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Evaluation of Bio-Organic Preparations on Yield of Sharbati Wheat Varieties under Kymore Plateau and Satpura Hill Zone of Madhya Pradesh

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A B S T R A C T

A field study was conducted in the Department of Agronomy, JNKVV, Jabalpur during 2015-16 and 2016-17 to judge the effect of bio-organic preparations (viz., BD-500, BD-501 and panchgavya) blended with vermicompost on the yield of Sharbati wheat varieties. The results showed that the combined application of all bio-organic preparations i.e. BD-500, BD-501 and panchgavya along with vermicompost recorded superior values of yield attributes tillers/m^2 (320.94), grains/ear head (27.65), test weight (36.90 g) and ear length (7.77 cm) along with noteworthy hike (22.28, 18.25 and 6.39 percent) in seed yield of wheat over alone application of BD-500, BD-501 and panchgavya with Vermicompost respectively. The Sharbati wheat varieties JW-3020 out yielded to other varieties under organic production system with superior values of yield attributes (tillers 288.30 m^2, grains/ear head 28.71, test weight 35.6 g and ear length 7.40 cm. The cultivation of wheat variety JW-3020 and combined application of all bio-organic preparations (VC+BD-500+BD-501+Panchagavya) along with vermicompost gave higher yield as compared to other combinations of wheat varieties and application of other bio-organic preparations.

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important staple food crops of the world. Wheat is grown in about around 219.61 million ha area across 43 countries in the world with the production of 729.1 million tonnes (FAO, 2016). In India, it is cultivated in about 30.97 million hectares area with the production and productivity of nearly 88.94 million tonnes and 2872 kg/ha respectively. Madhya Pradesh contributes 17.95 and 15.94 per cent to the total area and production of wheat in the country but the productivity is still low (2550 kg/ha) compared to Haryana 4579 kg/ha and Punjab 4495 kg/ha (Agriculture Statistics, 2015). Currently, heavy use of chemicals in wheat, has weakened the ecological base and degrading the soil, water resources and quality of the food. At this juncture, a keen awareness has sprung on the adoption of organic farming in which scientific community are working hand in hand to develop a strong workable and compatible package of nutrient management through organic resources viz., biodynamic preparations, vermicompost, panchgavya etc. for various crops. Biodynamic preparations combining biological and dynamic agriculture practices, has recently emerged as an

advancement in the field of organic agriculture. Biodynamic techniques enhance, rejuvenate, add to and maintain soil quality in terms of biological properties. The biodynamic preparations are believed to work synergistically with BD-500 mainly improving the overall soil fertility and BD- 501 being active in enhancing the plant physiological response to the light radiation (Koepf, 1976). On the other side, Panchgavya is another source of plant nutrients in organic farming which enhances biological activities, soil health and quality. Vermicompost contains significant quantities of nutrients, beneficial microbial population and biologically active metabolites (Jack *et al.,* 2011). Studies of Chandrakala (2008) reported that impact of biodynamic practices and panchgavya alone or in combination for organic nutrient management has been found effective on various crops in different agro-climatic zones. But, very scarce literature is available depicting the combine effect of biodynamic preparations, panchgavya with vermicompost in wheat under organic production system. Most of the farmers are growing traditional varieties of wheat under organic farming which are low yielding. However, there is a wide range of Sharbati wheat varieties of varying duration and productivity which have differential performance under organic management. Hence, it is most important to judge varietal response under varying nutrient management involving alone application of BD-500,501, panchgavya with vermicompost and combined use of all bio-organic preparations with vermicompost for Kymore Plateau and Satpura hill zone of Madhya Pradesh.

