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EFFECT OF VERMICOMPOST AND NPK FERTILIZERS ON THE POTASSIUM AND SULPHUR CONTENTS IN WHEAT AND THE POST HARVEST SOIL

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ABSTRACT

A field experiment was conducted at the Sher-e-Bangla Agricultural University Farm, Dhaka 1207 during the *Rabi* season of 2004-2005 to study the effect of vermicompost and NPK on potassium and sulphur content of wheat and in the post harvest soil. The treatments consisted of 4 levels of vermicomposts viz. V_0 (0 t ha^{-1}), V_1 (1 t ha^{-1}), V_2 (2 t ha^{-1}), V_3 (3 t ha^{-1}), and 4 levels of chemical fertilizers viz. F_0 = (0-0-0 kg NPK ha^{-1}), F_1 = low (40-30-20 kg NPK ha^{-1}), F_2 = medium (80-60-40 kg NPK ha^{-1}), F_3 = high (120-80-60 kg NPK ha^{-1}) as N-P_2O_5-K_2O with 16 treatments combinations. The results demonstrated that with increasing the doses of vermicomposts and chemical fertilizers, K and S content were increased in wheat straw at three stages and in the post harvest soil significantly. The highest doses of vermicompost and chemical fertilizers enhanced potssium and sulphur content at the maximum tillering stage.

Key words: vermicompost, NPK and nutrient content

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop after rice in Bangladesh. About 642.10 thousand hectares of land in Bangladesh is covered by wheat cultivation with the annual production of 1253 thousand tons (BBS, 2005). Wheat is well adapted to our climate and can play a vital role in recovering our food shortage. Unfortunately, the average yield of wheat is quite low in Bangladesh in comparison to other wheat growing countries of the world. Imbalanced fertilizer application is one of the major causes of low yield of wheat in Bangladesh (Saerah *et al.*, 1996).The excessive use of urea, imbalance use of phosphate and potassium fertilizers in the field of horticulture and agronomic crops without considering the other micro or macronutrients are a common practice in Bangladesh. A balanced supply of essential nutrients is indispensable for optimum plant growth. Continuous use of large amounts of only N, P and K is expected to decrease not only the availability of other nutrients to plants because of possible interaction between them but also the build up of some of the nutrients creating imbalances in soils and plants leading to decrease fertilizer use efficiency (Nayyar and Chhibba, 1992). Among the different sources of organic manure, vermicompost is important in maintaining and enhancing the quality of soil environment and conserving soil resources for sustainable agriculture (Simanaviciene *et al.*, 2001). Vermicompost is the outcome of earthworm activities in the decomposition of organic matter. Use of organic matter with common chemical source of plant nutrients is one of the easy and simple ways to increase the quality and total yield of wheat as well as nutrient content at three stages and post harvest soil.

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The objective of this experiment was to study the effect of vermicompost and NPK on the nutrient content of wheat plant and in the post harvest soil.

