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Production potential realization and quality enhancement of mung bean through integrated nutrient management

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ABSTRACT

A field experiment was conducted during summer and autumn seasons of 2008-09 and 2009-10 at Bidhan Chandra Krishi Viswavidyalaya to evaluate production potential and quality enhancement of mung bean through integrated nutrient management. Application of sulphur along with recommended dose of NPK and farm compost increased yield of mung bean. Highest seed yield was obtained from single super phosphate added treatments followed by phospho-gypsum @ 30 kg S ha^{-1} along with recommended dose of NPK. Treatment receiving different doses of farm compost gave satisfactory yield and was in increasing trend in terms of seed yield and the treatments were at par with the treatments having higher doses of sulphur or phosphogypsum. Application of sulphur along with recommended dose of NPK increased the nitrogenase activity and leghaemoglobin content in nodules, but nitrogenase activity and leghaemoglobin content in nodules were more in treatments receiving farm compost. The seed protein content increased by 8.1-11.4% by application of sulphur @ 10-30 kg ha^{-1} along with NPK over the treatment where no sulphur was added. Application of farm compost @ 4-8 t ha^{-1} increased the seed protein content of mung bean by 6.5-9.0% over the fertilized control treatment.

***Keywords*:** Compost, integrated nutrient management, mung bean, production, quality

Mung bean has high demand for sulphur due to production of several protein containing materials and fatty acids, in which sulphur is an important constituent. Sengupta *et al.* (2001) reported that mung bean showed a distinct positive effect on leaf area indices, dry matter accumulation and grain yield when NPK were applied along with S-containing fertilizer. Banik and Sengupta (2012) found that the dose of 20-30 kg S ha^{-1} may be optimum and better option for increasing the yield of mung bean in an intensive cropping system where mung bean is grown as catch crop/ soil restoring crop. Sharma and Singh (1993) reported that seed yield of mung bean increased with rates up to 50 kg P and 40 kg S ha^{-1}. Application of P and S increased seed protein content. S application also increased seed methionine and cystine contents in mung bean. Kadam *et al.* (2006) reported that sulphur in combination with potassium increased seed yield of mung bean. Banik and Sengupta (2013) reported that rational applications of organic or inorganic source of plant nutrients not only increased seed yield of mung bean but can also sustain a stable production level. Organic manure application increased yield of mung bean over the control (Abraham and Lal, 2004). Application of increasing levels of FYM improved various yield attributing characters and seed yield of mung bean (Vikrant *et al*., 2005).

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MATERIALS AND METHODS

The experiment was undertaken at farm of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal (The farm is situated at 22º56' N latitude, 88º32' E longitude and at an altitude of 9.75 m above mean sea level in New Alluvial zone) during autumn and summer seasons of 2008-09 and 2009-10 to evaluate production potential and quality enhancement of mung bean through integrated nutrient management. The experiment was laid out in randomized complete block design with 9 treatments and 3 replications. The treatment were T_1= Absolute control (No nutrient input), T_2= Fertilized control (Recommended fertilizer dose 20-40-40 :: N-P_2O_5-K_2O kg ha^{-1}, without any S; P through DAP), T_3= Recommended fertilizer dose 20-40-40 :: N-P_2O_5-K_2O kg ha^{-1} (with S; P through SSP), T_4= T_2 + Phospho-gypsum at 10 kg S ha^{-1}, T_5 = T_2 + Phospho-gypsum at 20 kg S ha^{-1}, T_6 = T_2 + Phospho-gypsum at 30 kg S ha^{-1}, T_7= Farm compost at 4 t ha^{-1}, T_8= Farm compost at 6 t ha^{-1}, T_9= Farm compost at 8 t ha^{-1}. The physico-chemical properties of surface soil were textural class - sandy loam, soil pH 6.92, organic carbon 0.78 per'cent, total nitrogen 0.07 per'cent, available sulphur 8.5 ppm, with available P_2O_5 24.06 kg ha^{-1} and available K_2O 167.45 kg ha^{-1}. Mungbean [*Vigna radiata (L.) Wilczek*] variety was 'Bireshwar (WBM 4-34-1-1)'. Available green matter comprising common weeds, water hyacinth, banana leaves, crop residues and cow dung were used as raw materials for the preparation of farm compost. Biologically activated and potentized extract of three common plants *viz. Cynodan dactylon, Ocimum bascilicum and Sida cordifolia* were used for preparation of composting solution. The farm compost analysed 1.01% nitrogen, 0.62% phosphorus, 0.5% potassium and C:N ration 15:1. Observations on the growth and quality characters and yield were taken and analysis was done.

