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Household Waste Based Vermicompost and Fertilizer Effect on Yield and Attributes of Pot Culture Rice (*Oryza sativa*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Organic matter content in soil improves the soil health with supporting large microbial population and stabilizing soil health deterioration. The soil physical, chemical parameters improve according to the significant application of organic matter in soil. Integrated application of organic and inorganic sources and analysis of these components in response to its effect on rice growth and yield attributes at different stages is of major concerned study. Application of four levels of vermicompost (0 t ha^{-1}, 1.25 t ha^{-1}, 2.5 t ha^{-1}, 3.7 t ha^{-1}) and three levels of fertilizer (0%, 100%, 50% Recommended Dose of Fertilizer) were taken in a pot culture experiment and total of 36 pots i.e. twelve treatments replicate thrice for analyzing its effects on growth and yield attributes of rice crop (Variety-*Rajendra Bhagawati*) with using factorial Completely Randomized Design statistical method for data analysis and validation. Application of higher doses of vermicompost 3.7 t ha^{-1} and higher dose of fertilizer i.e. 100% RDF content in combination produced elevated grain and straw yield and also boosted growth attributes (Panicle length, test weight, number of tillers, grains per panicle), root volume as well as chlorophyll content from initial growth up to the harvesting time over the control due to buildup of organic matter and nutrient mobilization in soil.

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1. INTRODUCTION

The heavy application of fertilizers to boost up the production to mitigate the food crisis has deteriorated the soil health. Rice is grown most extensively in the whole world as a major cereal crop to feed the half of the total population [1]. More than 90% of the rice production is there in Asia and India is the second largest grower after China. Higher concentration off nutrient along with balanced dose of fertilizer with organic sources has proved to be efficient in enhancing the yield [2] along with better yield attributes over control. Among plant nutrients N application helps in better vegetative growth and increased grain yield with better carbon utilization [3,4,5]. Application of vermicompost and other organic sources reduces soil pollution, enhance the microbial activity, increase microbial activities with higher nutrient mobilization [6] and its availability (Kumar et al., 2020) to plants elevate the yield and yield attributes [1].

Organic sources along with fertilizer sources help in buildup of organic matter in soil and helps in improving soil physico-chemical along with biological properties. The elevated nutrient use efficiency in relation to balanced organic and inorganic sources reduces the cost of cultivation with improved soil health. This experiment was conducted to analyze the combined effect of household waste vermicompost and fertilizer on improving the soil nutrient status along and nutrient utilization by plants to enhance yield as well as yield attributes, root volume and chlorophyll content for understanding better sink source with photosynthesis process of plant.

2. MATERIALS AND METHODS

An experiment was conducted at Dr. RPCAU, Pusa, Samastipur, Bihar, India situated at the coordinates 25^0 58' 54'' N latitude, 85^0 40' 25'' E longitudes and at 55 meter above mean sea level with combination of four levels of vermicompost (0 t ha^{-1}, 1.25 t ha^{-1}, 2.5 t ha^{-1}, 3.7 t ha^{-1}) and three levels of fertilizer fertilizers (0%, 100%, 50% Recommended Dose of Fertilizer) in pot culture with rice crop grown in pots according to different treatment combination following Factorial Completely Randomized Design, in which 12 treatments are replicated thrice given in Table 1.

2.1 Root Volume (cm^3 $plant^{-1}$)

Freshly uprooted root was properly cleaned with water and was kept under shade for drying. Then it was dipped in measuring cylinder filled with water and volume of displacement was noted down and final root volume was calculated.

2.2 Spad Reading (mSPU)

The chlorophyll content reading was taken in standard SPAD (Soil-Plant Analyses Development) meter i.e. SPAD-502 Plus Chlorophyll Meter.

