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The effect of integrated use of vermicompost, biofertilizer (*Azotobacter chroococcum*) and inorganic fertilizers (N, P, K and Zn) on yield and nutrient content and their uptake by wheat

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ABSTRACT

A pot culture experiment was conducted in the pot house of the department of Agricultural Chemistry and Soil Science A.S. (P. G) college, Lakhaoti, Bulandshahr, U.P. to study the effect of integrated use of Vermicompost, Azotobacter and inorganic fertilizers on yield and nutrient content and their uptake by wheat. Conjuctive use of Vermicompost, Azotobacter and Zinc in collaboration with 100% recommended fertilizer dose produced significantly higher grain and straw yield of wheat. However, these results remained at par with those recorded with 75% recommended fertilizer dose plus Zn, Vermicompost (Vc) and Azotobacter. 100% NPK + VC + Zn + Azotobacter treatment appeared to be best. Significant improvement owing to appropriate combination of NPK, VC, Zn and Azotobacter was observed for the nutrient content and their uptake by the crop and the maximum nutrient content and their uptake was noticed due to 100% RFD of NPK + VC + Zn and Azotobacter and minimum with control.

Key words : Wheat, Vermicompost, *Azotobacter chroococcum*, Yield, Nutrient content and uptake

INTRODUCTION

Fertilizer use especially (NPK) is considered as a corner stone in any drive for increasing the wheat yield. But the continuous use of micronutrient free high analysis NPK fertilizer in the intensive cropping system with diminishing use of organic manures has resulted in the depleting use of micronutrients from the soil reserves. Integration of organics with inorganics has been found to be quite promising not only in maintaining higher productivity but also in providing greater stability in crop production (Nambiar and Abrel, 1992)

Application of organic manures may also help to check the emerging deficiency of nutrients other than the N, P and K. Further it brings economy and efficiency in fertilizers. The INM affects the physical, chemical and biological environment of the soil and thus preserves the soil health. As such the goal of sustainable production could be achieved without any disastrous effects on soil and environment. Considering the above facts, present investigation was carried out to find out the effect of integrated use of Vermicompost, Azotobacter and inorganic fertilizers (N, P, K and Zn) on yield and nutrient content and their uptake by wheat.

MATERIALS AND METHODS

A pot culture experiment was carried out in the pot house of department of Agricultural Chemistry and Soil Science, A.S. (P.G.) College, Lakhaoti, Bulandshahr (U.P) during the *rabi* season of 2006 – 07. The soil was well drained sandy loam, slightly alkaline in reaction (pH 8.0), having E.ce – 1.2 dSm^{-1}, organic carbon – 2.80 g/kg soil, available K – 285.0 kg ha^{-1} and DTPA – Zn 1.4 mg kg^{-1}. Seventeen treatments consisted of 4 levels of NPK (50%, 75%, 100% alone and in combination with Vermicompost, Zn and Azotobacter and 150% alone) along with one absolute control were laid out in factorial randomized block design (RBD) with three replications. Nitrogen, phosphorus, potassium and zinc were applied in the form of urea, single super phosphate, muriate of potash and zinc sulphate @ 120, 60,40 and 25kg ha^{-1}, respectively. The whole amount of potassium and phosphorous and half quantity of nitrogen was applied at the time of sowing as basal dressing and rest half of nitrogen was applied in two splits, as top dressing at the CRI and tillering stages. Vermicompost (5t/ha) as per treatment was also applied as basal dressing. Biofertilizer (*Azotobacter chroococcum*) was applied through seed treatment. The wheat variety H.D 2329 was used as test crop.

