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Impact of Integrated Vermicompost and Chemical Fertilizer Use on Productivity, Nutrient uptake and Economics of Rice

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ABSTRACT: Restoration of soil fertility and improvement of rice yield in terms of quantity and quality can only be achieved through integrated use of chemical fertilizers along with organic manures. A field experiment was carried out to study the integration of chemical fertilizers with vermicompost on growth, productivity, quality, nutrient uptake, and economics of rice during *kharif* 2019. The experiment was laid out in randomized block design with 10 treatments replicated three times. The treatments include; control, RDF and integration of RDF with vermicompost at varying doses and varied application time. The treatment received 100% RDF + vermicompost 2.5 t ha^{-1} in two split doses resulted in better crop growth *viz.* plant height, dry biomass, as well as yield attributes *viz.* effective tillers m^{-2}, grains panicle^{-1}, grain and straw yield of rice, it is followed by 100% RDF + vermicompost 2.5 t ha^{-1} applied in one dose. The highest grain yield of rice was recorded (4.23 t ha^{-1}) in T_3 vermicompost, which significantly at par with 100% RDF + vermicompost2.5 t ha^{-1} as basal dose (4.17 t ha^{-1}).

Keywords: Fertilizer, Nutrient uptake, Rice, Soil fertility, Vermicompost.

INTRODUCTION

Fertilizers are the major source of nutrients for rice under intensive cultivation. However, continuous and extensive use mainly attributed to macronutrient imbalance, micro-nutrients deficiency and fertilizer related environmental pollution (Biswas *et al.*, 2019; Kumar *et al.*, 2018). Further, the produce of chemical farming are poor in quality that affects the market acceptability. Under such situation, the restoration of soil fertility and improvement in rice yield and its quality could only be achieved through integrated use of chemical fertilizers in combination with organic manures (Chowdhury *et al*., 2015). Application of organics like farm yard manure, poultry manure, vermicompost, bio-fertilizers, and recycling of crop residues play a vital role in nutrients cycling, improves physical, chemical and biological properties of soil (Patel *et al.*, 2015).

Vermicompost is a nutrient-rich, microbiologically-active organic amendment that result from the interactions between earthworms and microorganisms during the breakdown of organic matter (Lazcano and Dominguez 2011). It is a stabilized, finely divided hums-like material with low C: N ratio, high porosity and high water holding capacity, in which most nutrients are present in forms that are readily taken up by plants (Dominguez, 2004). Apart from supply of macro and micro-nutrients, vermicompost is also enriched with vitamins, enzymes, antibodies and growth hormones. Unlike compost, vermicompost exhibit different physical and chemical characteristics that affect soil properties and plant growth in diverse ways. Compared with raw manure materials and its traditional compost, vermicompost possesses a greater capacity for cation exchange and a larger surface area (Meier *et al.*, 2017). Hence, now a day's vermicompost is gaining importance as a source of manure in commercial cultivation of rice as well as other crops. The mineralization of organic nitrogen (N) in vermicompost is a key process in determining the effectiveness of N nutrition for rice. In integrated nutrient management system, synchronizing the mineralization of N from vermicompost with periods of maximum N demand for a determinate crop like rice is a critical challenge. This synchrony could only be attained by split application of vermicompost in combination with synthetic N fertilizers at different critical growth stages of rice (Peng *et al.*, 2010). Thus, proper understanding of both N dynamics in soil and its uptake by crops is necessary to improve nitrogen use efficiency (Gastal and Lemaire 2002).