Table 1. Details of treatments used in experiment

Treatments	Details
$V_0 F_0$	No manure + No Fertilizer- Control
$V_0 F_{100}$	No manure + 100% RDF
$V_0 F_{50}$	No manure + 50% RDF
$V_{1.25} F_0$	Vermicompost (1.25tha^{-1}) + No Fertilizer
$V_{1.25} F_{100}$	Vermicompost (1.25t ha^{-1}) +100% RDF
$V_{1.25} F_{50}$	Vermicompost (1.25t ha^{-1}) + 50% RDF
$V_{2.50} F_0$	Vermicompost (2.5t ha^{-1}) + No Fertilizer
$V_{2.50}F_{100}$	Vermicompost (2.5t ha^{-1}) + 100%RDF
$V_{2.50}F_{50}$	Vermicompost (2.5t ha^{-1}) + 50% RDF
$V_{3.75}F_0$	Vermicompost (3.75t ha^{-1}) + No Fertilizer
$V_{3.75}F_{100}$	Vermicompost (3.75t ha^{-1}) + 100%RDF
$V_{3.75}F_{50}$	Vermicompost (3.75t ha^{-1}) +50% RDF

2.3 Yield Attributing Parameters

Number of tillers

Total number of tillers per hill was recorded at 30 DAS/DAT and at harvest on four selected hills and expressed as average number of tillers per hill.

Length of Panicle (cm)

The length of the panicle was observed from the node with standard measuring instrument and expressed in cm.

Grains/panicle

The random panicles were chosen for counting grains per panicle. The filled and unfilled grains were made by pressing it with fingers and they were counted and recorded.

1000 grain weight (g)

Total One thousand filled grains were separately counted and weighed for observation.

2.4 Yield Parameters

Grain yield (g pot^{-1})

The crop was harvested from the individual pots and threshed separately and sun dried. The grain weight was recorded and expressed in g pot^{-1}.

Straw Yield (g pot^{-1})

Straw from the net individual pot after threshing was sun dried and weight was recorded and expressed in g pot^{-1}.

2.5 Statistical Analysis

All the data obtained in the experiment will be analyzed statistically applying **Factorial Completely Randomized Design** by the method of "Analysis of Variance" as described by Gomez and Gomez [7]. The Significance of the treatment effect was judged with the help of variance ratio test. Critical Difference (C.D.) at 5 percent and 1 percent level of significance worked out to determine the difference between treatment means. All the statistical analysis were done by using OPSTAT (http://14.139.232.166/opstat/default.asp) analysis software.

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

The effect of vermicompost and fertilizer levels on the plant height is shown in the Table 2. The vermicompost of levels 2.5 t ha^{-1} and 3.75 t ha^{-1} were significantly superior over no vermicompost level, as well as fertilizer levels 50% RDF and 100% RDF were significantly higher over no fertilizer level. The combined application of vermicompost (3.75 t ha^{-1}) + 100% RDF showed higher plant height i.e. 116.33 cm. The interaction among the levels of vermicompost and fertilizer were found non-significant.

The increase in plant height might be due to the more availability of nitrogen to the plant thus, photosynthetes was increased with cell division and increased plant height. The results obtained were supported by Dutta and Sangtam [8].

3.2 Panicle Length (cm)

The data pertaining to panicle length presented in Table 2 reveals significant influence of vermicompost and fertilizer. The combined application of highest level of vermicompost (3.75 t ha^{-1}) + 100% RDF showed panicle length i.e. 24.30 cm, which was found superior over control (21.00 cm) but the interaction among the levels of vermicompost and were found non-significant.

3.3 Grains per Panicle

The influence of levels of vermicompost (no manure, 1.25 t ha^{-1}, 2.5 t ha^{-1}, 3.75 t ha^{-1}) and fertilizer levels (no fertilizer, 50% RDF, 100% RDF) on grains per panicle is shown in the Table 3. The interactions among different levels of vermicompost and fertilizer were found non-significant; however the vermicompost of 2.5 t ha^{-1} and 100% RDF produced higher grains per panicle i.e. 114.00 over control i.e. 103.00.

The increase in grains/panicle might be due to the more availability of NPK and micro nutrients to the plant might have influenced better translocation of photosynthates into the sink due to better enzymatic activities increased grains/panicle. Close findings were observed by Mahmud et al., [9].

3.4 Panicles per Plant

The trend for panicles per plant with respect to different levels of vermicompost and fertilizer is shown in the Table 3. The interactions among different levels of vermicompost and fertilizer recorded significant panicles per plant. The combined applications of vermicompost 2.5 t ha^{-1} + 100% RDF and 3.75 t ha^{-1} + 100% RDF as well as vermicompost 3.75 t ha^{-1} + 50% RDF showed same panicles per plant [10].

