 100% N through Industrial waste-2	33.16	11.71	44.87	2.60	0.87	3.47	7.74	33.60	41.35
T-8 75% N through Industrial waste-2	23.37	8.30	31.68	1.72	0.45	2.17	4.95	23.99	28.95
T-9 100% N through FYM	30.02	10.6	40.62	3.00	0.61	3.61	8.33	35.30	43.63
T-10 75% N through FYM	24.41	8.29	32.71	2.01	0.46	2.48	5.54	30.70	36.24
CD (0.05%)	2.50	0.85	3.082	0.42	0.06	0.45	1.02	2.62	3.40

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