MATERIALS AND METHODS

This research work was conducted at the Sher-e-Bangla Agricultural University Farm during the *Rabi* season of 2004-2005. A composite sample was made by collecting soil from several spots of the field at a depth of 0-15 cm before the initiation of the experiment. The physical and chemical characteristics of initial soil were: pH 6.0, Textural Class Silty clay, Total N 0.078%, Organic matter 0.88%, available Phosphorous 15 ppm, Potassium 0.0053 % and available Sulphur 17 ppm. Vermicompost contained organic matter 11.03%, total N 0.6398%, available Phosphorous 225.90 (ppm), available Potassium 776.1(ppm) and available Sulphur 306.10 (ppm). Shatabdi (BARI GOM-21), a high yielding variety of wheat was used as the test crop in this experiment. The plot was prepared for seed sowing through various methods on the 3rd November 2004. The experiment was laid out in Randomized Complete Block Design. The number of treatments was 16 with 3 replications, so the total number of plots was 48; unit plot size was 4 m × 2.5 m (10 m^2). The distance maintained between two plots was 75 cm and between blocks was 150 cm. The experiment consists of 2 factors i.e. vermicompost and fertilizer each have four levels. Factor A (Vermicompost) V_0 = 0 t ha^{-1} (No vermicompost), V_1 = 1 t ha^{-1} (Low vermicompost), V_2 =2 t ha^{-1} (Medium vermicompost), V_3 = 3 t ha^{-1} (High vermicompost). Factor B (Fertilizer), F_0 = 0 kg N ha^{-1} + 0 kg P_2O_5 ha^{-1} + 0 kg K_2O ha^{-1} (No NPK), F_1 = 40 kg N ha^{-1} + 30 kg P_2O_5 ha^{-1} + 20 kg K_2O ha^{-1} (Low NPK), F_2 = 80 kg N ha^{-1} + 60 kg P_2O_5 ha^{-1} + 40 kg K_2O ha^{-1} (Medium NPK), F_3 =100 kg N ha^{-1} + 80 kg P_2O_5 ha^{-1} + 60 kg K_2O ha^{-1} (High NPK). Treatment combinations: V_0F_0 =Control (No vermicompost + No NPK), V_0F_1 = (No vermicompost + Low NPK),V_0F_2 = (No vermicompost + Medium NPK), V_0F_3 = (No vermicompost + High NPK), V_1F_0 = (Low vermicompost + No NPK), V_1F_1 = (Low vermicompost + Low NPK), V_1F_2 = (Low vermicompost + Medium NPK), V_1F_3 = (Low vermicompost + High NPK), V_2F_0 = (Medium vermicompost + No NPK), V_2F_1 = (Medium vermicompost + Low NPK), V_2F_2 = (Medium vermicompost + Medium NPK), V_2F_3 = (Medium vermicompost + High NPK), V_3F_0 = (High vermicompost + No NPK), V_3F_1 = (High vermicompost + Low NPK), V_3F_2 = (High vermicompost + Medium NPK), V_3F_3 = (High vermicompost + High NPK).The required amount of P_2O_5 (as TSP) and K_2O fertilizers(as MP) and 50% of the N fertilizer (urea) were uniformly spread as a basal dose. The remaining 50% of N (urea) was applied in two splits after 1^{st} and 2^{nd} irrigation at 17 and 50 DAS. The required amount of vermicompost was applied uniformly in the canals opened for sowing the seeds of wheat in lines. Wheat seeds were sown on the 10^{th} November 2004 in lines as row-to-row distance of 25 cm. The crop was harvested on 7^{th} March 2005. The harvested crop of each individual plots were recorded and the yields were expressed in t ha^{-1}. Plant samples were collected from every individual plot for laboratory analysis at three-growth stages i.e. maximum tillering, flowering and ripening stages. Five plants were randomly collected from each plot. The plant samples were dried in the electric oven at 70^0 C for 48 hours, and then grounded and stored for chemical analysis. Post harvest soil samples were collected from each plot at 0-15 cm depth on 8^{th} March 2005. The samples were air -dried, ground and sieved through a 2 mm (10 mesh) sieve and kept for analysis. The data obtained from the experiment were analyzed statistically to find out the significance of the difference among the treatments. The significance of the differences among pairs of treatment means was estimated by the least significant difference (LSD) test at 5% and 1% level of probability and DMRT was calculated (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