3.5 Panicles per Pot

The Table 3 showed panicles per pot with respect to different levels of vermicompost and fertilizer application. The interactions among different levels of vermicompost and fertilizer were found significant results regarding panicles per pot ranged between 11.00 to 21.00. The combined applications of vermicompost 2.5 t ha^{-1} + 100% RDF and 3.75 t ha^{-1} + 100% RDF as well as vermicompost 3.75 t ha^{-1} + 50% RDF were found similar in panicles per plant which were significantly superior over control.

3.6 Root Volume (cm^3 $plant^{-1}$)

The influence of vermicompost and fertilizer on the root volume is given in the Table 4.The interactions between vermicompost and fertilizer levels were found significant. The integrated applications of vermicompost 3.75 t ha^{-1} and 100% RDF recorded significantly higher root volume than control.

At post-harvest, the root volume ranged between 58.33 to 92.33 cm^3 $plant^{-1}$ in accordance to the levels of vermicompost, irrespective of fertilizer. The root volume varied from 46.50 to 105.50 cm^3 $plant^{-1}$ with applications of different levels of fertilizer, irrespective of vermicompost levels. The different levels of vermicompost recorded significantly superior root volume over no vermicompost level application. The 50 and 100% RDF showed significantly higher root volume over no fertilizer level. At the post-harvest the elevated root volume was found in the treatment receiving (vermicompost-3.75 t ha^{-1}+ 100% RDF) i.e. 125.00 which was significantly superior over control (no-vermicompost + no fertilizer) i.e. 35.00.

The increase in root volume during tillering and post-harvest stages might be due to more availability of nutrients and increased nutrient uptake capacities of the roots thus by providing proper growth to the roots.

3.7 Chlorophyll SPAD value (mSPU)

The chlorophyll content was recorded with SPAD-502. The SPAD data with respect to vermicompost and fertilizer combination treatments is shown graphically in the Fig. 1.

All the sole application of vermicompost and fertilizers did not show significant rise in the SPAD content. The integrated application of vermicompost (3.75 t ha^{-1}) + 100% NPK showed higher amount of SPAD content in whole 8 weeks observations i.e. 36.05 mSPU, 36.31 mSPU, 36.49 mSPU, 36.62 mSPU, 36.76 mSPU, 37.01 mSPU, 37.47 mSPU, 37.93 mSPU, respectively over the control. There was increase in the mean chlorophyll content according to the treatment combination of application of vermicompost and fertilizer.

The interaction among the vermicompost levels and fertilizer levels was found non-significant in most observations and significant in two stages of observations but the integrated application of vermicompost and fertilizer was considered significantly superior over control. The chlorophyll content has direct correlation with the nitrogen content. The increased organic matter might have supplied more nitrogen to plants and close similarity results were found by Meena et al., [11] in mustard crop.

3.8 Grain Yield (g pot^{-1})

The data pertaining to grain yield as influenced by vermicompost and fertilizer levels presented in Table 5 are statistically significant. The interactions among the levels of vermicompost and fertilizer were found significant. The integrated application of vermicompost (3.75 t ha^{-1}) + 100% NPK resulted in significant higher amount of grain yield i.e. 54.66 g pot^{-1} at post-harvest over the control (24.10 g pot^{-1}) which was at par with the treatment receiving vermicompost (2.5 t ha^{-1}) + 100% NPK i.e. 53.35 g pot^{-1}.

The increase in grain yield might be due to the more and steady availability of nutrients to the plant from vermicompost and NPK which have enhanced grain yield, similar close findings were made by Manivannan et al., [12].

3.9 Straw Yield (g pot^{-1})

The Table 5 the influence of vermicompost and fertilizer on the straw yield. The interactions of vermicompost and fertilizer levels were found significant over control in each treatment. The integrated application of 3.75 t ha^{-1} vermicompost along with 100% RDF showed significantly higher straw yield i.e. 60.40 g pot^{-1} over other combinations.

The increase in straw yield might be due to more and steady availability of nutrients to the plant from vermicompost and NPK reducing the chances of fixation which have enhanced the plant growth than usual and increased straw yield. Similar findings were observed by Urkurkar et al. (2010) and [12].

