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Research Paper

Increased production in mungbean (*Vigna radiata*) through nutrient management and utilization of residual soil productivity for raising succeeding crop

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ABSTRACT

A field experiment was conducted during the autumn and summer seasons of 2008–09 and 2009–10 at Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia to find out the best nutrient management for mungbean [*Vigna radiata* (L.) Wilczek] and its residual effect on succeeding crop. Application of N, P and K along with sulphur and farm compost increased the yield of mungbean. Highest grain yield was obtained from treatment including single superphosphate (SSP) followed by phospho–*gypsum* @ 30 kg S/ha along with recommended dose of N, P and K. Treatments receiving different doses of farm compost gave satisfactory yield in increasing trend in terms of grain yield. The response to residual nutrients on seed yield of linseed (*Linum usitatissimum* L.) or sesame (*Sesamum indicum* L.) was positive and significant. Recommended N, P and K dose @ 20:40:40 kg/ha (with sulphur, when phosphorus supplied through SSP) recorded highest grain yield, which was significantly higher from fertilized control treatment where recommended N, P and K dose @ 20:40:40 kg/ha was given without any sulphur and phosphorus applied through diammonium phosphate (DAP). Farm compost @ 6–8 t/ha recorded at par yield with recommended dose of N, P and K plus 30 kg S/ha added through phospho-gypsum.

Key words : Crop production, Mungbean, Nutrient management, Residual soil productivity, Sulphur

Pulses constitute an important group of crops and are the main stay in Indian agriculture, as they restore soil fertility, improve physical condition of soil and provide nutritious food and fodder. Increasing yield of pulse crops should be the top priority to fill up the existing gap in the requirement and availability of pulses. Excess and indiscriminate use of synthetic agro-chemicals has resulted in deterioration of natural resources by polluting crop environment leading to unsustainable productivity of land. mungbean being a legume crop has high demand for sulphur for the production of sulphur containing materials and fatty acids. (Sengupta *et al.,* 2001) reported that mungbean showed a distinct positive effect on leaf-area indices, dry-matter accumulation and grain yield when N, P and K were applied along with S-containing fertilizer. (Kadam *et al.,* 2006) reported that sulphur in combination with potassium increased seed yield of mungbean. Application of organic manure increased yield of mungbean over the control (Abraham and Lal, 2004) and increasing levels of FYM improved various yield attributing characters and seed yield of mungbean (Vikrant *et al*., 2005). The experiment was conducted to evaluate production augmentation of mungbean through integrated nutrient management and residual soil productivity on succeeding crop.

MATERIALS AND METHODS

The experiment was during autumn and summer seasons of 2008–09 and 2009–10 conducted at University Farm, Mohanpur, Nadia (22°56' N, 88°32' E, 9.75 m above mean sea-level) The site was sandy loam alluvial soil, low in S and neutral in reaction. The initial soil nutrient status of the experimental field was: organic carbon 0.78%, available P 24.06 kg/ha, available K 167.45 kg/ha, and available S 8.5 ppm. The experiment was laid out in randomized complete block design with 9 treatments [Absolute control; Fertilized control (recommended N, P and K @ 20:40:40 kg/ha, without any sulphur, phosphorus through DAP); N, P and K @ 20:40:40 kg/ha (with sulphur, phosphorus through SSP); N, P and K @ 20:40:40 kg/ha, without any sulphur + phospho-gypsum @ 10 kg S/ha; N, P and K @ 20:40:40 kg/ha, without any sulphur + phospho-gypsum @ 20 kg S/ha, N, P and K @ 20:40:40

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kg/ha, without any sulphur + phospho-gypsum @ 30 kg S/ha; farm compost @ 4 t/ha, farm compost @ 6 t/ha; farm compost @ 8 t/ha] and 3 replications. Mungbean [*Vigna radiata* (L.) Wilczek] cv. 'Bireshwar (WBM 4-34-1-1)', linseed [*Linum usitatissimum* L.] cv. 'Neelam' and sesame [*Sesamum indicum*] cv. 'Rama' were raised. Easily available green matter comprising common weeds, water hyacinth, banana leaves, crop residues and cowdung were used as composting materials. Biologically activated and potentized extract of three common plants, viz. *Cynodan dactylon, Ocimum bascilicum* and *Sida cordifolia*, were used for preparation of composting solution which was sprayed thrice during the preparation of farm compost (at first, 8^{th} and 15^{th} day). The farm compost was analyzed and on an average it contained 1.01% nitrogen, 0.62% phosphorus, 0.5% potassium with C:N ratio 15:1. Microbial population in per gram moist compost counted total bacterial population 46.5×10^{16}, total fungal population 23.5×10^{16}, total actinomycetes population 13.0×10^{16} and microbial biomass carbon 1.18%.