Potassium content at various stages

The highest potassium content 1.00%, 1.04% and 1.07% were recorded in V_3 treatment 3 t ha^{-1}, at maximum tillering stage, flowering stage and ripening stage, respectively. On the other hand, the lowest potassium content 0.90%, 0.91% and 0.98% were recorded in the V_0 treatment for above mentioned three stages, respectively, where no vermicompost was applied. (Table 1)
Among the different doses of chemical fertilizers, F_3 (High NPK) showed the highest potassium content 1.09%, 1.13% and 1.19% in plant at maximum tillering stage, flowerining stage and ripening stage respectively(Table 1). On the contrary, the lowest potassium content 0.82%, 0.84% and 0.87% was recorded in F_0 treatment at the three growth stages, respectively where no fertilizer was applied.
Combined application of different doses of vermicompost and fertilizer showed no significant effect on the potassium content at the maximum tillering stage of wheat. At flowering stage the highest potassium content (1.17%) was recorded in the treatment combination of V_3F_3 (High vermicompost + High NPK). On the other hand, the lowest potassium content (0.75%) was observed in V_0F_0 (No vermicompost + No NPK) treatment. At ripening stage the highest potassium content 1.24% was recorded in the treatment combination of V_0F_3 (No vermicompost + High NPK). On the other hand, the lowest potassium content (0.74%) was found in V_0F_0 (No vermicompost + No NPK) treatment combination. (Table 1).

Table 1. Effect on vermicompost and NPK fertilizer in potassium content in wheat plant at various stages

Fertilizer / Vermicompost	Maximum Tillering Stages					Flowering Stages					Ripening Stages				
	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean
Vo	0.75	0.82	0.98	1.06	0.90	0.75	0.83	0.96	1.09	0.91	074	0.84	1.08	1.24	0.98
V_1	0.82	0.83	1.05	1.10	0.95	0.81	0.86	1.12	1.14	0.98	0.83	0.99	1.05	1.19	1.02
V_2	0.85	0.86	1.01	1.09	0.95	0.89	0.92	0.93	1.10	0.96	0.93	0.93	0.97	1.14	0.99
V_3	0.86	0.98	1.05	1.11	1.00	0.92	0.98	1.09	1.17	1.04	0.97	0.96	1.13	1.20	1.07
Mean	0.82	0.87	1.02	1.09		0.84	0.90	1.03	1.13		0.87	0.93	1.06	1.19	
	lsd (1%) Vermicompost (V) 0.037 lsd (1%) Fertilizer (F) 0.037 lsd (VxF) non significance					lsd (1%) vermicompost (V) 0.037 lsd (1%) Fertilizer (F) 0.037 lsd (1%) (VxF) 0.075					lsd (1%) vermicompost (V) 0.026 lsd (1%) Fertilizer (F) 0.026 lsd (1%) (VxF) 0.091				

Sulphur content at three stages

The highest sulphur content 0.81%, 0.77% and 0.74% was recorded in V_3 (3 t ha^{-1}) at maximum tillering stage, flowering stage and ripening stage respectively. On the other hand, the lowest sulphur content 0.62%, 0.57% and 0.55% were recorded in the V_0 treatment for the above mentioned three growth stages, respectively. (Table 2)
Different doses of chemical fertilizers applied in different combinations showed significant variation in respect of sulphur content in wheat plant (Table 2). Among the different doses, F_3 (High NPK)

treatment showed the highest sulphur content 0.84%, 0.82% and 0.79% in plant at maximum tillering stage, flowering stage and ripening stage, respectively. On the contrary, the lowest sulphur content 0.53%, 0.48% and 0.47% were recorded in F_0 treatment for above mentioned three stages, respectively.

Different doses of vermicompost and fertilizer at different combinations resulted in a significant variation in the sulphur content in plant at three stages of wheat (Table 2). The highest sulphur content (0.93%) was recorded in the treatment combination of V_3F_3 (High vermicompost + High NPK) and the lowest sulphur content (0.45%) was found in the treatment combination of V_0F_1 (No vermicompost + Low NPK) at maximum tillering stage. Similarly the highest sulphur content (0.89%) was recorded in the treatment combination of V_3F_3 (High vermicompost + High NPK). On the other hand, the lowest sulphur content at the flowering stage (0.40%) was observed in the treatment combination of V_0F_0 (No vermicompost + No NPK). At ripening stage the highest sulphur content (0.85%) was recorded in the treatment combination of V_3F_3 (High vermicompost + High NPK). On the other hand, the lowest sulphur content (0.38%) was found in V_0F_0 (No vermicompost + No NPK) treatment combination that was statistically identical with V_0F_1 (No vermicompost + Low NPK).

