International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 2034-2038

Received: 24-07-2017
Accepted: 25-08-2017

Amit Kumar
Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh-India

BP Dhyani
Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh-India

Ashish Rai
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh-India

Vipin Kumar
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh-India

Correspondence
Ashish Rai
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh-India

Effect of timing of vermicompost application and different level of NPK on growth, yield attributing characters and yield of rice in rice-wheat cropping system

Amit Kumar, BP Dhyani, Ashish Rai and Vipin Kumar

Abstract
Two field experiments were conducted during 2011-12 and 2012-13 in the Crop Research Centre, of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh taking rice (PB-1) as a test crop. The maximum and significantly higher numbers of tillers per meter row length were recorded in T_2 (100% NPK) followed by vermicompost with 75% N, 100% P and K before sowing. Maximum plant height was recorded with the application of 100% NPK. Recommended dose of NPK were significant in case of dry matter yield at maximum tillering and panicle initiation. Maximum grain yield during both the years was recorded with the application of 100% NPK (T_2). Grain yield recorded under T_2 differ significantly from T_1, T_9 and T_{10}. Maximum straw yield was recorded in T_2 followed by T_1, T_8, T_9 and T_{10} during. Maximum biological yield found in T_3.

Keywords: Vermicompost, NPK, yield attributing characters, grain yield and straw yield.

Introduction
The green revolution transformed farming practice in many regions of the tropics and sub tropics where the principal food crops were rice, wheat and maize. There is no doubt that the Green Revolution made the country self-sufficient in food production. As a matter of fact, the Green Revolution created buffer stocks at times exceeding 60 million tonnes, which made the nation proud (Dhaliwal, 2005) [2]. With the availability of high-yielding varieties of rice and wheat after green revolution rice-wheat cropping system of Indian agriculture is the cornerstone of the nation's food security. This system contributes about 75% of the nation's total food grain production (Mahajan *et. al.,* 2002) [6]. The rice-wheat cropping system covers an estimated area of 13.5 m ha^{-1} in Indo-Gangetic plains in south Asia consisting of Bangladesh, India, Nepal and Pakistan (Ladha *et. al.,* 2003) [5]. Indiscriminate use of inorganic fertilizers and plant protection chemicals for maximizing crop yield has resulted in the deterioration of the physical, chemical and biological properties of rice–wheat growing soils. There is a growing concern about the sustainability of the rice-wheat cropping system as the growth rate of rice and wheat yields are either stagnant or have declined. Therefore despite the early benefits, it became apparent that there are many negative impacts from the green revolution such as reduced natural fertility of soil, salinization of the agricultural soil, decline in soil organic matter, and poor soil physical condition particularly in rice-wheat system.

In rice-wheat areas of north- west India, deficiency of Zn, Cu, and Mn have been found to the extent of 52-75%, 8.32%, 2.4%, and 1-8% respectively (Yadav *et. al.,* 1998) [12]. To sustain or increase the productivity of rice-wheat system, it is important that soil status must be perfect the level of organic matter in soil should be enough and overall the soil must be without any constraints. It is therefore imperative to supply plant nutrients through chemical and organic fertilizers since application of neither chemical fertilizers nor organics alone can assist in sustaining the yield of rice-wheat cropping system. Vermicompost is the conversion of biodegradable organic waste materials into granular compost through earthworms consisting of worm casts rich in nutrients and micro-flora than conventional compost. Some of the secretions of worms and associated microbes act as growth promoter along with other nutrients. Much interest in vermicomposting has been noticed due to the fact that earthworms play an important role in soil improvement, organic matter decomposition and enhancing plant growth (Gupta and Bhagat, 2004) [4].