MATERIALS AND METHODS

The experiment was carried out during *kharif* 2019 at the Agricultural Research Station, Binjhagiri, Chhatabar, Faculty of Agricultural Sciences (IAS), Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar, Odisha (20°15′N latitude and 85°40′E longitude and at an altitude of 58.0 m above mean sea level). The soil of the experiment was clay loam in texture, low in organic carbon (0.47 %), available N (210.64 kg/ha) and K_2O (133.25 kg/ha), but medium in available P_2O_5 (21.64 kg/ha). The experiment was laid out in randomised block design with 10 nutrient management treatments in three replications. The treatments are T_1-Control, T_2- 100% RDF, T_3-100% RDF + basal application of vermicompost 2.5 t ha^{-1}, T_4- 100% RDF + vermicompost2.5 t ha^{-1} (50% basal + 50% top dressing), T_5-100% RDF + vermicompost 2.0 t ha^{-1} as basal, T_6- 100% RDF + VC 2.0 t ha^{-1} (50% basal + 50% topdressing), T_7-100% RDF + vermicompost 1.5 t ha^{-1} as basal, T_8- 100% RDF + VC 1.5 t ha^{-1} (50% basal + 50% topdressing), T_9- 100% RDF + vermicompost 1.0 t ha^{-1} as basal, T_{10}- 100% RDF + VC 1.0 t ha^{-1} (50% basal + 50% topdressing). The rice variety used was *Shabhagidhan*. Twenty five days old seedlings were uprooted and transplanted in rows at spacing of 20 cm x 10 cm in the main field. As, basal dose of 25 % N (15 kg N ha^{-1}), full dose of phosphorus (30 kg P_2O_5 ha^{-1}) and potassium (30 kg K_20 ha^{-1}) were applied through urea, single super phosphate and muriate of potash, respectively and incorporated properly into the top layer up to a depth of 15cm. The remaining quantity of nitrogen was applied as 50% N was top-dressed in two splits at 21 DAT & 40 DAT. The vermicompost was weighed and it was broadcasted evenly to the treatments according to the requirement (basal and top dressing). The total nutrient content of the vermicompost used was; N-1.28%, P_2O_5-0.85% and K_2O- 1.08%. Two hand weeding were applied before 1st and 2nd top dressing.

The observations on crop growth parameters (plant height and dry matter accumulation) were recorded at various growth stages. The yield attributes (number of effective tillers m^{-2} and number of grains $panicle^{-1}$) and yield (grain and straw yield) were taken during the harvesting. The nutrient uptake was calculated by multiplying the nutrient content of seed and stover with respective yields. The economics of various treatments was worked out taking into account the existing market price of various production factors and produce during the experimental period. The results pertaining to analysis of soil and plant samples, rice yield and uptake values were subjected to analysis of variance (ANOVA) and correlation statistics as suggested by Gomez and Gomez (1984). The nutrient balance of soil was determined by using the formula as proposed by Raghuwanshi *et al.* (1991):

$$B = Y - (X - A) - N$$

Where, B = Balance sheet of nutrient
Y = Uptake of nutrient by crop
X = Initial nutrient status of the soil
A = Final nutrient status of the soil
N = Nutrient added through fertilizer and manure.

Rice grain qualities like hulling, milling and head rice recovery were determined with Mc Gill Miller No. 3, where whole or a part of the brown layer was removed from the brown rice to produce milled or polished rice. The broken grains of milled rice were then separated from unbroken rice and the weight of head rice was recorded. Hulling, milling and head rice recovery were calculated by following formulae as suggested by Khush *et al.* (1979):

$$\text{Hulling \%} = \frac{\text{Weight of brown rice (g)}}{\text{Weight of rough rice (g)}} \times 100$$

$$\text{Milling \%} = \frac{\text{Weight of milled rice (g)}}{\text{Weight of rough rice (g)}} \times 100$$

$$\text{Head rice recovery \%} = \frac{\text{Weight of head rice (g)}}{\text{Weight of rough rice (g)}} \times 100$$

RESULTS AND DISCUSSION

The tallest rice plants with an average height of 94.27 cm were observed in the treatment T_4(100% RDF + vermicompost (vermicompost) 2.5 t ha^{-1} (50% basal + 50% top dressing). It was noticed that the treatments received vermicompost as basal and top dressing responded well and provided better results than those receives vermicompost in single dose (Table 1). This may be due to the fact that application of split doses of nutrient via fertilizers and vermicompost gives a better environment to the plants, so that plant can utilize the applied nutrient more efficiently from the soil. It is also fact that the losses of nutrients are less when it is applied in splits.A plant height of 71.97 cm was recorded with RDF i.e. 60 kg N, 30 kg P_2O_5 and K_2O kg ha^{-1} (Table 1). The shortest plants with a height of 48.40 cm was recorded in the control. Similar result was found by Pradhan (2019). At harvest, maximum dry matter of 722.84 g m^{-2} was recorded in the treatment T_4 and it was at par treatment T_3 (100% RDF + VC 2.5 t ha^{-1} as basal) showing a dry weight of 708.67 g m^{-2}. The treatments received RDF + 2.0 t of vermicompost ha^{-1} at either full as basal or 50% basal and rest 50% in TD stood next with the values of 699.03 g m^{-2} and 686.27 g m^{-2}, respectively (Table 1). In treatment T_2 *i.e.* RDF, produced a dry matter of 594.83 g m^{-2} whereas, the lowest dry matter (380.67 g m^{-2}) was observed under the control. Optimistic transformation in dry matter accumulation was due to alteration in NPK levels may be attributed to increase in the amount and efficiency of chlorophyll, which might have prejudiced the photosynthetic efficiency and construction of additional nitrogenous compounds *viz*. amino-acids, proteins, alkaloids and protoplasm resulting in upsurge in plant height and contributed towards increased dry matter accumulation. These findings are long-established by the result of Pradhan (2019); Chowdhury (2015).

