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EFFECTS OF INTEGRATED USE OF FERTILIZERS AND VERMICOMPOST ON QUALITY OF SOYBEAN SEEDS

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A field experiment was conducted during *Rabi* season on soybean (Glycine *max* var. sohag) sohag (PB-1) to study the effects of fertilizers and vermicompost on quality of soybean seed. Four rates of each of vermicompost (V_0 = 0, V_1 = 2, V_2 = 4 and V_3 = 6 t ha^{-1}) and fertilizers, F_0 ($N_0P_0K_0S_0$), F_1 ($N_{20}P_{60}K_{40}S_{10}$), F_2 ($N_{30}P_{80}K_{60}S_{20}$) and F_3 ($N_{40}P_{100}K_{80}S_{30}$) kg ha^{-1} in all possible combinations were applied following a randomized block design with three replications. Single and double application of vermicompost and fertilizers caused an increase in concentration of NPKS in seed grain with increasing level of the amendments over the control. Vermicompost and fertilizers showed a positive and significant effect on NP content of seed irrespective of the treatments applied. However, the treatments showed no significant variation in KS content of seed except the treatments receiving highest level of the amendments. The highest concentration of NPKS was recorded in V_3F_3 treatment achieving 6.23, 0.61, 2.17 and 0.51%, respectively. All most similar pattern was found in protein content of the seed of soybean too. Oil content of seed improved significantly due to treatments over the control significantly. The variation in oil content between the levels of individual amendment and in most of their interactions showed significant change among them. The highest content of oil was estimated in the treatment supplemented with only vermicompost applied at the rate of 6 t ha^{-1}.

Keywords : Fertilizers; Nutrients; Oil; Protein; Quality; Soybean; Vermicompost.

Introduction

Soybean (*Glycine max* (L) Merr.) is one of the world's most important oil seed crop. It has become the leading source of edible oils and fats, constituting about 20% of the world's supply and more than any other single source of these essential food constituents[1]. Soybean oil is very much popular as a cooking oil in Bangladesh but the present production is not sufficient enough to extract oil profitably. The seed contain 42-45% best quality protein and 20-22% edible oil[2]. Moreover, soybean is an important source of good quality protein and oil, and can play an important role in solving the malnutrition problem of Bangladesh. Organic farming is the management practice that produces crop not only of good quality but also quantity by using eco-friendly technology which can co-exist in nature. To get more food, farmers are using fertilizers and pesticides in increasing amount, which are making ecological backlashes, resulting in deterioration of soil health[3]. Vermicompost helps in building soil structure, stimulate plant growth particularly that of roots, drilling mud and emulsifiers[4]. Long term applications of fertilizer cause an imbalanced condition and affect the various beneficial soil microorganisms adversely resulting in loss of soil fertility as well as productivity day by day. On the contrary, if only organic matter is used, the soil physical properties will be improved but the nutrient demand of the crop can not be satisfied due to its relatively low content of nutrients. Combined application of both chemical and organic fertilizers will be more effective for the improvement of soil and supply of essential plant nutrients. Thus, an attempt has been made in a field trial to follow the effects of vermicompost and fertilizers on the quality of soybean seed.

Material and Methods

A field experiment was conducted at Sher-e-Bangla Agricultural University Farm, Dhaka during the *Rabi* season using soybean (*Glycine max* var sohag) sohag (PB-1) as a test crop. Four rates of each of vermicompost (V_0 = 0, V_1 = 2, V_2 = 4 and V_3 = 6 t ha^{-1}) and fertilizers, F_0 ($N_0P_0K_0S_0$), F_1 ($N_{20}P_{60}K_{40}S_{10}$), F_2 ($N_{30}P_{80}K_{60}S_{20}$) and F_3 ($N_{40}P_{100}K_{80}S_{30}$) kg ha^{-1} in a full factorial combinations were applied as urea-N, TSP-P_2O_5, MP-K_2O and gypsum-S following a randomized block design with three replications. PKS were applied as a basal dose together

with 50% of N. The remaining 50% of N was broadcasted after first irrigation.