RESULTS AND DISCUSSION

Seed yield of autumn crop

The seed yield of mung bean crop varied significantly from treatment to treatment in both the years. In the first year (Table 1) the seed yield of mung bean crop varied from 704.1 kg ha^{-1} to 1271.2 kg ha^{-1}. All the treatments were significantly higher yielder than T_1 *i.e.* absolute control treatment where no nutrient input was applied. However, the treatments with lower doses of phospho-gypsum (*i.e.*, T_4 and T_5) and treatments receiving farm compost were at par with fertilized control treatment (T_2). Other treatments like T_3, and T_6 gave significantly higher yield than treatment T_2 and T_4. The highest yield was obtained from the treatment T_3, where SSP was applied for both S and P nutrients, followed by T_6, having phospho-gypsum at 30 kg S ha^{-1} along with recommended dose of NPK. Treatments T_7, T_8 and T_9 (receiving different doses of farm compost) gave satisfactory yield and were in the increasing trend in terms of grain yield, and, the treatments T_8 and T_9 were *at par* with T_3 and T_6. Favourable effects of organic manure application have also been reported by Reddy *et al*. (1991).

In the second year (Table 1), the trend was quite similar with that of the first year results. The range of variation in seed yield was from 621.0 kg ha^{-1} to 1167.9 kg ha^{-1}. The treatments T_5, T_4, T_7, T_8, and T_9 were *at par* with the fertilized control treatment (T_2); treatments T_3, and T_6 were significantly higher producer than T_2 treatment. The highest yield was obtained from treatment T_3 which was followed by T_6, T_9, T_5 and T_8. The lowest yield was obtained from the treatment T_1, *i.e*. absolute control treatment, which was significantly lower than all other treatments.

Seed yield of summer crop

In summer season also the seed yield of mung bean crop varied significantly from treatment to treatment in both the years. The first year (2009) observations showed that seed yield varied from 687.2 kg ha^{-1} to 1051.6 kg ha^{-1} (Table 1). The highest seed yield was obtained from the treatment T_6, (with phospho-gypsum at 30 kg S, along with NPK). Though it was significantly higher than four treatments *viz*., absolute control (T_1), fertilized control (T_2), treatment receiving farm compost at 4 t ha^{-1} (T_7) and the treatment (T_4) (with phospho-gypsum at 10 kg S ha^{-1} along with NPK), however, other treatments like T_5, (with phospho-gypsum at 20 kg S, along with NPK), T_3 (using SSP as source of P), T_8 and T_9, (receiving farm compost at 6 and 8 t ha^{-1}, respectively) were *at par* with the highest yielding treatment (T_6). The treatment T_6 was followed by the treatments T_3, T_9 and T_8. The treatments T_5, T_4, T_2, and T_7 were in decreasing order of yield. The lowest yield was obtained from absolute control (T_1) and all the treatments except T_7 were significantly higher yielder than T_1. T_7 was *at par* with the fertilized control treatment T_2.

In the second year (2010), almost same trend was obtained (Table 1). In this year, the seed yield varied from 598.4 kg ha^{-1} to 1186.2 kg ha^{-1}. The highest producer was the treatment T_3, which was closely followed by T_6 (1149.1 kg ha^{-1}) and T_9 (1120.8 kg ha^{-1}). Treatment T_3 was significantly higher seed yielder than treatment T_1 (absolute control), T_2 (fertilized control without any sulphur), T_4 (phospho-gypsum @ 10kg S ha^{-1} along with recommended dose of NPK) and T_7 (farm compost @ 4 t ha^{-1}). Unlike 2009 (first year), treatments T_8 and T_9 produced significantly higher yield than fertilized control treatment (T_2) and treatment T_7 where farm compost @ 4 t ha^{-1} was applied. All the treatments gave significantly higher yield than the absolute control treatment (T_1), while like first year treatment T_3 and T_6 and T_9 were statistically *at par*. Similarly treatments T_2, T_4 and T_7 were statistically *at par* like first year.