The number of panicles m^{-2} varied significantly with the variation in treatments (Table 1). The more number of panicles (213 m^{-2}) was recorded under 100% RDF + VC 2.5 t ha^{-1} (1:1 as basal & top dress) which was significantly superior to all the nutrient management practices (Table 1). Treatment T_3 and T_6 followed next with values of 202.0 and 192.0 respectively. The next higher values were recorded with T_5 (190) followed by T_8 (189), T_7 (184), T_{10} (180) and T_9 (176) respectively. Under RDF the value was 154 and under control it was the least *i.e*. 108. Likewise, the number of grains $panicle^{-1}$ varied significantly under different treatment combinations. The superior value was 204 in the treatment T_4 (RDF + 2.5 t of vermicompost ha^{-1} 50% at basal and 50% at TD). The treatment T_3 and T_6 showed net higher values. Under RDF 139 grains $panicle^{-1}$ and under control 112 grains $panicle^{-1}$ were counted respectively (Table 1).

Grain and straw yield varied significantly with different nutritional management treatments. The highest grain yield of 4.23 t ha^{-1} was recorded in the treatment received RDF + 2.5 t of vermicompost ha^{-1} (50% as basal + 50% at TD). This is at par with T_3 with a yield of 4.17 t ha^{-1} (Table 1). Under the treatment, T_6 and T_5 the next higher yield of 3.97 t ha^{-1} and 3.91 t ha^{-1} were recorded respectively where two t of vermicompost were applied either basal or as basal + top dressing in addition to RDF. The grain yield under RDF is 3.21 t ha^{-1} while the lowest yield of 2.15 t ha^{-1} was recorded in control. The highest straw yield of 5.65 t ha^{-1} was recorded in the treatment T_4 that was at par with treatment T_3 producing 5.59 t ha^{-1} (Table 1).

In treatment T_6 the straw yield was 5.40 t ha^{-1} followed by in treatment T_5 recorded a straw yield of 5.32 t ha^{-1}. In the treatment T_2 *i.e*. RDF the yield was 4.30 t ha^{-1} and the least were found under T_1 treatment (2.94 t ha^{-1}). Similar result were also conveyed by Kundu (2012); Chowdhury (2015); Pradhan (2019) who stated that the integration of different sources of plant nutrients (e.g. FYM, vermicompost, crop residues etc.) has a satisfactory role on all the yield attributes vis-à-vis yield of rice grown either as a single sole crop or as a component crop of a cropping sequence of three or four crops. This may be due to the fact a little bit substitution of chemical fertilizers through organic manures has been proved to be a better choice. Because such type of combined use usually keeps the physical condition of soil better besides providing nutrients to the plant progressively but in a steady manner along with the added advantage of rapid, bounty and easy nutrient supplying capacity of chemical fertilizer to the crops and ultimately results in yield escalation.