Materials and Methods

Two field experiments were conducted at the Crop Research Centre (CRC), Chirodi of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.) which is located at latitude of 29^0 40′ North and longitude of 77^0 42′ East and at an altitude of 237 meter above mean sea level (MSL). The region enjoys semi-arid and subtropical climate with extremes of hot weather in summer and cold in winter season. The area receives on an average 862 mm of rains annually of which 90% is confined to rainy season. A composite soil sample was collected from a depth of 0-15cm of the experimental site. The experimental soil was sandy loam in texture (Sand, 63.2%, Silt 18.5 % and Clay 18.3 %), alkaline in pH (8.04), having low organic carbon (0.43%), available nitrogen (155.5 kg/ha) medium in phosphorus (13.8 kg/ha) and potassium (141.5 kg/ha). To study the effect of vermicompost scheduling on growth performance and yield of rice crop an experiment consisting ten treatments was conducted in randomized block design with three replications in rice-wheat system during 2011-12 and 2012-13. Treatments of the experiment included; T_1-Control (without NPK) in rice, T_2-100% RDF to rice, T_3-75% N,100% P and K+Vermicompost @ 2 ton ha^{-1}as basal to rice, T_4-75% N,100% P and K + Vermicompost @ 2 ton ha^{-1} at tillering stage to rice, T_5-75% N,100% P and K + Vermicompost @ 2 ton ha^{-1} at panicle initiation, T_6-75% N,100% P and K + Vermicompost @ 2 ton ha^{-1} at flowering stage to rice, T_7-50% N,100% P and K + Vermicompost @ 4 ton ha^{-1} as basal to rice, T_8-50% N,100% P and K + Vermicompost @ 4 ton ha^{-1} at tillering stage to rice,T_9-50% N,100% P and K + Vermicompost @ 4 ton ha^{-1} at panicle initiation to rice and T_{10}-50% N,100% P and K + Vermicompost @ 4 ton ha^{-1} at flowering stage to rice. Recommended dose of fertilizers (NPK) for rice crop was 120, 60 and 60 kg ha^{-1}, respectively.

Randomly, five plants were marked for recording various growth observation of the crop. Growth observations were recorded at maximum tillering, panicle initiation; flowering and harvesting stage in rice. Yield and yield attributing characters were recorded at harvest. The number of tillers per meter length from the randomly selected row was counted. Tillers at maximum tillering, panicle initiation, flowering and harvesting were counted in rice.

Five hills of rice were marked in the plot and the plant height was measured. Plants from one meter length from sampling area were cut close to the ground surface from each plot separately at various growth stages of rice. After initial sun drying, the samples were kept in hot air oven at 60$\pm$5 ^{0}C for 72 hours or till the constant weight were achieved.

The dry matter accumulation were recorded at maximum tillering, panicle initiation, flowering and harvesting for rice and at harvest for wheat and expressed in qha^{-1}. Length of five panicles or spikes were measured and averaged to express in cm. Numbers of grain obtained from the five panicles or spikes were counted and expressed as mean number of grains per panicle or spike. 1000 grains were counted and weighed for test weight which was expressed in gram.

The weight of grains of rice and wheat harvested from the net plot area was recorded in kg and finally expressed in q ha^{-1}. The straw yield was computed on difference basis. Grain yield was subtracted from the biological yield of net plot and expressed as kg ha^{-1} and finally expressed in q ha^{-1}. The raw data collected for all parameters at different crop stages during the course of investigation was compiled and subjected to statistical analysis using the analysis of variance technique (Gomez and Gomez, 1984) [3]. The critical difference (at 5 % level of probability) was computed for comparing treatment mean in cases where effect came out to be significant by F-test.