3.10 Test Weight (gram)

The effect of vermicompost and fertilizer levels on the test weight is presented in the Table 5. The test weight (g) varied from 21.85 to 22.47 with the applications of different levels of vermicompost, irrespective of fertilizer levels of application. The test weight (g) variations ranged between 21.62 to 22.47 with applications of different levels of fertilizer, irrespective of vermicompost levels. All the levels of vermicompost i.e. 1.25 t ha^{-1}, 2.5 t ha^{-1} and 3.75 t ha^{-1} gave non-significant over no vermicompost application, while in case of fertilizer the levels of 50 and 100% RDF recorded significantly higher results in test weight (g) over no fertilizer level application. The overall interactions among the different levels of vermicompost and fertilizer were found to enhance concentration of nutrients and increase in test weight signifies better uptake of nutrients and better translocation of photosynthesis material from source to sink [13].

3.11 Grain Nitrogen Content (%)

A inspection of data in Table 6 discovered that increasing dose of vermicompost and chemical fertilizer separately and in combination improved the nitrogen content in grain. The nitrogen content in grain as influenced by various treatment combinations varied from 0.631 to 0.782% in different vermicompost levels, irrespective of fertilizer. The fertilizer level varied the grain nitrogen content from 0.633 to .758%., irrespective of vermicompost.

The treatment involving highest dose of vermicompost (3.75 t ha^{-1}) in combination with RDF recorded higher value (0.816%) but significant variation due to combined effect of vermicompost and fertilizer was not observed among treatment combinations. The levels of vermicompost and fertilizer were significantly superior over no vermicompost and no fertilizer, respectively. Higher grain nitrogen content might be due to mobilization and assimilation of nutrients in soil and grain, similar close result was observed by Meena et al., [11] in mustard crop.

3.12 Grain Phosphorus Content (%)

The effect of different levels of vermicompost and fertilizer on grain phosphorus content is presented in the Table 6. The grain phosphorus content varied from 0.129 to 0.183 mg pot-1, irrespective of fertilizer. Irrespective of vermicompost levels, with the increasing fertilizer levels varied from 0.133 to 0.175 mg pot^{-1}. The grain phosphorus content with respect to the different levels of vermicompost and fertilizer showed significantly higher grain phosphorus content than individual no vermicompost and no fertilizer levels, respectively. The interactions among the vermicompost and fertilizer levels were found significant. The high dose of vermicompost 3.75 t ha^{-1} and 100% RDF recorded significantly superior grain phosphorus content i.e. 0.192 mg pot^{-1} , which was statistically at par with treatments receiving 3.75 t ha^{-1} + 50% RDF (0.189 mg pot^{-1}) and 2.5 t ha^{-1} vermicompost and 100% RDF (0.190 mg pot^{-1}).

The increase in grain phosphorus content might be could be due to the more and stable availability of phosphorus to the plant thus the phosphorus content in grain increased [9].

3.13 Grain Potassium Content (%)

The effect of different levels of vermicompost and fertilizer on grain potassium content is presented in the Table 6. The grain potassium content varied from 0.161 to 0.195 mg pot^{-1} with different vermicompost levels, irrespective of fertilizer levels. Irrespective of vermicompost levels, the grain potassium contentwith respect to the different fertilizer levels ranged between 0.171 to 0.190 mg pot^{-1}. The vermicompost levels i.e. 1.25 t ha^{-1}, 2.5 t ha^{-1} and 3.75 t ha^{-1} recorded significantly higher grain potassium content over no vermicompost level. The 50 and 100% RDF levels also gave significantly higher grain potassium content over no fertilizer level. The interactions regarding vermicompost and fertilizer levels were non-significant. However the vermicompost of 3.75 t ha^{-1} + 100% RDF recorded higher grain potassium content i.e. 0.205%.