Nitrogen uptake by grain and straw differed significantly with variation in nutrient management treatments. The highest N uptake by grain and straw was observed under 100% RDF + vermicompost 2.5 t ha^{-1} (1:1 as basal: top dress) (49.24 and 37.71 kg ha^{-1}) followed by 100% RDF + 2.5 t ha^{-1} as basal (48.29 and 36.24 kg ha^{-1}), respectively, both of which were at par (Table 2). With the treatment RDF the N uptake were 33.89 kg ha^{-1} and 21.92 kg ha^{-1} respectively for grain and straw. Application of 100% RDF alone resulted in the N uptake of 33.89 and 21.92 kg ha^{-1} by grain and straw, respectively, where the grain and straw N uptake was 31.2 and 15.3% lesser than the best performing nutrient management practice. The total N uptake followed the same trend of grain and straw uptake. The highest uptake of 86.95 kg ha^{-1} was recorded in the treatment which received, RDF +2.5 t of vermicompost ha^{-1} 50% at basal and 50% at topdressing (Table 2). It was at par with T_3. A total uptake of 55.81 kg ha^{-1} was recorded in RDF while the least total N uptake of 35.09 kg ha^{-1} was calculated in the treatment T_1. The highest P uptake of 22.03 kg ha^{-1} and 16.62 kg ha^{-1} were calculated with the treatment T_4 for grain and straw respectively, it was found at par with T_3 (Table 2). The value was 13.46 kg ha^{-1} and 9.45 kg ha^{-1} for grain and straw respectively in RDF. The lowest P uptake of 8.25 kg ha^{-1} and 6.08 kg ha^{-1} was found in T_1 control. A total uptake P uptake of 38.65 kg ha^{-1} was observed in T_4. It was closely followed by T_3 showing a value of 36.58 kg ha^{-1} (Table 2). Likewise, N and P uptake, K uptake by grain and straw followed the same trend of K uptake by the same. The highest K uptake by grain and straw was 16.52 kg ha^{-1} and 77.78 kg ha^{-1}calculated in the treatment T_4 respectively (Table 2). It was found at par with the treatment received RDF + 2.5 t of VC ha^{-1} at basal, where the uptake values were 15.59 kg ha^{-1} and 76.10 kg ha^{-1} respectively for grain and straw.

The highest total K uptake of 94.30 kg ha^{-1} was calculated in the treatment T_4 that receives 100% RDF + 2.5 t of vermicompost in two split doses. In RDF (60 kg N, 30 kg P_2O_5 and K_2O kg ha^{-1}) the uptake by grain and straw was 10.40 and 51.84 kg ha^{-1} while total K uptake was 62.24 kg ha^{-1} (Table 2). The least uptake of 6.62 kg ha^{-1}, 31.30 kg ha^{-1} and 37.93 kg ha^{-1} was found for grain, straw and total respectively in treatment T_1 respectively. Similar types of results were reported by Acharya (2007); Kundu (2012).

The initial N status was 210.64 kg ha^{-1} which was low in status. The N status after harvest of rice changes due to applied N as per different treatments and uptake by the crop. The N status was further decreasing in control after harvest of rice as the treatment did not receive any nutrient. It has been noticed that with addition of vermicompost of varying dose increased the soil N status than initial value after harvest of the crop. The N status also increased in the treatment received RDF through fertilizer. The highest N status was calculated with the treatment T_4 with a + 28.44 kg ha^{-1} than the initial (Table 3). It was closely followed by T_3 and T_6 where the values were +24.55 kg ha^{-1} and +22.89 kgha^{-1} respectively. With decrease in the dose of vermicompost the range of +ve value of N after harvest decreased. It has been observed that the treatment received vermicompost in split doses further shows a +ve value than the same dose of vermicompost, where it was applied full as basal. Likewise**,** nitrogen, phosphorous status in soil also showed a +ve status after harvest of rice except control. In the treatment control the value was 16.69 kg ha^{-1} whereas the highest value (30.12 kg ha^{-1}) was at treatment T_4, in RDF it was 22.59 kg ha^{-1} (Table 3). The intent of increase was also highest with the treatment T_4 with a value of +8.48 kg ha^{-1}, while in control it was -4.95 kg ha^{-1}. With RDF the increment was +0.95 kg ha^{-1}. The initial value was 21.64 kg ha^{-1}. Soil potassium status was also showing +ve status after harvest of rice. Initially the potassium value was 133.25 kg ha^{-1}, which changes to 125.16 kg ha^{-1}, 134.35 kg ha^{-1} and 154.52 kg ha^{-1} in control, RDF and T_4 treatments respectively (Table 3). The +ve extent was highest in treatment T_4 +21.27 kg ha^{-1} whereas at RDF it was +1.10 kg ha^{-1} in control it was -8.09 kg ha^{-1}.