RESULTS AND DISCUSSION

Increasing the levels of NPK caused increment in the grain and straw yield of wheat. The application of Zn along with 100% RFD of NPK or 75% RFD of NPK or with 50% RFD of NPK produced higher grain yield per hectare as compared to application of Vermicompost and Azotobacter (Table 1). The treatment comprising of 100% RFD of NPK + Zn + Vermicompost + Azotobacter producted significantly higher grain yield (57.28 q/ha) over all other treatments except T_{11} (75% RFD of NPK + VC + Zn + Azotobacter) and T_6 (50% RFD of NPK + VC +

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Table 1: Effect of different treatments on yield and protein content of grain and straw of wheat

Treatments	Yield				Protein (%)	
	Grain		Straw		Grain	Straw
	g/pot	q/ha	g/pot	q/ha		
T_1:Control	02.67	10.68	07.56	30.24	03.42	00.71
T_2:50% RFD of NPK	08.74	34.96	14.63	58.52	04.49	01.28
T_3:50% RFD of NPK + Zn	10.00	40.00	16.40	65.60	05.99	01.85
T_4:50% RFD of NPK + VC	09.80	39.20	16.35	65.40	04.46	01.28
T_5:50% RFD of NPK + Azotobacter	09.60	38.40	16.30	65.20	04.54	01.57
T_6:50% RFD of NPK+ Zn +VC +Azotobacter	12.67	50.68	17.50	70.00	07.13	02.27
T_7:75% RFD of NPK	09.75	39.00	15.56	62.24	05.44	01.25
T_8:75% RFD of NPK + Zn	11.15	44.60	17.14	68.56	07.04	02.33
T_9:75% RFD of NPK + VC	10.92	43.68	17.13	68.52	05.34	01.74
T_{10}:75% RFD of NPK + Azotobacter	10.75	43.00	17.05	68.20	05.47	01.83
T_{11}:75% RFD of NPK +Zn + Vc + Azotobacter	13.45	53.80	18.00	72.00	07.92	02.67
T_{12}:100% RFD of NPK	10.79	43.16	16.55	66.20	06.39	01.80
T_{13}:100% RFD of NPK + Zn	12.40	49.60	17.95	71.80	08.09	02.84
T_{14}:100% RFD of NPK + VC	12.10	48.40	17.92	71.68	06.28	01.97
T_{15}:100% RFD of NPK + Azotobacter	11.69	46.76	17.57	70.28	06.49	02.14
T_{16}:100% RFD of NPK + Zn + Vc + Azotobacter	14.32	57.28	18.65	74.60	08.72	02.91
T_{17}:100% RFD of NPK	11.89	47.56	17.50	70.00	08.66	02.72
C.D. (P=0.05)	00.84	06.80	00.92	02.90		

Table 2: Effect of different treatments on nutrient content (N, P, K and Zn) of wheat grain and straw

Treatments	Grain				Straw			
	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (ppm)	Nitrogen (%)	Phosphorous (%)	Potassium (%)	Zinc (ppm)
T_1	0.601	0.109	0.057	21.00	0.126	0.049	0.106	32.00
T_2	0.788	0.171	0.099	30.50	0.226	0.068	0.129	44.40
T_3	1.051	0.220	0.107	35.50	0.326	0.082	0.249	51.50
T_4	0.783	0.336	0.089	33.50	0.226	0.111	0.130	45.50
T_5	0.797	0.264	0.066	30.60	0.276	0.092	0.136	45.20
T_6	1.251	0.453	0.138	39.50	0.399	0.139	0.441	54.70
T_7	0.955	0.216	0.114	32.50	0.220	0.089	0.199	47.30
T_8	1.236	0.253	0.117	36.80	0.410	0.090	0.307	55.50
T_9	0.938	0.380	0.102	36.55	0.306	0.118	0.220	49.50
T_{10}	0.960	0.296	0.100	33.50	0.322	0.105	0.208	48.50
T_{11}	1.391	0.482	0.144	44.05	0.469	0.144	0.478	61.50
T_{12}	1.122	0.261	0.123	35.50	0.316	0.111	0.269	50.50
T_{13}	1.421	0.286	0.129	40.50	0.499	0.099	0.366	60.50
T_{14}	1.102	0.425	0.118	37.60	0.346	0.126	0.307	53.50
T_{15}	1.139	0.323	0.115	36.40	0.376	0.118	0.280	52.60
T_{16}	1.531	0.511	0.151	48.60	0.511	0.149	0.516	69.50
T_{17}	1.520	0.420	0.139	38.00	0.478	0.135	0.382	49.50
C.D. (P=0.05)	0.27	0.075	0.014	10.90	0.151	0.012	0.136	21.06