Nitrogenase activity in nodules

Di-nitrogen (N_2) fixing efficiency of nodules was determined by measuring the nitrogenase activity through acetylene reduction technique at 35 DAS (Fig. 1). Rate of C_2H_2 reduction was more in treatments receiving organic source of plant nutrients. Plants raised in plots where farm compost or sulphur was added showed better N_2 fixing efficiency than that raised in plots receiving only NPK (T_2-fertilized control) or no nutrient input, *i.e.*, absolute control (T_1) and the trend was similar in both the years. All fertilized treatments at 30 DAS during the first year experiment (T_2 to T_9) were significantly superior over absolute control treatment (T_1), however, only a few S-

Table 1: Effect of nutrient management on seed yield (kg ha^{-1}) of mung bean crop

Treatments	Autumn crop			Summer crop		
	2008	2009	Pooled	2009	2010	Pooled
T_1	704.1	621.0	662.6	687.2	598.4	642.8
T_2	1008.9	868.4	938.7	865.0	798.5	831.8
T_3	1271.2	1167.9	1219.6	1018.7	1186.2	1102.5
T_4	1020.0	887.5	953.8	901.6	893.6	897.6
T_5	1075.8	1006.1	1041.0	955.1	1007.5	981.3
T_6	1219.1	1140.7	1179.9	1051.6	1149.1	1100.4
T_7	914.6	701.5	808.1	803.8	791.7	797.8
T_8	1100.0	910.7	1005.4	985.3	989.6	987.5
T_9	1162.1	1085.2	1123.7	996.5	1120.8	1058.7
SEm (±)	**66.42**	**71.36**	**60.1**	**43.69**	**51.33**	**40.5**
LSD (0.05)	**198.60**	**213.35**	**180.0**	**130.56**	**153.91**	**120.5**

treatments (T_3, T_5 and T_6) were significantly better than T_2 (fertilized control receiving only NPK). The crop receiving only NPK (T_2) recorded appreciably higher acetylene reduction over that receiving no nutrient input (T_1). Similar type of observation was recorded in the second year experiment. Treatment T_2 (receiving only NPK) showed better nitrogenase activity in nodules than T_1 (absolute control treatment) in both the years. Treatment T_3 (receiving SSP) recorded significantly better nodule activity than T_2, other fertilized treatments were at par. At both occasions maximum nodule activity was observed in T_3 treatment and minimum or lowest activity was recorded in T_1.

Leghaemoglobin content in nodules

The leghaemoglobin content in nodules is related with bacteroid containing effective tissue volume of the nodules, further there is a direct relation between leghaemoglobin content in nodules and the amount of N_2 fixed by them, thus leghaemoglobin content in nodules gives an indication of N_2-fixing efficiency of nodules.

Leghaemoglobin contents in nodules were determined at 35 DAS at two seasons in both the years. The data recorded revealed that although application of S along with NPK increased the leghaemoglobin content in nodules, over the control treatment.