Table 2. Effect of vermicompost and fertilizer on panicle length and plant height of rice crop during growth period

Treatments	Plant height (cm)				Panicle length (cm)			
	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean
V_0	93.67	109.33	105.67	**102.89**	21.00	22.30	22.00	**21.77**
$V_{1.25}$	95.67	113.00	109.00	**105.89**	22.00	23.70	23.00	**22.90**
$V_{2.5}$	100.67	116.33	111.00	**109.33**	23.00	23.80	23.40	**23.40**
$V_{3.75}$	110.33	112.67	114.67	**112.56**	23.60	24.30	23.93	**23.94**
Mean	**100.09**	**115.33**	**110.09**		**22.40**	**23.53**	**23.08**	
Factors	CD (5%)		SEm(±)		CD (5%)		SEm(±)	
Vermicompost (V)	3.05		1.04		0.64		0.22	
Fertilizers (F)	2.64		0.90		0.55		0.19	
V X F	NS		1.80		NS		0.38	

V_o= Vermicompost (no manure), $V_{1.25}$= Vermicompost (1.25 t ha^{-1}), V2.5= Vermicompost (2.5 t ha^{-1}), $V_{3.75}$ = Vermicompost (3.75 t ha^{-1}), F_0= Fertilizer (no fertilizer) , F_{100}= Fertilizer (100% RDF), F_{50}= Fertilizer (50% RDF) and V_0F_0 = control (no vermicompost + no fertilizer).

Table 3. Effect of vermicompost and fertilizer on grains per panicle, panicles per plant and panicles per pot of rice crop during growth period

Treatments	Grains/ panicle				Panicles/ plant				Panicles/ pot			
	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean
V_0	103.00	106.00	105.00	**104.67**	2.75	4.25	3.50	**3.50**	11.00	17.00	14.00	**14.00**
$V_{1.25}$	110.00	112.00	108.00	**110.00**	300	5.00	4.25	**4.08**	12.00	20.00	16.00	**17.33**
$V_{2.5}$	109.00	114.00	109.00	**110.67**	4.00	5.25	5.00	**4.75**	16.00	21.00	20.00	**19.00**
$V_{3.75}$	110.00	113.00	110.00	**111.00**	4.00	5.25	5.25	**4.83**	16.00	21.00	21.00	**19.33**
Mean	**108.00**	**111.250**	**108.00**		**3.44**	**4.94**	**4.50**		**13.75**	**19.75**	**18.00**	
Factors	CD (5%)		SEm(±)		CD (5%)		SEm(±)		CD (5%)		SEm(±)	
Vermicompost (V)	3.03		1.03		0.13		0.04		0.50		0.17	
Fertilizers (F)	2.62		0.89		0.11		0.04		0.43		0.15	
V X F	NS		1.79		0.22		0.07		0.86		0.29	

V_o= Vermicompost (no manure), $V_{1.25}$= Vermicompost (1.25 t ha^{-1}), V2.5= Vermicompost (2.5 t ha^{-1}), $V_{3.75}$ = Vermicompost (3.75 t ha^{-1}), F_0= Fertilizer (no fertilizer) , F_{100}= Fertilizer (100% RDF), F_{50}= Fertilizer (50% RDF) and V_0F_0 = control (no vermicompost + no fertilizer).

Table 4. Effect of vertmicompost and fertilizer on root volume of rice crop during growth periods

Treatments	Root volume (cm^3 $plant^{-1}$)							
	Tillering stage				Post-harvest stage			
	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean
V_0	10.00	20.00	15.00	15.00	35.00	90.00	50.00	**58.33**
$V_{1.25}$	15.00	25.00	20.00	20.00	44.00	97.00	61.00	**67.33**
$V_{2.5}$	25.00	33.19	24.14	27.44	50.00	110.00	80.00	**80.00**
$V_{3.75}$	17.20	37.72	28.67	27.86	57.00	125.00	95.00	**92.33**
Mean	**16.80**	**28.98**	**21.95**		**46.50**	**105.50**	**71.50**	
Factors	CD (5%)		SEm(±)		CD (5%)		SEm(±)	
Vermicompost (V)	0.71		0.24		2.41		0.82	
Fertilizers (F)	0.62		0.21		2.08		0.71	
V X F	1.23		0.42		4.17		1.42	

V_o= Vermicompost (no manure), $V_{1.25}$= Vermicompost (1.25 t ha^{-1}), V2.5= Vermicompost (2.5 t ha^{-1}), $V_{3.75}$ = Vermicompost (3.75 t ha^{-1}), F_0= Fertilizer (no fertilizer) , F_{100}= Fertilizer (100% RDF), F_{50}= Fertilizer (50% RDF) and V_0F_0 = control (no vermicompost + no fertilizer).

