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INFLUENCE OF INORGANIC AND ORGANIC FERTILIZERS ON GROWTH AND YIELD OF SOYBEAN

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Abstract

The experiment was executed at the Agronomy researchfield of Sher-e-Bangla Agricultural University, Dhaka-1207, during the period from November, 2015 to March, 2016 to study the effects of fertilizer management of different combinations of inorganic and organic fertilizers on growth, yield attributes and yield of soybean (var. BARI Soybean 6). The treatment combinations wereT_0= Control, T_1= fertilization at recommended fertilizer dose (RFD - urea 50 kg ha^{-1}, TSP 150 kg ha^{-1}, MoP 100 kgha^{-1}, gypsum 80 kg ha^{-1} and boron 500 kg ha^{-1}), T_2= Bio-fertilizer + 50% RFD, T_3= Bio-fertilizer + 75% RFD, T_4= Mixed fertilizer + 50% RFD, T_5= Mixed fertilizer + 75% RFD, T_6= Vermi-compost + 50% RFD, T_7= Vermicompost + 75% RFD, T_8= Poultry litter + 50% RFD and T_9= Poultry litter + 75% RFD. Results indicated that application of fertilizer at recommended dose, vermi-compost + 75% RFD and poultry litter + 75% RFD produced higher grain yield 2053, 2073 and 2166 kg ha^{-1}, respectively over control. It was also observed thatconsidering the sustainable yield and environment friendly,poultry litter + 75% RFD (T_9) and vermi-compost + 75% RFD (T_7) couldbe promising for soybean cultivation.

Introduction

Proper fertilization is one of the major factors to gain higher yield but injudicious application of inorganic fertilizers without organic supplements causes environmental pollution, damaging soil physical, chemical and biological properties. Soybean (*Glycine max* L. Merrill) is one of the most economic and nutritious crop in the world with high protein content, excellent source of both oil and protein supplement (Mondal *et al.,* 2002). In Bangladesh soybean is mostly used as poultry and fish feed. Its demand is increasing with the increases of poultry and fish industries. In Bangladesh area coverage of soyabean is 60,893 ha and the annual production is 112,024 tons with an averageyield is 1.83 t ha^{-1} (FAOSTAT, 2014) which is very low to meet the increasing demand. Therefore, a huge quantity of soyabean is importing every year at the cost of substantial amount of hard currency. Use of organic manure alone or in combination of chemical will help to improve physio-chemical properties of soils providing a good substrate for the growth of microorganisms maintaining a favorable nutritional balance.One such strategy to maintain soil fertility for sustainable production of soyabean is through judicious use of fertilizers provided to be responsible for higher yield and with reduced fertilizer pollution (Bobde *et al.*, 1998) coupled with organic resources to achieve sustainability in production, where the use of organic manures alone is not sufficient (Prasad, 1996). It has also been brought out that the use of organic manures in integration with fertilizers meets the needof micronutrients of soybean (Joshi *et al.,* 2000). Some symbiotic N_2 fixing *Rhizobium* stains fix atmospheric nitrogen (N) in the nodules and show an antagonistic effect against soil borne pathogens (Ganesan *et al*., 2007) and thus it enriches the soil fertility (Mahabal, 1986).*B.*

Japonicum can fix about 300 kg ha^{-1} $year^{-1}$ in symbiosis with soyabean (Keser and Li, 1992). Vermi-compost contains most nutrients in the available forms such as nitrates, phosphates, exchangeable calcium and soluble potassium that have vital role for plants (Arancon *et al.*, 2005). Applications of vermicompost or poultry litter singly or in combination with other inorganic fertilizerhave been proved effective to enhance growth and yield of Soybean (Javed and Panwar, 2013; Chiezey and Odunze, 2009). Trails with poultry litter on the performance of soyabean are few. As such the present study was undertaken to investigate the effects of different combinations of inorganic and organic fertilizers on growth performances, yield attributes and yield of soybean.