Results and Discussion

Number of tillers/ meter row length of rice crop

From the table (Table 1) it is clear that the number of tillers/ meter row length at different stages varied significantly with the application of different treatments during both the years. At Maximum tillering stage the number of tillers / meter row length varied from 38.3 to 62.7 and 41.2 to 66.7 during 2011 and 2012, respectively. At panicle initiation 43.7 to 80.0 and 56.3 to 93.0, flowering 41.7 to 78.3 and 50.0 to 85.7 and at harvesting 39.3 to 76.0 and 48.0 to 82.7. The maximum and significantly higher number of tillers/ meter row length than the rest of the treatments at maximum tillering, panicle initiation, flowering and harvesting during 2011 as well as 2012 were recorded in T_2 where 100 % NPK was applied. Supplementation of 2 and 4 tons of vermicompost with 75% N, 100% PK and 50% N, 100% PK at transplanting resulted in significantly higher number of tillers than the treatments where vermicompost was not added with these nutrient levels. Application of vermicompost at flowering stage either with 75% N, 100% PK and 50%N, 100% PK T_6 and T_{10} produced statistically similar tillers/meter row length to the treatments consisting application of vermicompost at maximum tillering and panicle initiation stages and significantly lower than the treatments having basal application of vermicompost. The experimental soil was low in available nitrogen. Nitrogen is growth promoting nutrient. Nitrogen when absorbed during vegetative phase helps to synthesise the chlorophyll necessary for photosynthesis, promotes rapid leaf, stem and root growth as evidenced by an increase in number of tillers as well as an increase in the size of leaves. Nitrogen increases proportion of protoplast to cell wall and deal several consequences, one of them being increase in size of cell which express morphologically in increase plant height (Arnon 1953) [1]. Any reduction in nitrogen application rate will directly influence the plant growth. In the experiment soil having low N level only recommended dose of N was applied in T_2 while in T_3 to T_6 and T_7 to T_{10} 25 to 50% N application was curtailed although these proportion were substituted through vermicompost. Significantly higher number of tillers with early than delayed vermicompost application is well understood able with the fact that owing to mineralization nitrogen availability will be higher at maximum tillering& at panicle initiation stages in treatments fertilized with vermicompost earlier. Application of organic materials considerably improves soil physical properties and nutrient uptake resulting in greater growth, yield and yield components (Singh *et al*., 1994 and Mondal and Chettri, 1998) [9, 7].

Table 1: Effect of different treatments on number of tillers m^{-1} row length of rice at different growth stages

Treatments	Max. Tillering		Panicle Initiation		Flowering		At harvest	
	2011	2012	2011	2012	2011	2012	2011	2012
T_1	38.30	41.20	43.70	56.30	41.70	50.00	39.30	48.00
T_2	62.70	66.70	80.00	93.00	78.30	85.70	76.00	82.70
T_3	55.00	57.70	73.70	79.70	70.70	75.00	67.00	69.70
T_4	49.30	51.70	71.30	77.70	67.90	74.30	64.40	67.30
T_5	48.30	50.70	64.30	72.50	61.20	66.30	61.00	60.30
T_6	48.00	50.00	64.70	70.70	60.70	66.00	58.30	60.70
T_7	46.90	49.80	69.00	75.00	66.30	67.70	63.30	65.00
T_8	40.30	44.70	68.70	73.30	65.70	66.00	62.30	60.70
T_9	39.30	44.70	63.00	69.30	62.00	61.30	58.00	59.00
T_{10}	38.70	42.00	60.00	68.00	56.00	56.30	54.30	54.70
SE(m)	1.46	1.55	1.93	1.65	1.93	1.45	2.78	2.16
CD at 5%	4.37	4.65	5.79	4.94	5.77	4.35	8.32	6.47

Plant height (cm) of rice crop at different stages

Plant height increased with the advancement of crop growth in all the treatments. At Maximum tillering stage the plant height varied from 47.38 to 52.00 and 50.56 to 54.94 cm during 2011 and 2012, respectively (Table 2). At panicle initiation 58.5 to 77.3 and 60.6 to 80.0, flowering 70.3 to 91.6 and 76.3 to 95.8 and harvesting 73.0 to 102.8 and 78.4 to 105 cm. The maximum plant height at all the growth stages during both the years was found with the application of T_2. Application of 2and 4 tons of vermicompost with 75%N, 100%PK and 50%N, 100%PK at transplanting resulted in slightly taller plant than the treatments where vermicompost was not added with these nutrient levels.