Table 5. Effect of vermicompost and fertilizer on grain yield, straw yield and test weight of rice crop during growth period

Treatments	Grain yield (g pot^{-1})				Straw yield (g pot^{-1})				Test weight (gram)			
	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean
V_0	24.10	40.42	32.13	**32.22**	26.01	46.16	35.53	**35.90**	21.27	22.43	21.86	**21.85**
$V_{1.25}$	28.34	49.57	40.20	**39.37**	31.95	55.54	47.20	**44.90**	21.47	22.13	21.90	**21.83**
$V_{2.5}$	38.03	53.35	48.34	**46.57**	31.41	58.05	51.33	**46.93**	21.81	22.28	22.17	**22.09**
$V_{3.75}$	38.60	54.66	51.80	**48.35**	39.94	60.40	55.69	**52.01**	21.94	23.04	22.43	**22.47**
Mean	**32.27**	**49.50**	**43.12**		**32.33**	**50.09**	**47.44**		**21.62**	**22.47**	**22.09**	
Factors	CD (5%)		SEm(±)		CD (5%)		SEm(±)		CD (5%)		SEm(±)	
Vermicompost (V)	1.23		0.42		1.35		0.46		NS		0.21	
Fertilizers (F)	1.06		0.36		1.17		0.40		0.53		0.18	
V X F	2.13		0.72		2.33		0.80		NS		0.36	

V_o= Vermicompost (no manure), $V_{1.25}$= Vermicompost (1.25 t ha^{-1}), V2.5= Vermicompost (2.5 t ha^{-1}), $V_{3.75}$ = Vermicompost (3.75 t ha^{-1}), F_0= Fertilizer (no fertilizer) , F_{100}= Fertilizer (100% RDF), F_{50}= Fertilizer (50% RDF) and V_0F_0 = control (no vermicompost + no fertilizer).