Different nutritional management has a positive impact on post-harvest quality of rice grain (table 4). Hulling percentage varies from 75.3% in T_4 to 61.1% in T_1 (control); while the milling varies from 67.3% to 56.2% in the same treatments and the HRR values also shows the similar trend with the highest (65.4%) in T_4 and the lowest in 53.8% in control. The highest values of 75.3% of hulling, 68.4% milling with 65.4% HRR were obtained in the treatment T_4. So it is clearly been observed that application of different doses of vermicompost have better impact on post-harvest quality of rice grain. It is also observed that the split application of vermicompost have better influence over single application of vermicompost under different doses. Vermicompost is a rich blend of major and minor plant nutrients. A number of plant growth promoters are observed in earthworm casts and presence of earthworms help in aerating the soil.

It provide nutrients to the crop bit by bit but in a steady manner along with the added benefit of quick, amply and tranquil nutrient supplying capacity along with chemical fertilizer to the crops in integrated nutrient management Chowdhury *et al*. (2015). All these activities achieved by the heretofore-mentioned organic manures result in increased production of good quality product Acharya and Mondal (2007). Similar results were also reported by

The difference in cost of cultivation in this present study was due to the dissimilarity in different levels of nutrient under diverse treatments. The gross return of this experiment differs as per its yield and the market price. Here the highest gross return of ₹ 82428/- in the treatment T_4- RDF + 2.5 t of VC ha^{-1} 50% at basal and 50% at TD. The next higher value of gross return of ₹ 81279/- was found with treatment T_3 which received RDF + 2.5 t of VC ha^{-1} at basal. The lowest gross return of ₹ 41967/- was calculated in the control treatment. Similarly, as there was a variation in treatments there cost of cultivation also differed. The cost of cultivation varied from ₹ 38864/- in control to ₹ 53140/- in treatment T_4- RDF + 2.5 t of VC ha^{-1} 50% at basal and 50% at TD (Table 4).

The return $rupee^{-1}$ invested for all the treatments were calculated. The variation in these values clearly stated that there was positive effect of applying vermicompost in addition to RDF. At the treatment RDF the return $rupee^{-1}$ invested is 1.37, whereas the treatments received additional vermicompost of varying doses in addition to RDF showed return $rupee^{-1}$ invested ranged in between 1.50 to 1.55. The highest return $rupee^{-1}$ invested of 1.55 were worked out in treatment T_4 (RDF+2.5 t of VC ha^{-1} 50% at basal and 50% at TD) and T_3 (RDF+2.5 t of VC ha^{-1} at basal) respectively which received 2.5 t of vermicompost in addition to RDF (Fig. 1). Though there was a significant variation observed in their grain yield but as the labour requirement was more in T_4 than T_3 which compensate the gap and helped to achieve the same return $rupee^{-1}$ invested of 1.55 (Table 4). This statement was in conformation with the work conducted by Chowdhury (2015); Pradhan (2019). The return $rupee^{-1}$ invested was worked out 1.01 in control.

Table 1: Effect of different nutrient management on growth, yield attributing and yield of rice

Treatments	Plant height at harvest (cm)	Dry Matter Accumulation at harvest(g m^{-2})	No. of panicles m^{-2}	No. of grains $panicle^{-1}$	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1-Control	48.40	380.67	108	112	2.15	2.94
T_2- 100% RDF	71.97	594.83	154	139	3.21	4.30
T_3- T_2 + 2.5 t of vermicompost ha^{-1} as basal	91.90	708.67	202	192	4.17	5.59
T_4- T_2 + 2.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	94.27	722.84	213	204	4.23	5.65
T_5- T_2 + 2.0 t of vermicompost ha^{-1} at basal	89.07	686.27	190	181	3.91	5.32
T_6- T_2 + 2.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	90.13	699.03	192	187	3.97	5.40
T_7- T_2 + 1.5 t of vermicompost ha^{-1} as basal	83.10	657.00	184	169	3.75	5.08
T_8- T_2 + 1.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	82.80	669.03	189	173	3.79	5.17
T_9- T_2 + 1.0 t of vermicompost ha^{-1} as basal	78.37	626.06	176	148	3.58	4.98
T_{10}- T_2 + 1.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	80.97	633.43	180	155	3.62	5.03
SEm±	1.31	5.18	2.72	2.9	0.03	0.059
CD (P=0.05)	3.67	14.56	7.62	8.15	0.08	0.16

Table 2: Nutrient uptake by grain and straw as influenced by different nutrient management in rice.