The maximum plant height 77.3 and 80.0 (cm) in T_2at panicle initiation during 2011 and 2012, respectively, was statistically similar to plant height recorded in the treatments consisting 75% N, 100% PK application but significantly higher than those treatments where 50%N, 100% PK was applied. The maximum plant height at flowering stage 91.6 and 95.8 cm during 2011 and 2012, respectively in T_2 was statistically similar to T_3 and T_4 and significantly higher than the rest of the treatments. At harvest the maximum plant height 102.8 and 105.0 during 2011 and 2012, respectively, in T_2 was found statistically similar to T_3 and significantly higher than the rest of the treatments, these may be explained due to comparative higher level of nitrogen application at the time of transplanting. Non-significant difference between T_2 and T_3 after maximum tillering stage in respect of plant height during both the years may be attributed to release of nitrogen from vermicompost added at the time of transplanting. Pontillas *et al*., 2009 [8] reported that application of vermicompost alone results no significant differences in the height in comparison to inorganic fertilizer at 60 DAT. However, they reported that vermicompost can be a substitute for pure inorganic fertilizer since it affects growth, yield and economic return on rice production favourably.

Table 2: Effect of different treatments on plant height (cm) of rice at different growth stages

Treatments	Max. Tillering		Panicle Initiation		Flowering		At harvest	
	2011	2012	2011	2012	2011	2012	2011	2012
T_1	47.38	50.56	58.50	60.60	70.30	76.30	73.00	78.40
T_2	52.00	54.94	77.30	80.00	91.60	95.80	102.80	105.00
T_3	51.83	54.77	74.00	78.00	86.20	91.10	99.90	99.80
T_4	50.76	54.63	70.20	77.00	83.90	86.90	95.40	98.30
T_5	50.59	53.68	69.00	75.40	81.30	85.20	92.70	93.70
T_6	49.57	53.91	69.70	74.40	79.50	85.90	90.30	93.30
T_7	48.36	52.85	67.00	72.00	80.80	82.50	90.40	92.80
T_8	47.54	52.96	65.80	71.20	80.30	81.60	89.10	90.40
T_9	47.64	51.89	63.70	68.70	78.70	80.10	88.30	88.20
T_{10}	47.55	51.61	61.00	65.90	75.20	80.00	86.80	86.60
SE(m)	1.46	1.66	3.32	2.13	2.76	1.78	2.24	2.20
CD at 5%	N.S.	N.S.	9.93	6.37	8.26	5.33	6.72	6.57

Dry matter accumulation (q ha^{-1}) at different stages

At Maximum tillering stage, panicle initiation, flowering and harvest stage the dry matter accumulation (q ha^{-1}) varied from 6.17 to 10.00, 12.97 to 28.68, 35.3 to 60.2 and 59.8 to 99.58 q ha^{-1} during 2011, respectively and 4.87 to 9.50, 12.67 to 28.51, 33.60 to 59.70 and 59.00 to 99.08 qha^{-1} during 2012 (Table 3). Dry matter production with recommended NPK was significantly higher than the remaining treatments at maximum tillering and panicle initiation while it was at par to T_3 at flowering and harvest during both the years. Treatments consisting supplementation of two and four tons of vermicompost with 75% N, 100% PK and 50% N. 100% PK at transplanting did not resulted any significant effect over the treatments where vermicompost was not applied with these nutrient levels. Although the timing of vermicompost did not affected the dry matter accumulation significantly but comparatively higher quantity was recorded with earlier application at every growth stage during both the years. With the 100% NPK application initially nutrients availability was higher and that might have resulted in better growth and there by more dry matter accumulation. At maximum tillering stage no significant effect of vermicompost application at transplanting over 75 or 50% N and 100 % PK was found. This effect can be explained due to non significant difference in the number of tiller per meter row length. Among the vermicompost treated plots comparatively more dry matter was found with early than delayed application. It may be ascribed due to difference in nutrient releasing pattern.