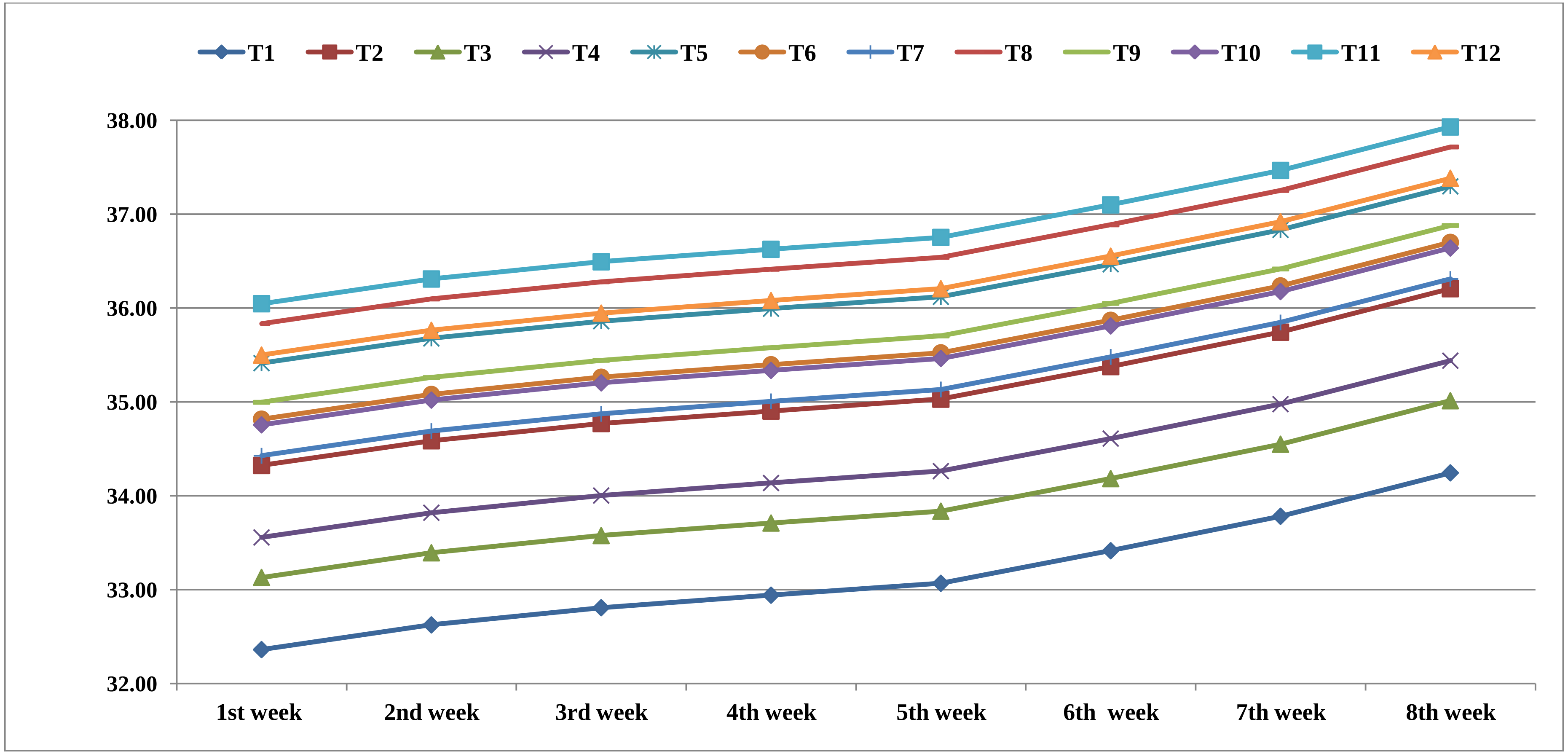

Fig. 1. Effect of vermicompost and fertilizer on chlorophyll SPAD value of rice crop during growth periods

Table 6. Effect of vermicompost and fertilizer on grain nutrient (N, P and K) contents of rice crop during growth period

Treatments	Total N %				Total P %				Total K %			
	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean
V_0	0.554	0.701	0.639	**0.631**	0.101	0.157	0.131	**0.130**	0.151	0.167	0.165	**0.161**
$V_{1.25}$	0.603	0.707	0.683	**0.664**	0.113	0.168	0.150	**0.144**	0.163	0.183	0.181	**0.176**
$V_{2.5}$	0.652	0.808	0.734	**0.731**	0.148	0.189	0.178	**0.172**	0.180	0.205	0.190	**0.192**
$V_{3.75}$	0.723	0.816	0.806	**0.782**	0.170	0.192	0.190	**0.184**	0.188	0.205	0.191	**0.195**
Mean	**0.633**	**0.758**	**0.716**		**0.133**	**0.177**	**0.162**		**0.171**	**0.190**	**0.182**	
Factors	CD (5%)		SEm(±)		CD (5%)		SEm(±)		CD (5%)		SEm(±)	
Vermicompost (V)	0.033		0.011		0.008		0.003		0.009		0.003	
Fertilizers (F)	0.029		0.010		0.007		0.002		0.007		0.003	
V X F	NS		0.020		0.013		0.004		NS		0.005	

V_o= Vermicompost (no manure), $V_{1.25}$= Vermicompost (1.25 t ha^{-1}), V2.5= Vermicompost (2.5 t ha^{-1}), $V_{3.75}$ = Vermicompost (3.75 t ha^{-1}), F_0= Fertilizer (no fertilizer) , F_{100}= Fertilizer (100% RDF), F_{50}= Fertilizer (50% RDF) and V_0F_0 = control (no vermicompost + no fertilizer).

Table 7. Effect of vermicompost and fertilizer on straw nutrient (N, P and K) contents of rice crop during growth period

Treatments	Total N %				Total P %				Total K %			
	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean	F_0	F_{100}	F_{50}	Mean
V_0	0.362	0.454	0.446	**0.421**	0.055	0.073	0.064	**0.064**	0.551	0.622	0.568	**0.580**
$V_{1.25}$	0.381	0.462	0.452	**0.432**	0.063	0.074	0.069	**0.069**	0.627	0.774	0.700	**0.700**
$V_{2.5}$	0.441	0.494	0.462	**0.466**	0.061	0.078	0.073	**0.071**	0.697	0.899	0.889	**0.828**
$V_{3.75}$	0.460	0.503	0.482	**0.482**	0.071	0.083	0.076	**0.077**	0.856	0.958	0.947	**0.920**
Mean	**0.411**	**0.478**	**0.460**		**0.063**	**0.077**	**0.071**		**0.683**	**0.813**	**0.776**	
Factors	CD (5%)		SEm(±)		CD (5%)		SEm(±)		CD (5%)		SEm(±)	
Vermicompost(V)	0.015		0.005		0.002		0.001		0.026		0.009	
Fertilizers(F)	0.013		0.004		0.002		0.001		0.023		0.008	
V X F	0.026		0.009		NS		0.001		0.046		0.016	