Materials and Methods

The experiment was conducted at the Agronomy field of Sher-e-Bangla Agricultural University (SAU). It is situated at $23^0$74' North latitude. The land was medium high and soil texture was silty clay with pH 6.1.The treatments of the experiment were as follows: T_0: Control (without fertilizer),T_1: Recommended Fertilizer Dose (RFD), T_2: Bio-fertilizer + 50% RFD , T_3: Bio-fertilizer + 75% RFD, T_4: Mixed fertilizer + 50% RFD, T_5: Mixed fertilizer + 75% RFD, T_6: Vermi-compost + 50% RFD, T_7: Vermi-compost + 75% RFD, T_8: Poultry litter + 50% RFD and T_9: Poultry litter + 75% RFD. The experiment was laid out in randomized complete block design with 3 replications. The size of unit plot was 3m×2m. Distance maintained between replication and plots were 1.0m and 0.75m, respectively. Well rotten poultry litter and vermi-compost were applied @ 10 and 2 t ha^{-1}, respectively before final land preparation according to treatment. The recommended inorganic fertilizer dose used for soybean was 50-150-100-80-0.5 kg ha^{-1} as Urea, TSP, MP, Gypsum and Boric acid, respectively. Full amount of all fertilizers as per treatment applied during final land preparation as basal dose. Seeds of the var, BARI Soybean-6 was sown on 25 November, 2015 in lines distance of 30 cm and plant to plant 5-6 cm. A light irrigation was given before sowing seed. First, second and third irrigation was given on 20, 35 and 56 days after sowing. The crop was protected from insects and ants through the application of Babiston 250WP on seed line. At different stages of crop growth (30, 45, 60, 75 DAS and at harvest), the height of five randomly selected plants from each plot were collected and sampled and data on plant height, dry weight of plant as well as yield contributing characters were recorded. The crop was harvested on 15 May, 2016. Grain yield was adjusted to 12% moisture content. The obtained data for different characters were statistically analyzed with the computer based software MSTAT-C and the difference among treatment means were estimated by the Least Significant Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

Results and discussion

Plant height of soybean varied significantly at 30, 45, 60, 75 DAS and at harvest for different combinations of inorganic and organic fertilizer (Table 1). Results of plant height showed increasing trend with the increases of growth stages and the highest increase was found at harvest. On the other hand, combination of fertilizers applied plots increased plant height over control for all sampling dates. Different combinations of inorganic and organic fertilizers showed significant variation for dry weight $plant^{-1}$ at 30, 45, 60, 75 DAS and at harvest (Table 2). Result revealed that dry matter weight increased significantly with inorganic and organic fertilizers combination treatment over control. Among the combinations. Treatment T_1 showed maximum dry weight followed by T_9 than other combinations for all sampling dates.This might be due to optimum and continuous supply and availability of nutrients through organic source which help in better uptake of nutrient that ultimately enhancing cell division and thereby increased all the growth attributes. These findings are in accordance with the results of Patil and Udmale (2016).The maximum seed yield was recorded from T_9 (2166 kg ha^{-1}), which was

statistically at par with T_7 and T_1, respectively for 2073 and 2053 kg ha^{-1}). On the other hand, the lowest yield was found in T_0 (1185 kg ha^{-1}). The result revealed that treatment T_9, T_7 and T_1 produced 82.78%, 74.94% and 73.25% higher yield over control (T_0). The maximum grain yield might be attributed to maximum dry matter weight plant^{-1}, number of pods plant^{-1}, seeds plant^{-1} and 100- seed weight. This might be due to adequate supply of nutrient element at the right time from organic and inorganic sources which helped optimum dry matter partitioning from the source to sink during reproductive stage of plant consequently increase the seed yield of soybean. The result corroborates with the findings of Falodun *et al.* (2015).

Table 1. Effect of inorganic and organic fertilizerson plant height of soybean at different Days after sowing

Treatment	Plant height (cm) at different days after sowing				
	30	45	60	75	At harvest
T_0	20.73 b	33.07 b	40.21 b	48.13 d	45.80 b
T_1	21.57 ab	40.83 a	52.55 a	54.80 ab	52.72 a
T_2	21.13 ab	39.20 a	48.87 a	50.73 b-d	49.05 ab
T_3	21.15 ab	37.80 a	49.48 a	51.07 b-d	47.80 ab
T_4	20.55 b	37.73 a	50.62 a	51.27 b-d	47.52 ab
T_5	21.27 ab	39.40 a	49.97 a	54.13 a-c	51.03 ab
T_6	21.54 ab	39.27 a	51.29 a	52.27 a-d	50.37 ab
T_7	20.35 b	39.67 a	52.15 a	55.53 a	51.83 a
T_8	21.20 ab	37.87 a	51.47 a	49.93 cd	47.85 ab
T_9	23.23 a	39.47 a	51.79 a	52.27 a-d	51.60 a
LSD $_{(0.05)}$	2.33	4.43	3.87	4.21	5.43
CV (%)	6.39	6.72	4.53	4.72	6.39