RESULTS AND DISCUSSION

Direct effect of nutrients on mungbean crop

Yield components of autumn and summer mungbean crop: Yield components of mungbean consist of number of pods/unit area, number of seeds/pod and test weight of seed i.e. 1,000-seed weight of which number of pods/unit area is the most important yield determinant. It should be mentioned here that the treatment differences in number of plants/m^2 were not significant. In autumn crop, number of pods/m^2 was satisfactory and quite high in both the years and the differences among different treatments varied significantly. The treatment, where SSP was used gave the maximum number of pods/m^2; it was closely followed by the treatments having recommended dose of N, P and K plus phospho-gypsum @ 30, 20 kg S/ha and farm compost @ 8, 6 t/ha, respectively, as nutrient source (Table 1); all those treatments were statistically at par. The treatments receiving farm compost at 6 and 8 t/ha were significantly better than treatment receiving farm compost @ 4 t/ha. All the treatments receiving nutrient inputs were significantly higher producer of pods/m^2 than the absolute control treatment (where no nutrient input was given). Fertilized control treatment was at par with the treatment where farm compost at 4 t/ha was applied. There were significant treatment differences for seeds/pod and the range of variation was 8.75 to 11.35. The highest value was recorded in the treatment where recommended dose of N, P and K was applied along with phospho-gypsum @ 30 kg S/ha, followed by the treatments where farm compost @ 8 t/ha and single superphosphate were applied respectively (Table 1). All the treatments receiving external nutrient inputs were statistically at par and significantly superior to the absolute control treatment. The values of test weight were not varied significantly; the highest value (48.78 g) was obtained from the treatment where farm compost was applied @ 8 t/ha, and it was very closely followed by the treatments receiving SSP and phospho-gypsum @ 20 and 30 kg S/ha along with recommended doses of N, P and K. The values ranged between 48.78 g and 46.98 g (Table 1).

In summer mungbean crop, pods/m^2 area varied from 195.15 to 312.95 (Table 1), being highest in the treatment

Table 1. Effect of nutrient management on yield components of mungbean crop (pooled data of 2 years)

Treatment	Autumn crop (Pooled of 2008 and 2009)			Summer crop(Pooled of 2009 and 2010)		
	Pods/m^2	Seeds/pod	Test weight (g)	Pods/m^2	Seeds/pod	Test weight (g)
Absolute control (No nutrient input)	216.7	8.7	46.9	195.1	8.0	48.9
Fertilized control (recommended N, P and K @ 20,40,40 kg/ha, without any sulphur; phosphorus through DAP)	328.9	9.6	47.3	258.5	9.0	51.3
Recommended N, P and K @ 20,40,40 kg/ha (with sulphur; phosphorus through SSP)	401.1	10.6	48.7	312.9	10.5	50.9
Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur + phospho-gypsum @ 10 kg S/ha	372.1	10.4	46.5	282.1	9.8	51.1
Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur + phospho-gypsum @ 20 kg S/ha	380.5	10.5	48.5	289.4	9.9	50.3
Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur + phospho-gypsum @ 30 kg S/ha	398.2	11.3	48.3	302.0	10.7	51.0
Farm compost @ 4 t/ha	296.8	10.0	46.0	256.7	9.1	49.2
Farm compost @ 6 t/ha	361.7	10.5	47.3	282.9	9.8	49.4
Farm compost @ 8 t/ha	374.8	10.8	48.7	293.9	10.0	51.3
SEm±	14.3	0.4	1.2	7.7	0.4	1.4
CD (P=0.05)	43.1	1.2	NS	23.2	1.1	NS

where single superphosphate was used as the source of phosphorus, followed by the treatment with phospho-gypsum @ 30 kg S/ha, while the lowest number of pods/m^2 was obtained from the absolute control treatment where no nutrient input was applied. Pod/m^{-2} were significantly higher with recommended dose of NPK with sulphur than the treatment where only recommended dose of NPK was applied without any sulphur (diammonium phosphate was used as the source of phosphorus). All the treatments receiving external nutrient inputs produced significantly more number of pod/m^{-2} than the absolute control treatment. Except the treatment with lowest dose of farm compost (@ 4 t/ha) other treatments received nutrient input were significantly superior to the fertilized control treatment. Number of seeds/pod varied significantly among the treatments, being 8.05 to 10.74. The highest number was obtained from the treatment where phospho-gypsum @ 30 kg S/ha was applied along with recommended dose of N, P and K, followed by the treatment where single super phosphate was used as the source of phosphorus. The treatments receiving external nutrient inputs through farm compost were at par with the fertilized control treatment; however, higher doses of farm compost (@ 6 or 8 t/ha) showed significantly higher value than the absolute control (Table 1). The differences in test weight due to treatments (varied between 48.91 and 51.34 g) were not significant.