Materials and Methods

The field experiment was conducted during *rabi season* of 2015-16 and 2016-17 on *'Vertisol'* at Adhartal krishi nagar of JNKVV, Jabalpur ($23^0$90' North latitude and $79^0$58' East longitude with an altitude of 411.78 m mean sea level), Madhya Pradesh. This region enjoys sub-humid and tropical climate with hot dry summer and cool dry winters and comes under Kymore Plateau and Satpura hills Agro-climatic zone of Madhya Pradesh and is broadly known as rice-wheat crop zone. The experiment was consisted with seven bio-organic preparations as main plot treatments viz. N1: VC @ 4t/ha+ BD–500 @75 g/ha, N2: VC @ 4t/ha+ BD–501 @2.5 g/ha,N3: VC @ 4t/ha+ Panchagavya @3% at CRI, tillering and jointing, N4: VC @ 4t/ha+ BD-500 @ 75 g/ha +BD–501@ 2.5 g/ha,N5: VC @4t/ha+ BD-500 @75 g/ha+BD-501@ 2.5 g/ha+ Panchagavya @3% at CRI, tillering, and jointing, N6: VC @ 4t/ha (control), N7: Absolute control and four varieties of wheat V_1: C-306 V_2: Sujata V_3: HW-2004 (Amar) and V4: JW-3020 as sub plot treatments and these were laidout in split plot design with thrice replications.

Preparation and application of the biodynamic preparations

Two biodynamic formulations (BD-500 and BD-501) from the SUPA Biotech (P) Ltd., Nainital, India were tried. BD-500 (horn manure preparation), the "prime starter of biodynamic," is prepared by stuffing the dung of a lactating cow into a horn and buried in the soil during the autumn equinox (September) and taken out during the spring equinox (March). The humified dung from horn is stored in an earthen pot away from sunlight. For preparing the spray solution for one ha, 75 g of this material was dissolved in 500 litre warm water with continuous stirring for 1h (alternately in clock wise and anti-clock wise directions). The liquid mixture was sprinkled as big droplets on soil surface in the evening on day before sowing with the help of broom-stick. BD-501 is "cow horn silica" and is made from quartz crystals ground to alum powder consistency, stuffed into a cow horn,

buried during spring equinox (March), and taken out during autumn equinox (September). BD-501 spray solution was prepared by dissolving 2.5 g in 500 litre warm water, with continuous stirring for 1 hr to that of BD-500. After an hour, the mixture was sprayed as a fine mist on the plant foliage (*i.e.* before 9.00 am) with the help of Pneupsack sprayer. Panchagavya was prepared by using the ingredients obtained from the cow viz., cow dung 7 kg, cow urine 3 litre, cow's milk 2 litre, Cow's curd 3 litre, cow's clarified ghee 1 kg. Fresh cow dung and ghee were mixed together and kept in a fresh plastic bucket for two days and this was stirred daily once. On third day, added three liter of cow urine, ten liters of water and fermented it for 12 days and then add two liters of curd, two liters of milk, ferment it for another 15 days. Thereafter, mixture in container was covered with wire mesh and kept under shade for fermentation and stirred thoroughly The contents were stirred for about 20 minutes, both in the morning and evening to facilitate aerobic microbial growth, aeration and to increase the storability period. All the materials were put into a wide mouthed earthen pot and kept open under shade. After 10 days, the Panchagavya stock solution was ready for use. From the stock solution 3 per cent concentration was prepared according to the requirement (To get 3% concentration, 3 litre of Panchagavya was mixed with 100 litre of water). Out of which, 15 litre solution was mixed in 500 litre of water and was applied using hand sprayer.

Results and Discussion

Effect of bio-organic preparations on yield attributes and yield

It is obvious from the data presented in Table 1 that all the yield attributing characters, were significantly influenced by the different treatments. Maximum number of effective tillers (320.94 m^{-2}), grains ear^{-1} (27.65), ear length (7.77 cm) and test weight (36.90 g) were recorded in the plots receiving combined application of BD-500 + BD-501 + Panchagavya along with vermicompost and proved superior over other treatments except Panchagavya applied with vermicompost and BD-500+BD-501 with vermicompost being the minimum (effective tillers 150.61m^{-2}, grains ear^{-1} 18.07, ear length 5.17 cm and test weight 29.23 g) under absolute control plots.

This may be because of the fact that in Panchagavya presence of naturally occurring beneficial micro-organisms predominately bacteria and certain fungi colonize in the leaves and increase the ammonia uptake and thereby enhancing the total N supply.