Table 3: Effect of different treatments on dry matter accumulation (q ha^{-1}) of rice at different growth stages

Treatments	Max. Tillering		Panicle Initiation		Flowering		At harvest	
	2011	2012	2011	2012	2011	2012	2011	2012
T_1	6.17	4.87	12.97	12.67	35.3	33.60	59.80	59.00
T_2	10.00	9.50	28.68	28.51	60.2	59.70	99.58	99.08
T_3	8.40	7.10	22.76	23.46	54.71	55.41	95.19	93.89
T_4	8.25	6.75	22.41	21.78	49.3	48.13	93.45	91.95
T_5	7.79	6.33	21.85	20.39	45.71	44.35	89.57	88.21
T_6	7.92	6.43	21.94	20.91	46.79	45.30	87.82	87.33
T_7	7.36	5.87	20.27	18.45	44.62	44.15	86.20	85.71
T_8	7.06	5.25	20.79	18.32	43.97	43.08	84.33	83.86
T_9	6.66	5.18	17.63	17.53	42.56	42.45	80.17	79.36
T_{10}	6.50	5.25	17.56	17.15	42.48	40.48	78.58	78.55
SE(m)	0.34	0.45	1.20	1.11	1.99	1.86	2.79	2.45
CD at 5%	1.02	1.34	3.60	3.33	5.96	5.57	8.36	7.32

Panicle length (cm)
It is clear from the table (Table 4) that the panicle length differ significantly under different treatments and ranged from 20.60 to 28.67 and 21.33 to 25.87 cm during 2011and 2012, respectively. The maximum panicle length 28.67 cm during 2011, recorded in T_2 was significantly higher than the rest of the treatments while such affect was not noticed during 2012. Earlier application of vermicompost resulted in lengthy panicle and panicle length in T_3, T_4 was significantly higher than T_5 and T_6. Similarly panicle length in T_7, T_8 was significantly higher than T_9 and T_{10}. Panicles which bears the grain was measured and it was found that panicle length differ significantly under different treatments during both the years. Maximum panicle length was recorded with the application of 100% NPK. Comparatively lengthy panicles were also found with the early application of vermicompost than delayed. This effect may be explained due to better vegetative growth with the application of 100% NPK or earlier application of vermicompost as reflected by more tiller numbers and dry matter accumulation. Better vegetative growth might have resulted in better reproductive growth.

Number of grains per panicle
The maximum and significantly higher grains per panicle than the most of the treatments 120.0 during 2011 were recorded in T_2 where 100% NPK applied (Table 4). Only two treatments T_3 and T_4 having earlier application of vermicompost were found statistically at par to T_2. Number of grains per panicle differs significantly during 2011 but no such effect was found during 2012. Number of grains per panicle with the application of 100% NPK as well as earlier application of vermicompost with 75% N and 100 % PK were significantly higher than the remaining treatments. This effect may be supposed due to better flowering with adequate nutrition at maximum tillering and panicle initiation stage. Non significant effect during 2012 could not be explained with suitable cause.

Test weight (g)
From the table (Table 4) it is clear that the test weight was significantly affected by different treatments during both the years. The test weight (g) varied from 16.76 to 21.42 and 15.95 to 21.29 during 2011 and 2012, respectively. Timing of vermicompost application did not resulted any significant effect on test weight during both the years although earlier application resulted in higher test weight during both the years. Test weight increased significantly due to application of different treatments during both the years. Minimum test weight was noted in control plot which is obvious due to poor photosynthetic activity with lower leaf area index (LAI) and leaf area duration (LAD) as a consequence of inadequate nitrogen.

Table 4: Effect of different treatment on yield attributing characters of Rice crop

Treatments	Length of Panicle (cm)		No. of grains $Panicle^{-1}$		1000 grains weight (g)	
	2011	2012	2011	2012	2011	2012
T_1	20.60	21.33	87.00	85.00	16.76	15.95
T_2	28.67	25.87	120.00	121.00	21.42	21.29
T_3	26.93	25.60	114.00	112.00	20.23	20.34
T_4	26.43	25.57	106.00	103.00	20.16	20.10
T_5	24.37	25.03	98.00	95.00	20.12	19.34
T_6	24.40	25.10	95.00	96.00	20.15	19.53
T_7	25.66	23.50	100.00	118.00	20.11	19.75
T_8	24.93	22.70	96.00	115.00	20.02	19.72
T_9	23.40	23.10	92.00	92.00	20.09	19.67
T_{10}	23.23	23.83	92.00	90.00	19.99	19.37
SE(m)	0.37	0.32	5.24	12.63	0.51	0.56
CD at 5%	1.11	0.94	15.70	N.S.	1.52	1.65