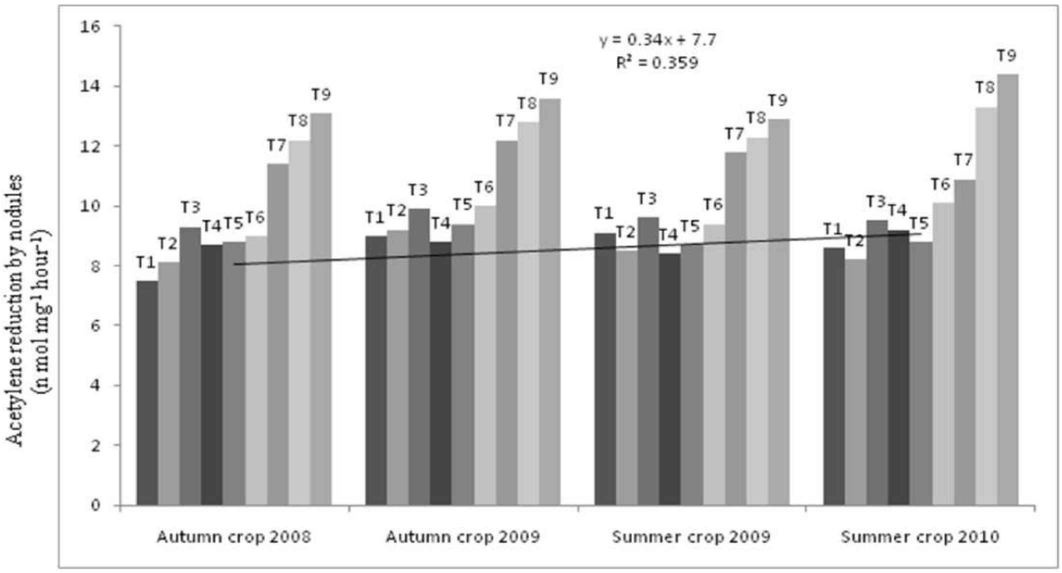

Fig. 1: Effect of nutrient management on nitrogenase activity (n mol mg^{-1} $hour^{-1}$) in nodules of mung bean crop at 35 DAS

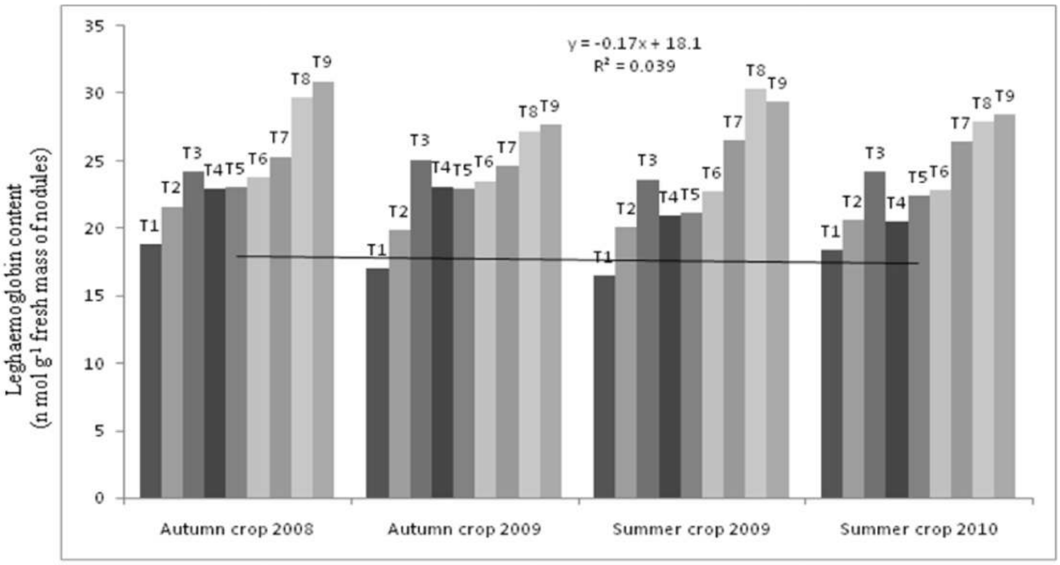

Fig. 2: Effect of nutrient management on leghaemo globin content (n mol g^{-1} fresh mass) in nodules of mung bean crop at 35 DAS