Besides, the presence of growth hormones (IAA and GA) might have favored rapid cell division and cell elongation in crop plants which ultimately stimulated crop growth and development when bio-organic preparations (BD-500+ BD-501 and Panchagavya) were used alone with vermicompost and might have favoured in the formation of superior values of yield attributing traits of Sharbati wheat. However, reverse was true in case of other treatments which had poor values of aforesaid characters.

Grain yield of Sharbati wheat and harvest index were also affected significantly due to different treatments (Table 3). Significantly higher grain yield (2462.17 kg ha^{-1}), straw yield (3149.87 kg ha^{-1}) and harvest index (43.74 per cent) were recorded under the combined application of BD-500+BD-501+ Panchagavya along with vermicompost followed by Panchagavya with vermicompost and BD-500+BD-501 with vermicompost as these gave a noteworthy hike of 22.28, 18.25 and 6.39 percent on seed yield of wheat over alone application of BD-500, BD-501 and panchgavya with Vermicompost.

Table.1 Yield attributes of wheat as influenced by different treatments (mean data of 2 years)

Treatments	Effective tillers/m^2	Grain/ Ear head	Test weight (g)	Ear length (cm)
Bio-organic preparations				
N_1: VC+ BD–500	215.95	24.80	33.76	7.35
N_2: VC+ BD–501	241.41	24.84	33.92	7.43
N_3: VC+ Panchagavya	303.64	26.82	35.48	7.51
N_4: VC+ BD-500 +BD–501	279.56	25.73	35.44	7.48
N_5:VC+BD-500+BD-501+Panchagavya	320.94	27.65	36.90	7.77
N6: VC (control)	186.66	22.78	30.83	6.80
N7: Absolute control	150.61	18.07	29.23	5.17
SE(m)	0.94	0.39	0.14	0.08
CD	2.90	1.21	0.421	0.24
Varieties				
V1: C-306	284.18	26.12	35.35	7.14
V2: Sujata	183.45	17.77	30.61	6.79
V3: HW-2004	214.80	24.95	33.05	6.97
V4: JW-3020	288.30	28.71	35.6	7.40
SE(m)	0.46	0.25	0.08	0.04
CD	1.33	0.72	0.24	0.12

Table.2 Interaction effect of bio-organic preparations and varieties on grain yield (kg/ha) of Sharbati wheat varieties

Treatments	Bio-organic preparations							
Varieties	**N_1**	**N_2**	**N_3**	**N_4**	**N_5**	**N_6**	**N_7**	**mean**
C-306	1870.33	1900.33	2351.00	2075.50	2500.00	1678.17	1420.00	1970.76
Sujata	1309.00	1568.00	1779.83	1722.33	1893.67	1364.00	1181.33	1545.45
HW-2004	1549.83	1555.67	1906.83	1771.00	2015.00	1485.00	1295.00	1654.05
JW-3020	2925.00	3026.50	3181.67	2983.17	3440.00	2507.17	1860.00	2846.21
SE(m)	72.23							
CD	77.91							

Table.3 Grain yield, straw yield and harvest index (%) as influenced by different bio-organic preparations and Sharbati wheat varieties

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)			Harvest index (%)		
	2015-16	2016-17	Mean	2015-16	2016-17	Mean	2015-16	2016-17	Mean
Bio-organic preparations									
N_1: VC+ BD–500	1818.83	2008.25	1913.54	2702.75	2716.31	2709.53	38.62	42.58	40.60
N_2: VC+ BD–501	1882.25	2143.00	2012.63	2743.58	2757.14	2750.36	37.51	38.95	38.23
N_3:VC+ Panchagavya	2164.50	2445.17	2304.83	2984.75	3156.65	3070.70	37.63	41.68	39.66
N_4:VC+BD-500+BD–501	1980.08	2295.92	2138.00	2738.67	2935.56	2837.11	40.11	42.25	41.18
N_5:VC+BD-500+BD-501+ Panchagavya	2279.42	2644.92	2462.17	3001.42	3298.31	3149.87	42.14	44.84	43.49
N_6: VC (control)	1705.33	1811.83	1758.58	2529.83	2543.39	2536.61	36.12	36.67	36.39
N_7: Absolute control	1480.83	1397.33	1439.08	2491.08	2504.64	2497.86	29.79	37.86	33.83
SE(m)	42.64	49.05	45.76	67.36	2173.92	2134.55	0.06	0.18	0.10
CD	131.38	151.14	141.01	207.55	6698.51	6577.19	0.19	0.55	0.32
Varieties									
V_1: C-306	1873.612	2067.90	1970.76	2801.71	2972.42	2887.07	37.81	41.66	39.74
V_2: Sujata	1505.048	1585.86	1545.45	2379.72	2393.28	2386.50	36.53	39.33	37.93
V_3: HW-2004	1568.43	1739.67	1654.05	2364.33	2449.32	2406.83	35.87	38.21	37.04
V_4: JW-3020	2659.33	3033.09	2846.21	3421.14	3563.27	3492.21	39.45	43.57	41.51
SE(m)	25.83	28.92	27.30	48.88	50.64	44.17	0.10	0.14	0.10
CD	73.71	82.53	77.91	139.50	144.53	126.05	0.28	0.40	0.29