V_o= Vermicompost (no manure), $V_{1.25}$= Vermicompost (1.25 t ha^{-1}), V2.5= Vermicompost (2.5 t ha^{-1}), $V_{3.75}$ = Vermicompost (3.75 t ha^{-1}), F_0= Fertilizer (no fertilizer) , F_{100}= Fertilizer (100% RDF), F_{50}= Fertilizer (50% RDF) and V_0F_0 = control (no vermicompost + no fertilizer)

3.14 Straw Nitrogen Content (%)

A critical analysis of data (Table 7) revealed that nitrogen content in rice straw varied from 0.362 to 0.503%. The treatment involving highest dose of vermicompost (3.75 t ha^{-1}) in combination with RDF recorded significantly higher value (0.503%) and was equally at par with treatment receiving vermicompost (2.50 t ha^{-1}) with RDF (0.494%) and vermicompost (3.75 t ha^{-1}) and 50% RDF (0.482%).

Result reveals that increasing dose of vermicompost and chemical fertilizer separately and in combination significantly improved the N-content of rice straw. The interaction effect was found significant. A perusal of data indicated that combined use of vermicompost and chemical fertilizer i.e. vermicompost (3.75 t ha^{-1}) in combination with RDF recorded 38.95% increase over control. The increase in straw nitrogen content might be due to the more availability of nitrogen to the plant thus increased straw nitrogen content [9].

3.15 Straw Phosphorus Content (%)

The (Table 7) deals with influence of vermicompost and fertilizer levels on the straw phosphorus content of rice crop in the pot experiment. The vermicompost of levels 1.25 t ha^{-1}, 2.5 t ha^{-1} and 3.75 t ha^{-1} all were found significantly higher over no vermicompost level. The fertilizer levels of 50% and 100% RDF were found significantly superior over no fertilizer level. The combined application of highest level of vermicompost (3.75 t ha^{-1}) + 100% RDF showed straw phosphorus content i.e. 0.083%, which was significantly superior over control (0.055%) but the interactions among the different levels of vermicompost and fertilizer were found non-significant.

3.16 Straw Potassium Content (%)

The effect of different levels of vermicompost and fertilizer on straw potassium is presented in the Table 7. Straw phosphorus content varied between 0.064 to 0.077% with respect to different levels of vermicompost, irrespective of fertilizer levels. The straw phosphorus ranged between 0.063 to 0.077% in according to different levels of fertilizer, irrespective of vermicompost. The vermicompost of levels 1.25 t ha^{-1}, 2.5 t ha^{-1} and 3.75 t ha^{-1} all were found significantly higher over no vermicompost level. The fertilizer levels of 50% and 100% RDF were found significantly superior over no fertilizer level. However the vermicompost of 3.75 t ha^{-1} + 100% RDF recorded higher straw potassium content i.e. 0.958%, which was statistically at par with the treatment receiving 3.75 t ha^{-1} vermicompost and 50% RDF (0.947%).

4. CONCLUSION

Application of combined sources of vermicompost and fertilizer improved soil health an reduced the harmful effect of fertilizer in soil. Among all other treatments higher dose of vermicompost (3.75 t ha^{-1}) along with higher dose of fertilizer (100% Recommended Dose of Fertilizer) showed elevated results for the both grain and straw yield for the pot cultured rice. The higher yield of grain was accompanied by higher grains per panicle, panicle length, plant height, panicles per plant, root volume, nutrient content in grains and straw, chlorophyll content and other growth attributes of rice plant in the experiment during crop growth stages was possibly due to assimilation and absorption of higher amount of nutrients buildup in pot culture soil in due course of plant growth.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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