Grain yield (q ha^{-1})
Grain yield varied from 26.00 to 38.50 and 19.20 to 38.40 q ha^{-1} during 2011and 2012, respectively (Table 5). The maximum grain yield 38.50 and 38.40 q ha^{-1} during 2011 and 2012, respectively, was recorded in T_2 with 100% NPK application. During 2011, with the exception of T_1, T_9 and T_{10}, rest of the treatments were found statistically at par to T_2 while during 2012, all the treatments consisting application of 50% N, 100% PK along with vermicompost as well as T_1 were found significantly inferior to T_2. Although the timing effect of vermicompost application on grain yield was non significant but it was observed that earlier application of vermicompost either with 75% N, 100% PK and 50% N, 100% PK produced higher yield than delayed application. Earlier application of vermicompost either with 50% or 75% N and 100 % PK yielded comparatively higher than late application. Although grain yield recorded with the application of 100% NPK was higher by 3.7 and 4.2 qha^{-1} from T_5 and T_6, 4.0 and 4.5 from T_7 and T_8 but difference could not reach to significance level during 2011. This non significant difference may be supposed due to release of plant nutrients from the added vermicompost application at the earlier growth stages (Vasanthi and Kumarswamy, 2000; Vijaya and Balasubramian, 2002) [10, 11].

Straw yield (qha^{-1})
Data regarding the effect of different treatments on straw yield of rice are presented in The straw yield varied from 32.60 to 54.05 and 32.80 to 51.86 q ha^{-1} during 2011and 2012, respectively (Table 5). The maximum straw yield 54.05 and 51.86 q ha^{-1} during 2011and 2012 was recorded in T_2 with 100% NPK application. During both the years, with the exception of T_1, T_8, T_9 and T_{10}, rest of the treatments were found statistically at par to T_2 while these treatments were found significantly lower than T_2 in respect of their effect on straw yield. Straw yield also differ significantly with the application of different treatments. With exception of T_7, fertilized with 50% N and 100 % PK + vermicompost along with control yielded significantly lower straw yield than T_2 during. This variation may be due less number of tillers and shorted plant height with these treatments.

Biological yield of rice crop

The biomass yield (Sum of grain and straw yield) of rice which ranged from 58.60 to 92.55 and 52.00 to 90.29 q/ha during 2011 and 2012, respectively, was influenced significantly by different treatments (Table 5). Maximum biomass yield 92.55 and 90.29 q ha^{-1} during 2011 and 2012, respectively recorded in T_2 with 100 % NPK application was found statistically at par with the biomass yield recorded in T_3 during 2011 as well as 2012 and significantly higher than the remaining treatments during both the years.

Table 5: Effect of different treatments on grain and straw yield (q ha^{-1}) of rice

Treatments	Grain Yield		Straw Yield		Biological Yield	
	2011	2012	2011	2012	2011	2012
T_1	26.00	19.20	32.60	32.80	58.60	52.00
T_2	38.50	38.40	54.05	51.86	92.55	90.29
T_3	36.80	36.20	51.59	49.14	88.42	85.34
T_4	35.50	34.50	50.07	46.93	85.57	81.46
T_5	34.30	33.40	48.95	47.25	83.29	80.62
T_6	34.80	30.80	49.46	48.28	84.29	79.11
T_7	34.50	32.60	49.46	48.96	83.96	81.59
T_8	34.00	30.60	46.91	45.87	80.94	76.50
T_9	32.30	29.80	44.26	43.72	76.59	73.55
T_{10}	31.20	28.50	44.60	43.29	75.77	71.75
SE(m)	1.52	1.92	1.89	1.94	1.97	2.92
CD at 5%	4.56	5.75	5.66	5.82	5.88	8.75