Treatments	Uptake by grain (kg ha^{-1})			Uptake by straw (kg ha^{-1})			Total uptake (kg ha^{-1})		
	N	**P**	**K**	**N**	**P**	**K**	**N**	**P**	**K**
T_1-Control	21.19	8.25	6.62	13.90	6.08	31.30	35.09	14.33	37.93
T_2- 100% RDF	33.89	13.46	10.40	21.92	9.45	51.84	55.81	22.91	62.24
T_3- T_2 + 2.5 t of vermicompost ha^{-1} as basal	48.29	20.92	15.59	36.24	15.66	76.10	84.41	36.58	91.69
T_4- T_2 + 2.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	49.24	22.03	16.52	37.71	16.62	77.78	86.95	38.65	94.30
T_5- T_2 + 2.0 t of vermicompost ha^{-1} at basal	44.59	18.63	13.96	32.27	14.19	69.26	76.86	32.83	83.22
T_6- T_2 + 2.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	45.42	19.36	14.42	33.62	14.76	72.37	79.04	34.11	86.79
T_7- T_2 + 1.5 t of vermicompost ha^{-1} as basal	42.48	16.89	12.93	28.38	12.36	63.98	70.85	29.25	76.91
T_8- T_2 + 1.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	43.16	17.62	13.30	28.96	13.05	65.57	72.12	30.67	78.88
T_9- T_2 + 1.0 t of vermicompost ha^{-1} as basal	40.31	15.51	11.85	25.69	11.44	61.71	66.00	26.95	73.56
T_{10}- T_2 + 1.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	40.87	16.05	12.11	26.82	11.89	62.67	67.69	27.94	74.77
SEm±	0.91	0.42	0.31	1.24	0.35	1.89	1.91	0.47	1.93
CD (P=0.05)	2.54	1.17	0.87	3.47	0.97	5.29	5.34	1.31	5.40

Table 3: Changes in soil nutrient status and fertility build-up after harvesting of rice.

Treatments	Final soil status after harvest (kg ha^{-1})			+ or - over initial soil status (kg ha^{-1})		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
T_1-Control	180.65	16.69	125.16	-29.99	-4.95	-8.09
T_2- 100% RDF	214.56	22.59	134.35	+3.92	+0.95	+1.10
T_3- T_2 + 2.5 t of vermicompost ha^{-1} as basal	235.19	29.73	151.59	+24.55	+8.09	+18.34
T_4- T_2 + 2.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	239.08	30.12	154.52	+28.44	+8.48	+21.27
T_5- T_2 + 2.0 t of vermicompost ha^{-1} at basal	226.35	27.52	146.28	+15.71	+5.88	+13.03
T_6- T_2 + 2.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	233.53	28.46	148.26	+22.89	+6.82	+15.01
T_7- T_2 + 1.5 t of vermicompost ha^{-1} as basal	222.49	25.41	143.52	+11.85	+3.77	+10.27
T_8- T_2 + 1.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	225.4	26.44	145.07	+14.76	+4.80	+11.82
T_9- T_2 + 1.0 t of vermicompost ha^{-1} as basal	218.56	24.71	140.68	+7.92	+3.07	+7.43
T_{10}- T_2 + 1.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	221.38	25.22	141.75	+10.74	+3.58	+8.50

Table 4: Quality parameters and economics influences by different nutrient management practices.

Treatments	Hulling %	Milling %	Head Rice Recovery %	Gross Return (Rs./ha)	B:C
T_1-Control	64.1	56.2	53.8	41967.0	1.01
T_2- 100% RDF	66.0	58.4	56.3	62558.0	1.37
T_3- T_2 + 2.5 t of vermicompost ha^{-1} as basal	74.2	67.3	64.6	81279.0	1.55
T_4- T_2 + 2.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	75.3	68.4	65.4	82428.0	1.55
T_5- T_2 + 2.0 t of vermicompost ha^{-1} at basal	72.8	64.8	61.2	76290.0	1.51
T_6- T_2 + 2.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	73.5	65.3	62.0	77452.0	1.51
T_7- T_2 + 1.5 t of vermicompost ha^{-1} as basal	70.4	63.5	59.6	73139.0	1.50
T_8- T_2 + 1.5 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	71.8	63.9	60.4	73956.0	1.51
T_9- T_2 + 1.0 t of vermicompost ha^{-1} as basal	68.2	61.2	58.3	69953.0	1.50
T_{10}- T_2 + 1.0 t of vermicompost ha^{-1}(50% basal + 50% topdressing)	69.5	62.4	58.9	70728.0	1.50
SEm±	0.37	0.63	0.32	-	-
CD (P=0.05)	1.10	1.9	0.94	-	-