Vermicompost was applied uniformly in the canals opened for sowing the seeds of soybean in lines. Soybean seeds were sown in lines with a distance of 30 and 50 cm between lines and within the plants respectively. Irrigation was given at 35 and 60 days of sowing of seeds. Attack of cutworm after 10 days of emergence of seedlings was controlled by applying malathion.

At maturity, the seeds were collected and preserved for quality analysis (NPKS, protein, oil). Grain sample was digested with a mixture of 4% $HClO_4$ and conc. H_2SO_4 acids[5]. The digest was used to determine N (Kjeldhal method), PS (Spectrophotometrically[6-9]) and K (Flame Photometrically). Protein content was estimated by multiplying the percent N with the conventional factor 6.25 and that of oil was measured by following a standard method[10].

Results and Discussion

Effects of fertilizers and vermicompost on quality of soybean seed have been assessed and the results thus obtained are presented in Table 1. Results revealed that the main effects of vermicompost and fertilizers and their interactions on nitrogen content of soybean grain showed no significant variation at all among the treatments used. However, the treatments showed an increase in nitrogen content of grain with increasing level of vermicompost and fertilizers. The maximum content of nitrogen recorded in V_3F_3 treatment was 6.23% which was significantly higher than of the control.

Phosphorus concentration in the seed was improved due to addition of vermicompost and fertilizers alone over the control though not significantly except the highest dose of vermicompost i, e. 6 t ha^{-1} and higher doses of fertilizers i, e. at V_0F_2 and V_0F_3 treatments (Table 1). The intermediate doses of vermicompost and fertilizers showed no significant variation between them in phosphorus content of soybean grain. Interestingly, the interactions of vermicompost and fertilizers exerted significant effect to increase the phosphorus content of grain over the control too showing a nonsignificant variation among the applied treatment interactions themselves. The highest content of phosphorus (0.61%) was observed in grain treated with highest level of fertilizers applied alone and in association with higher levels of vermicompost (V_2F_3, V_3F_3).

Similarly, the potassium content of soybean seed increased with the increasing level of vermicompost and fertilizers over the control but not significantly except the highest dose of fertilizers which showed 2.13% potassium attaining the highest value among the applied single doses of vermicompost and fertilizers (Table 1). Similar result was also found in grain collected from plants grown in plots treated with V_2F_3. The interactions of vermicompost and fertilizers also showed an increase in concentration of potassium in soybean grain over the control only exerting no significant variation among them.

As regard to sulphur content of soybean grain, the main effects of vermicompost and fertilizers as well as their interactions showed an increase in the sulphur content with the increasing level of the applied amendments over the control (Table 1). However, the variation among the treatments applied with respect to the concerned nutrient was not statistically significant at all showing an identical value among the treatments imposed. The maximum content of sulphur (0.51%) was estimated in the grain obtained from the plants grown in plot supplied with highest level of both vermicompost and fertilizers together. Vermicompost and fertilizers applied alone and in combination resulted no effective and significant variation in sulphur content of soybean grain even in comparison to the control except the highest level of vermicompost with higher levels of fertilizers applied in combination i, e. in V_3F_2 and V_3F_3 treatments.

On overall summarization of the results, it could be seen that the content of nutrients (NPKS) as influenced by vermicompost and fertilizers showed no appreciable variation between them indicating the fact that the amendments were almost equally effective in modifying the quality of soybean seed with respect to NPKS contents.

Protein content of soybean grain increased with increasing level of fertilizers nonsignificantly ranging from 30.85 to 35.73% (Table 1). Percentage of protein increased up to medium level of fertilizer and thereafter decreased nonsignificantly (Table 1).

Similarly, the content of protein also increased with increasing level of vermicompost ranging from 30.85 to 34.38%. The results showed that the variation in protein content was not significant due to variation in amount of vermicompost applied. Interaction of vermicompost and fertilizers improved the content of protein not only over the control but also over their individual effects ranging from 32.04 to 38.92% in V_2F_1 and V_3F_3 treatments, respectively.

Close observation of the data revealed that protein content varied from 30.85 to 35.73 and 30.85 to 34.38% due to application of fertilizers and vermicompost, respectively. Fertilizers showed its superiority over the vermicompost but not significantly. The maximum values were recorded in V_0F_1 and V_3F_0 treatments, respectively

Table 1. Effects of vermicompost and fertilizers on the quality of soybean seed.