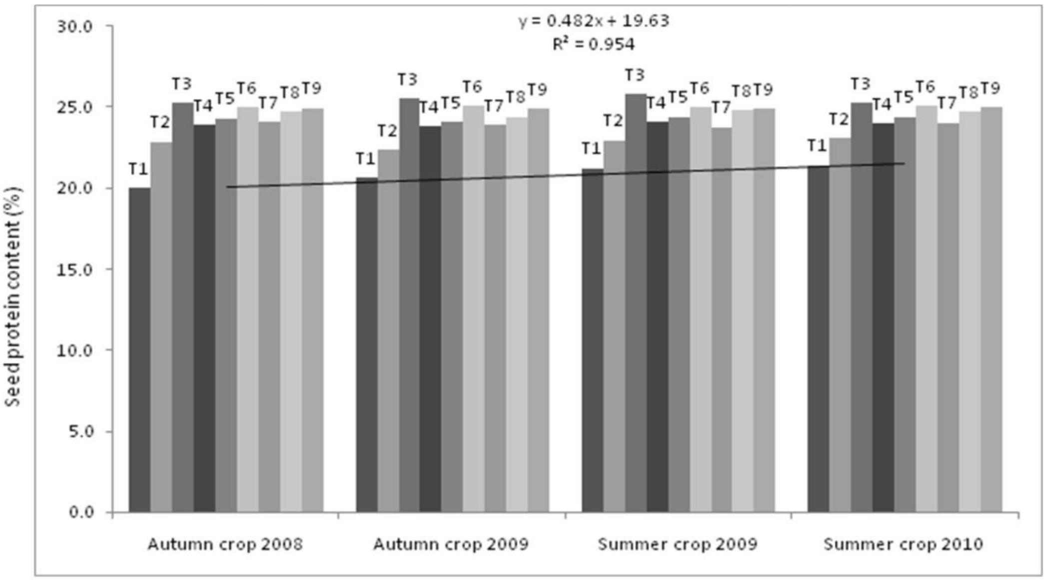

Fig. 3: Effect of nutrient management on seed protein content (%) of mung bean crop

Leghaemoglobin content in nodules was more in treatments receiving farm compost (T_7 to T_9). The leghaemoglobin contents in nodules of summer crop during the year 2009 ranged from 16.5 n mol g^{-1} fresh mass of nodules under T_1 to 30.3 n mol g^{-1} fresh mass of nodules under T_8 and that in the year 2010 ranged from 18.4 n mol g^{-1} fresh mass of nodules under T_1 to 28.4 n mol g^{-1} fresh mass of nodules under T_9, however, there was a little difference between T_8 and T_9.

In the autumn season also there was a very small difference among the treatments receiving S in both the years. The leghaemoglobin content varied between 18.8 n mol g^{-1} fresh mass of nodules under T_1 to 30.9 n mol g^{-1} fresh mass of nodules under T_9 in the year 2008; during 2009 it varied between 17.0 n mol g^{-1} fresh mass of nodules under T_1 to 27.7 n mol g^{-1} fresh mass of nodules under T_9 (Fig. 2).

Seed protein content

Seed protein content is an important character of pulse crops. Protein content in seeds was determined for all mung bean crops and expressed in percentage.

Autumn crop

Seed protein content was increased appreciably due to application of S. In the first year crop (2008) seed protein content of mung bean varied from 20.02% in the control treatment (T_1) to 25.26% in the treatment T_3 where SSP was applied and the increment was about 26%. On an average application of S increased the protein content by 11.4% over the fertilized control treatment (T_2).

In the second year (2009) seed protein content varied in between 20.65% to 25.54%, the highest value was recorded in T_3 and the lowest was obtained in T_1 and the increment was nearly 23.8% over the control treatment. Seed protein content was also increased appreciably due to application of compost (Fig. 3). On an average application of compost increased the seed protein content of mung bean by 18.3% and 9.0% over the no nutrient input control treatment (T_1) and fertilized control treatment (T_2), respectively.

Summer crop

Protein content in seeds of summer mung bean crop was comparatively slightly more than that recorded in seeds of autumn crop. In the first year (2009), the percentage value of seed protein content varied from 21.24 to 25.83%; the lowest value was recorded in no nutrient input control treatment (T_1) and the maximum value was obtained under T_3 (received SSP as a source of P). Application of S, on an average, increased the seed protein content by approximately 8.1% over the fertilized control treatment (T_2); the maximum increment was observed in T_3.

Almost similar trend was observed in the second year (2010). The lowest increment due to S application was observed in T_6 and the maximum increment was recorded in T_3. Application of NPK only (as in T_2) increased the seed protein content by 7.5% over the unfertilized control treatment (T_1). Application of compost increased the seed protein content of mung bean by 6.5% over the fertilized control treatment (T_2).

Results of the present experiment revealed that application of farm compost @ 6-8 t ha^{-1} recorded significantly higher yield of mung bean which are at par with the treatments receiving sulphur @ 20-30 kg ha^{-1} along with recommended dose of NPK. Results also showed that application of sulphur along with recommended dose of NPK increased the nitrogenase activity and leghaemoglobin content in nodules, but nitrogenase activity and leghaemoglobin content in nodules were more in treatments receiving farm compost. The seed protein content increased by 8.1-11.4% by application of sulphur @ 10-30 kg ha^{-1} along with NPK over the treatment where no sulphur was added. Application of farm compost @ 4-8 t ha^{-1} increased the seed protein content of mung bean by 6.5-9.0% over the fertilized control treatment. Results of the present experiment established that a good quality compost like farm compost can be used for the production of mung bean in place of chemical fertilizers, as the compost gave on par yield with the recommended dose of fertilizers as well as ensured good quality seed of mung bean.

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