Table 2. Effect on vermicompost and NPK fertilizer in sulphur content in wheat plant at various stages

Fertilizer / Vermicompost	Maximum Tillering Stages					Flowering Stages					Ripening Stages				
	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean
V_0	0.50	0.45	0.76	0.78	0.62	0.40	0.41	0.72	0.76	0.57	0.38	0.39	0.72	0.74	0.55
V_1	0.45	0.61	0.81	0.81	0.67	0.42	0.58	0.76	0.79	0.64	0.40	0.44	0.72	0.78	0.59
V_2	0.51	0.78	0.85	0.86	0.75	0.49	0.76	0.81	0.84	0.72	0.47	0.60	0.78	0.80	0.66
V_3	0.66	0.78	0.88	0.93	0.81	0.62	0.72	0.82	0.89	0.77	0.61	0.70	0.79	0.85	0.74
Mean	0.53	0.65	0.82	0.84		0.48	0.62	0.79	0.82		0.47	0.53	0.76	0.79	
	lsd (1%) Vermicompost (V) 0.016 lsd (1%) Fertilizer (F) 0.016 lsd (5%) (VxF) 0.032					lsd (1%) vermicompost (V) 0.012 lsd (1%) Fertilizer (F) 0.012 lsd (1%) (VxF) 0.024					lsd (1%) vermicompost (V) 0.011 lsd (1%) Fertilizer (F) 0.011 lsd (1%) (VxF) 0.022				

Potassium content in post harvest soil

Significant variation was recorded in the K content of post harvest soil, where different doses of vermicompost were applied (Table 3). Application of vermicompost at the rate of 3 t ha^{-1} showed the highest K content (0.0059%), which was closely followed by V_2 (2 t ha^{-1}) and V_1 (1 t ha^{-1}). On the other hand, the lowest K content (0.0053%) was observed in the V_0 treatment where no vermicompost was applied.

Significant differences were also recorded in the K content of post harvest soil due to the application of different doses of fertilizers. F_3 fertilizer treatment showed the highest K content (0.0062%) and F_0 treatment showed the lowest (0.0050%) K content in post harvest soil that was statistically similar with F_1 treatment.

The effect of combined application of vermicompost and fertilizer showed no significant differences in respect of K content of soil after harvest of wheat. (Table 3)

Table 3. Exchangeable potassium content in soil after wheat harvest as influenced by vermicompost and fertilizer

Fertilizer / Vermicompost	F_0	F_1	F_2	F_3	Mean
Vo	0.0047	0.0051	0.0053	0.0060	0.0053
V_1	0.0055	0.0053	0.0054	0.0060	0.0056
V_2	0.0053	0.0055	0.0057	0.0061	0.0057
V_3	0.0057	0.0053	0.0061	0.0067	0.0059
Mean	0.0050	0.0053	0.0057	0.0062	

lsd (1%) vermicompost (V) 0.003
lsd (1%) Fertilizer (F) 0.003
lsd (VxF) non significance

Sulphur content in post harvest soil

Significant variation was recorded in the S content of soil after harvest of wheat where the plots were incorporated with different doses of vermicompost (Table 4). Maximum S content (21 ppm) of post harvest soil was recorded under the V_3 vermicompost treatment and minimum S content (18 ppm) was recorded under V_0 treatment.

Table 4. Effect of vermicompost and fertilizer on available sulphur content (ppm) in soil after wheat harvest

Fertilizer / Vermicompost	Fo	F_1	F_2	F_3	Mean
Vo	16	17	18	19	17
V_1	17	17	18	19	18
V_2	17	19	21	23	20
V_3	18	20	21	23	21
Mean	17	19	20	21	

lsd (ppm) vermicompost (V) 1.3
lsd (ppm) Fertilizer (F) 1.3
lsd (VxF) non significance

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