Zn + Azotobacter) which produce 53.80 q/ha and 50.68 q/ha, respectively.All treatments were significantly different with absolute control. Straw yield also followed a similar trend. The increment in grain and straw yield due to integration of organics with inorganics might be observed due to adequate and balanced nutrition of plants which might have favourable influence on the plant growth and development, which ultimately depicted in higher yield. Similar results were also reported by Singh and Pathak (2003) and Pandey *et al*. (1999). NPK and Zn content in grain and straw yield of wheat were obtained highest under the treatment comprising 100% RFD of NPK + VC + Zn + Azotobacter which was significantly superior to control or its counterpart comprising 50%, 75%

Table 3 : Effect of different treatments on N,P,K and Zn uptake by grain and straw (mg/pot) of wheat

Treatments	Grain				Straw			
	Nitrogen	Phosphorus	Potassium	Zinc	Nitrogen	Phosphorous	Potassium	Zinc
T_1	16.04	02.91	01.52	0.05	09.52	03.70	08.01	0.24
T_2	68.87	14.94	08.65	0.26	33.06	09.94	18.87	0.64
T_3	105.10	22.00	10.70	0.35	53.46	13.44	40.83	0.84
T_4	76.73	32.92	08.72	0.32	36.95	18.14	21.25	0.74
T_5	76.51	25.34	06.33	0.29	44.98	14.99	22.16	0.73
T_6	158.50	57.39	17.48	0.50	69.82	24.32	77.17	0.95
T_7	93.11	21.06	11.11	0.31	34.23	13.84	30.96	0.73
T_8	137.81	28.20	13.04	0.41	70.27	15.42	52.61	0.95
T_9	102.42	41.49	11.13	0.39	52.41	20.21	37.68	0.84
T_{10}	103.20	31.82	10.75	0.36	54.90	17.90	35.46	0.82
T_{11}	187.08	64.82	19.36	0.59	84.42	25.92	86.04	1.10
T_{12}	121.06	28.16	13.27	0.36	52.29	18.37	44.51	0.83
T_{13}	176.20	35.46	15.99	0.50	89.57	17.77	65.69	1.08
T_{14}	133.34	51.42	14.27	0.45	62.00	22.57	55.01	0.95
T_{15}	133.14	37.75	13.44	0.42	66.06	20.73	49.19	0.92
T_{16}	219.23	73.17	21.62	0.69	95.30	27.78	96.23	1.29
T_{17}	180.72	49.93	16.52	0.45	83.65	23.62	66.85	0.86
C.D. (P=0.05)	46.54	17.65	0.30	5.49	22.02	3.98	33.57	0.56

and 150% RFD of NPK along with single component of INM as well as applied jointly. However, 100% RFD of NPK clubbed with Zn + VC + Azotobacter also registered a noticeable turnover of nutrients in grain and straw of wheat. The increase in NPK and Zn content was invariably due to their liberal absorption by plants when they were applied in the form of organics and inorganics. The clubbing of NPK with either VC or Azotobacter further enhanced their intake in plants. Zn availability was more or less associated with its addition through its treatment besides lateral effects of VC or Azotobacter. The significant increase in protein content was comparable to influences of treatments on nitrogen content of wheat grain and straw as influenced by various treatments were found comparable to their content noted against identical treatment (Table 2). A pronounced increase in uptake of N, P, K and Zn was registered while using organics and inorganics together at higher levels of fertility (Table 3). The highest uptake of N, P, K and Zn by wheat grain were found to be 219.23, 73.17, 21.62 and 0.69mg/pot, respectively as against lowest in control being 16.04, 2.91, 1.52 and 0.05mg/pot, respectively. The higher uptake of nutrient by the crop might be due to liberal supply of nutrients through organics and inorganics which are ultimately absorbed by plants. The results are in conformity with the findings of Vyas *et al*. (1997) and Shivankar *et al*. (2000).

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