CONCLUSION

Thus, integrating recommended fertilizer dose i.e. 60 kg N, 30 Kg P_2O_5 & K_2O per ha with the application of 2.5 t of vermicompost in two equal splits at basal (50%) and top dressing (50%) appeared to be promising in terms of soil fertility built-up, higher productivity and profitability in rice during *kharif* season.

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Conflict of Interest. None.

REFERENCES

Acharya, D. and Mondal, S. S. (2007). Effect of integrated nutrient management on the potassium content in the plant and its effect on the quality characters and disease infestation of different crops in rice (*Oryza sativa*) based intensive cropping system. *Indian Journal of Agricultural Sciences*, *77*(10): 664-668.

Biswas, B., Nirola, R., Biswas, J. K., Pereg, L., Willett, I. R. and Naidu, R. (2019). Environmental Microbial Health Under Changing Climates: State, Implication and Initiatives for High-Performance Soils. In: Lal R., Francaviglia R. (eds) Sustainable Agriculture Reviews 29. *Sustainable Agriculture Reviews*, *29*. Springer, Cham.

Chowdhury, Md R., Roy, Choudhury, S., Brahmchari, K. and Kumar, V. (2015). Productivity and fertility build-up of the soil through INM under rice-onionresidual greengram crop sequence. *Green farming*, *6*(4): 716-720.

Chowdhury, Md R. (2015). Nutrient management through combined use of organic, inorganic and biological sources under rice-onion-greengram crop sequence. Ph.D. Thesis, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal.

Domínguez, J. (2004). State of the art and new perspectives on vermicomposting research. (In) Edwards, C.A. (Ed.) *Earthworm Ecology*. CRC Press LLC, pp. 401-424.

Gastal, F and Lemaire, G. (2002). N uptake and distribution in crops: An agronomical and ecophysiological perspective. *Journal of Experimental Botany*, *53*: 789-799.

Gomez, K. A. and Gomez, A. A. (1984). Statistical procedure for agriculture research, 2nd Edn. International Rice Research Institute, Los Banos, Philipines. John Wily and Sons, New York pp. 324

Kumar, A. B., Prakash, C. H. and Brar, N. S. (2018). Potential of Vermicompost for Sustainable Crop Production and Soil Health Improvement in Different Cropping Systems. *International Journal of Current Microbiology and Applied Science*, *7*(10): 1042-1055.

Kundu, R. (2012). Nutrient management through organic and inorganic sources in sunflower-fodder cowpea-rice-spinach beet cropping sequence. Ph.D. Thesis, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia, West Bengal.

Lazcano, C. and Domínguez, J. (2011). Effects of vermicompost as a potting amendment of two commercially-grown ornamental plant species. *Spanish Journal of Agricultural Research*, *8*(4), 1260-1270.

Meier, S., Curaqueo, G., Khan, N., Bolan, N., Cea, M., Eugenia, G. M., and Borie, F. (2017). Chicken−manure−derived biochar reduced bioavailability of copper in a contaminated soil. *Journal of Soils Sediments*, *17*(3): 741−750.

Patel, L. C., Chakrabarty, S. and Googoi, A. K. (2015). Organic cultivation of chilli – an assessment in West Tripura district of Tripura. *Journal of Eco-friendly Agriculture*, *10*(1): 15-19.

Pradhan, A. (2019). Nitrogen economy in rice (O*ryza sativa*) through integrated approach. M.Sc. (Ag) thesis. Siksha 'O' anusandhan. Bhubaneswar, Odisha.

Raghuwanshi, R. K. S., Umat, R., Nema, M. L. and Dubey, D. D. (1991). Balance sheet of nitrogen, phosphorus and potash in soil as influenced by wheat based cropping sequence. *Indian Journal of Agronomy*, *36*(3): 322-325.

Reddy, T. Y. and Reddy, G. H. S. (2016). Principles of Agronomy, Third revised edition, Kalyani Publication Ludhiana, pp 204-256.

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