Grain yield of autumn and summer mungbean: In autumn mungbean crop, an application of nutrients significantly increased the grain yield of mungbean crop. However, the treatments with lower doses of phospho-gypsum (@10 and 20 kg S/ha) and farm compost (@ 4 and 6 t/ha) were at par with fertilized control treatment. The highest yield was obtained from the treatment where SSP was applied followed by the treatment receiving phospho-gypsum @ 30 kg S/ha along with recommended dose of NPK. Treatments receiving different doses of farm compost gave satisfactory yield (0.82–1.12 t/ha) and were in the increasing trend in terms of grain yield, and the treatments receiving higher doses of compost were at par with the treatment having sulphur along with N, P and K. Kumar *et al*. (2003) and Singh *et al.* (2001), also reported favourable effects of organic manure application.

In Summer mungbean crop, the highest grain yield (1.11 t/ha) like autumn crop was obtained where SSP was applied followed by the treatment received phospho-gypsum @ 30 kg S/ha along with recommended dose of NPK and both the treatments were significantly higher than four treatments, viz. absolute control, fertilized control, treatment receiving farm compost @ 4 t /ha and the treatment got phospho-gypsum @ 10 kg S/ha along with NPK. However, rest of the treatments was at par with the highest yielding treatment where SSP was used as a source of phosphorous.

Residual soil productivity

Residual effect of nutrients on yield of succeeding crop: The residual effect of nutrients applied to mungbean crop on succeeding crop was apparent in increasing the yield of succeeding linseed or sesame crop (Table 2). Application of farm compost and sulphur levels to mungbean crop had some better influence on succeeding oilseed crop. The residual effect of farm compost, particularly at higher doses, was most conspicuous.

Table 2. Effect of nutrient management on grain yield (t/ha) of mungbean and succeeding linseed/sesame crop (pooled data of 2 years)

Treatment	Autumn mungbean crop	Summer mungbean crop	Linseed crop	Sesame crop
Absolute control (No nutrient input)	0.66	0.59	0.58	0.56
Fertilized control (Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur; phosphorus through DAP)	0.89	0.81	0.77	0.72
Recommended N, P and K @ 20,40,40 kg/ha (with sulphur; phosphorus through SSP)	1.20	1.11	0.94	0.98
Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur + phospho-gypsum @ 10 kg S/ha	1.00	0.90	0.86	0.88
Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur + phospho-gypsum @ 20 kg S/ha	1.04	1.01	0.90	0.93
Recommended N, P and K @ 20,40,40 kg/ha, without any sulphur + phospho-gypsum @ 30 kg S/ha	1.18	1.09	0.96	1.02
Farm compost @ 4 t/ha	0.82	0.78	0.74	0.70
Farm compost @ 6 t/ha	1.03	1.02	0.95	0.89
Farm compost @ 8 t/ha	1.12	1.08	1.07	1.14
SEm±	0.06	0.04	0.03	0.03
CD (P=0.05)	0.18	0.12	0.09	0.09

The responses to residual nutrients on yield of linseed were positive and significant and the average increase over the absolute control treatment (without any external nutrient input) was 36.20 %. Similar effect on residual soil fertility was reported by Lakpale *et al*. (2003). Sulphur application in general, benefited more than one crop grown in sequence and left a significant residual effect (Tandon, 1991; Bharathi and Poongothai, 2008). The residual effect of sulphur was positive (Table 2) and the higher doses of S produced significantly more yield than that recorded in fertilized control plot (where no sulphur was applied). Similarly, the residual effect of farm compost was positive and the higher doses of farm compost (6 or 8 t/ha) resulted significantly more yield than that recorded in fertilized control plot.

The grain yield of succeeding sesame crop was increased by 25.0–103.5% in the treatments getting the effect of residual nutrients than that was recorded in the absolute control treatment with no nutrient input (Table 2). The results are in line with those of Sharma and Vyas (2001). The residual effect of sulphur as well as farm compost was positive and the higher doses resulted in significantly more yield than that obtained in fertilized control plot.

Thus, the rational applications of organic or synthetic source of plant nutrients not only increased yield, but can also sustain a stable production level**.** Application of single superphoshphate for a recommended dose of P (through which 30 kg S/ha was added automatically) in sandy loam alluvial soil, low in S, was a very useful management practice that could easily be adopted to increase the yield and quality of annual grain legume like mungbean.

In pulse–oilseed sequence it is better to apply S in the form of single superphoshphate, as it showed an added advantage over other sulphur sources. The management of organic manure in particular should be considered for cropping system as a whole rather than individual crop because nutrients present in organic source cannot be fully utilized by the crop to which it is applied and a substantial amount is left in the soil for subsequent crop and thus the residual effects become an important dimension for the management of organic sources. Organic manure when used in sufficient quantity can effectively complement synthetic nutrient inputs.

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