Summary

The maximum and significantly higher number of tillers per meter row length then the rest of the treatments during all the growth stages were recorded in T_2 (100% NPK). Earlier application of vermicompost with 75% N and 100% PK resulted in comparatively higher number of tillers. Maximum plant height was recorded with the application of 100% NPK but could not differ significantly in most cases from the treatments where 2 ton of vermicompost was applied 75% N and 100% PK. Dry matter production with the recommended NPK was significantly higher than the remaining treatments at maximum tillering and panicle initiation while it was at par to T_3 at flowering and harvest during both the years. Comparatively higher quantity of dry matter production was recorded with early application of vermicompost. Reduction in N level through chemical fertilizer resulted in a smaller panicle. Application of 100% NPK through chemical fertilizer resulted in significantly higher number of grains per panicle than the most of the treatments during 2011. Early application of vermicompost along with 75%N 100%PK resulted in statistically similar number of grains per panicle to T_2. T_2 resulted in significantly higher test weight than T_1 only while during second year differ significantly from T_1, T_5, T_6 and T_{10}. Grain yield recorded under T_2 differ significantly from T_1, T_9,T_{10} during 2011 while all the treatments consisting application of 4 ton vermicompost and 50% N and 100% PK were significantly inferior to T_2. Maximum straw yield recorded with the application of 100% NPK was significantly higher than T_1, T_8, T_9 and T_{10} during both the years. Straw yield increased by 36.81 to 65.80 and 31.98 to 58.11 % over the control due to application of different treatments. Maximum biological yield statistically at par to T_3 and significantly higher than the rest was found with the application of 100% NPK (T_2).

Conclusion

25% nitrogen requirement of basmati rice can be supplemented through the application of 2 ton vermicompost ha^{-1} as basal, or panicle initiation or flowering stages of rice crop. No clarity was found about the substitution of 50%nitrogen requirement by higher dose of vermicompost since rice grain yield during the second year was significantly lower than T_2 (100% NPK through chemical fertilizer). During the first year early application of 4 ton vermicompost along with 50% nitrogen yielded statistically at par to T_2.

Reference

1. Arnon I. The physiology and biochemistry of phosphorus in green plants. Agronomy Monogram. 1953; 4:10.
2. Dhaliwal S. Crop diversification need of the hour. The Glimpses of Future. 2005; 20(71):4.
3. Gomez AK, Gomez AA. Statistical procedures for Agricultural Research Second Edition. John Wiley and Sons, New York. U.S.A, 1984.
4. Gupta RD, Bhagat KC. Earthworms do miracles in agriculture. Indian Farmers’ Digest. 2004; 37(2):41-44.
5. Ladha JK, Dawe D, Pathak H, Padre RL, Yadav RL, Singh B *et al*. How extensive are yield declines in long-term rice-wheat experiments in Asia? Field Crops Res. 2003; 81(2-3):159-180.
6. Mahajan A, Choudhary AK, Bhagat RM. Integrated plant nutrient management (IPNM) system for sustainability in cereal based cropping system. Indian Farmers’ Digest. 2002; 35(7):29-32.
7. Mondal SS, Chettri M. Integrated nutrient management for Sustaining Productivity and Fertility under Rice (*Oryza sativa*)-Based Cropping System. Indian J. Agr. Sci. 1998; 68(7):337-340.
8. Pontillas, Lugo, Malate, Lanioso. Efficacy evaluation of vermicompost and inorganic fertilizer applied in lowland rice. The Threshold. 2009; IV:66-75.
9. Singh Y, Singh B, Khera TS, Meelu OP. Integrated nutrient management of Green Manure, Farmyard Manure, and Nitrogen Fertilizer in a Rice-Wheat Rotation in Northeastern India. Arid Soil Res. Rehab. 1994; 8(2):199-205.
10. Vasanthi D, Kumarswamy K. Efficacy of vermicompost to improve soil fertility and rice yield. J. Ind. Soc. Soil Sci. 2000; 47(2):268-272.
11. Vijaya M, Balasubramaniam KA. Influence of nitrogen through integrated sources of organic and inorganic on rice blast disease. J. Myco and Plant Patho. 2002; 32(2):211-212.
12. Yadav RL, Prashad K, Gangwar KS, Dwivedi BS. Cropping systems and resource-use efficiency. Indian J. Agric. Sci. 1998; 68(8):548-58.