Table.4 Harvest index (%) of wheat as influenced by different treatment

Treatments	Harvest index (%)		
	2015-16	2016-17	mean
Bio-organic preparations			
N_1:VC+ BD–500	39.70	41.30	40.50
N_2:VC+ BD–501	39.99	42.91	41.45
N_3:VC+ Panchagavya	42.23	44.00	43.11
N_4:VC+ BD-500 +BD–501	42.12	43.84	42.98
N_5:VC+ BD-500+BD-501+ Panchagavya	43.04	44.44	43.74
N_6:VC (control)	39.85	41.24	40.54
N_7:Absolute control	37.13	35.64	36.39
SE(m)	0.79	0.73	0.74
CD	2.42	2.24	2.29
Varieties			
V1:C-306	40.01	40.89	40.45
V2:Sujata	38.72	39.58	39.15
V3:HW-2004	39.91	41.40	40.65
V4:JW-3020	43.68	45.77	44.72
SE(m)	0.513	0.53	0.48
CD	1.46	1.50	1.38

Superior values of yield attributing traits could be assigned the reason for higher yield of former treatment. Reeve (2011) and Sharma *et al.,* (2011) also endorsed the similar views.

Effect of different Sharbati varieties on yield attributes and yield

Yield attributing traits of Sharbati wheat varieties were also affected significantly. The effective tillers (288.304 m^{-2}), grains ear^{-1} (28.71), ear length (28.71cm) and 1000-grain weight (35.59 g) were significantly higher in JW-2030, followed by C-306. But, Sujata had the poor values of effective tillers (183.45 m^{-2}), grains ear^{-1} (17.77), ear length (6.79 cm) and test weight (30.61g). Among the varieties, JW-3020 gave highest grain yield (2846.21 kg ha^{-1}) straw yield and (3492.21 kg ha^{-1}) followed by C-306 (1970.76 kg ha^{-1} of grain yield and 2887.07 kg ha^{-1}). Application of various bio-organic preparations along with vermicompost might have provided better environment for growth and development of former varieties and finally had better yield attributing values traits, which in turn led to record higher yields of Sharbati wheat varieties. However, varietal differences in yields were mainly due to their genetic characteristics. Bloksma *et al.,* (2011) and Goldstein (2000) also found similar results.

Interactions

The interaction of bio-organic -preparations and Sharbati wheat varieties caused marked variation on grain yield of wheat (Table 2) wheat varieties JW-3020 and C-306 were out yielded when both were fed with BD-500+BD-501+ Panchagavya along with vermicompost followed by the application of Panchagavya. The integrated application of BD-500+BD-501+ Panchagavya with vermicompost enhanced the photosynthetic activities, microbial biomass, nutrient availability and various enzymatic activities within the plants and soil coupled with better genetic traits contributed to higher yield of wheat under former combination of bio-organic preparations and varieties.. However, reverse was true in case of other combinations.

Combined application of application of BD-500 + BD-501+ Panchagavya along with vermicompost (4 t/ha) in Sharbati wheat varieties JW-3020 and C-306 found more productive than other combinations.

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