Table 3. Effect of organic and inorganic fertilizers on dry weight plant^{-1} of soybean at different days after sowing

Treatments	Dry weight plant^{-1} (g) at different days after sowing				
	30	45	60	75	At harvest
T_0	0.27 c	1.33 f	3.20 e	4.67 f	5.33 f
T_1	0.43 b	2.22 a	5.33 a	7.17 ab	9.21 a
T_2	0.43 b	1.45 f	3.77 c-e	4.87 ef	5.67 f
T_3	0.42 b	1.78 c-e	3.33 de	5.50 d-f	6.83 de
T_4	0.46 ab	1.69 de	4.16 bc	6.53 bc	6.67 e
T_5	0.42 b	1.86 b-d	4.67 ab	6.53 bc	8.17 bc
T_6	0.50 a	1.56 ef	4.00 b-d	5.62 c-e	7.15 de
T_7	0.41 b	2.06 ab	5.00 a	6.17 cd	8.83 ab
T_8	0.30 c	1.56 ef	4.22 bc	6.07 cd	7.53 cd
T_9	0.42 b	2.01 a-c	5.15 a	7.53 a	8.93 ab
LSD $_{(0.05)}$	0.05	0.24	0.69	0.95	0.80
CV (%)	7.99	8.13	9.46	9.11	6.27

Table 4. Effect of organic and inorganic fertilizers on pods plant^{-1}, seeds pod^{-1}, pod length, 1000-seed weight, grain yield and Stover yield of soybean

Treatment	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	Pod length (cm)	1000-seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha $^{-1}$)
T_0	19.00 d	2.17 bc	3.290 b	10.45	1185 d	1552 c
T_1	26.20 a	2.63 a	3.850 a	11.74	2053 a	2464 a
T_2	19.73 cd	2.43 a-c	3.727 ab	10.53	1511 c	1777 bc
T_3	19.80 b-d	2.40 a-c	3.740 ab	10.66	1624 bc	1814 b
T_4	20.60 b-d	2.47 ab	3.673 ab	10.14	1610 bc	1828 b
T_5	20.80 b-d	2.57 a	3.810 a	10.79	1786 b	1951 b
T_6	22.07 b-d	2.45 ab	3.680 ab	10.88	1694 bc	1904 b

T_7	23.13 ab	2.08 c	3.750 ab	11.36	2073 a	2278 a
T_8	22.60 bc	2.57 a	3.780 a	10.97	1768 b	1977 b
T_9	26.47 a	2.67 a	3.847 a	11.65	2166 a	2372 a
LSD $_{(0.05)}$	3.35	0.36	0.48	NS	221.80	254.30
CV (%)	8.86	8.72	7.58	8.54	7.4	6.21

Here, T_0= Control, T_1= Fertilizer at Recommended Dose (RFD- Urea: 50 kg ha^{-1}, TSP: 150 kg ha^{-1}, MP: 100 kg ha^{-1}, Gypsum: 80 kg ha^{-1} and Boron: 500 g ha^{-1}), T_2= Biofertilizer + 50% RFD, T_3= Biofertilizer + 75% RFD, T_4= Mixed fertilizer + 50% RFD, T_5= Mixed fertilizer + 75% RFD, T_6= Vermicompost + 50% RFD, T_7= Vermicompost + 75% RFD, T_8= Poultry litter + 50% RFD and T_9= Poultry litter + 75% RFD.

The maximum stover yield was observed in T_1 (2464 kg ha^{-1}), which was statistically at par with T_9 and T_7 (2372 and 2278 kg ha^{-1}, respectively). Again the lowest stover yield was recorded fromT_0 (1552 kg ha^{-1}) which was statistically at par with T_2 (1777 kg ha^{-1}). The result agrees with the findings of Khaim *et al.* (2013). Dikshit and Khatik (2008) observed that application of organic and inorganic fertilizers increased the stover yield of soybean.

Conclusion

It may be concluded from the present study that inorganic fertilizer at recommended dose, vermicomost + 75% RFD and poultry litter + 75% RFD showed the better performance on growth and yield contributing characters of soybean. But considering the yield and sound environment, vermicomost + 75% RFD and poultry litter + 75% RFD could be used instead of inorganic fertilizer without significantly yield reduction. Poultry litter + 75% RFD and vermicomost + 75% RFD may be environment friendly management for higher soybean yield.

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