Treatments	Concentration (%)					
	N	P	K	S	Protein	Oil
V_0F_0	4.94 b	0.41 b	1.83 c	0.32 b	30.85 b	18.40 j
V_0F_1	5.38 ab	0.48 ab	2.00 abc	0.39 ab	35.73 ab	19.47 g
V_0F_2	5.61 ab	0.56 a	2.07 abc	0.38 ab	35.69 ab	19.73 h
V_0F_3	5.66 ab	0.61 a	2.13 ab	0.41 ab	35.37 ab	18.81 i
V_1F_0	5.17 ab	0.48 ab	1.84 c	0.40 ab	32.23 ab	19.38 h
V_1F_1	5.42 ab	0.57 a	2.00 abc	0.44 ab	33.88 ab	19.33 h
V_1F_2	6.00 ab	0.59 a	2.03 abc	0.41 ab	37.50 ab	19.75 d
V_1F_3	5.96 ab	0.59 a	2.10 ab	0.44 ab	37.25 ab	19.36 h
V_2F_0	5.15 ab	0.51 ab	1.90 bc	0.42 ab	32.21 ab	19.50 g
V_2F_1	5.18 ab	0.58 a	1.93 abc	0.44 ab	32.40 ab	19.82 c
V_2F_2	6.10 ab	0.59 a	2.10 ab	0.46 ab	38.15 ab	19.36 h
V_2F_3	6.11 ab	0.61 a	2.13 ab	0.41 ab	38.19 ab	19.63 e
V_3F_0	5.50 ab	0.55 a	1.93 abc	0.37 ab	34.38 ab	20.03 a
V_3F_1	5.74 ab	0.56 a	2.03 abc	0.45 ab	36.48 ab	19.47 g
V_3F_2	5.95 ab	0.59 a	2.10 ab	0.49 a	37.18 ab	19.57 f
V_3F_3	6.23 a	0.61 a	2.17 a	0.51 a	38.92 a	19.88 b
Level of Significance	0.01	0.01	0.01	0.01	0.01	0.01

In a column figures having similar letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT

due to their individual application. However, the range of protein in soybean grain increased from 30.85 to 37.50% when the amendments were applied together. Addition of vermicompost (2 t ha^{-1}) together with medium level of fertilizers showed the best result among the interactions of fertilizers with the lower level of vermicompost. Increase in vermicompost from 2 to 4 t ha^{-1} along with fertilizers improved the content of protein from 37.50 to 38.19%. However, this improvement in protein content was not significant rather than identical in terms of statistical comparison. Higher levels of fertilizers showed their best efficacy at the medium level of vermicompost (4 t ha^{-1}) so far the protein content is taken into account. No significant difference was observed between the higher

levels of fertilizers in the presence of medium level of vermicompost.

A further addition of vermicompost i, e. 6 t ha^{-1} in association with medium level of fertilizers showed a reduction in protein content though not significantly in comparison to lower level of vermicompost. Maximum content of protein was estimated in grain collected from plants provided with highest level of vermicompost and fertilizers (V_3F_3) together attaining up to 38.92% among the treatments used in this experiment.

Oil content of soybean seed was extracted and the amount estimated has been presented in Table 1. Application of vermicompost and fertilizers alone and in combination showed a variation in oil content of seed. Individual application of vermicompost and fertilizers caused a significant increase in oil content of grain ranging from 18.40 to 20.03 and 19.73% respectively. Content of oil showed an increase in percentage with increasing level of the amendments. However, the variation in oil content among the levels within and between the amendments were found to be statistically not significant.

Interaction of vermicompost and fertilizers also showed a significant increase in oil content of seed over the control but the pattern of change remained almost same as in the case of their individual performances imparting the fact that the levels of both vermicompost and fertilizers became almost ineffective and acted parallely resulting changes in the level of oil content insignificantly. It is interesting to note that the maximum content of oil (20.03%) was estimated in soybean seed obtained from plants supplied with only vermicompost at the rate 6 t ha^{-1}. Kane *et al.*[11] and Miladinovic *et al.*[12] also observed the similar trend in oil content of soybean seeds.

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