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Effect of organic manures and mineral nutrients on soil properties of clusterbean [*Cyamnposis tetragonoloba* (L.) Taub.]

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Abstract
A field experiment was conducted at Agronomy Farm, S.K.N. College of Agriculture, Jobner, (Rajasthan) during *kharif,* 2013 on loamy sand soil to study the effect of organic manures and mineral nutrients on soil properties and yield of clusterbean [*Cyamposis tetragonoloba* (L.) Taub.]. The treatments consisted of four levels of organic manures (Control, FYM @ 10 t/ha,vermicompost @ 3 t/ha and poultry manure @ 4 t/ha) and five levels of mineral nutrients (Control, elemental sulphur @ 40 kg/ha, elemental sulphur @ 40 kg/ha+ zinc sulphate @ 25 kg/ha, elemental sulphur @ 40 kg/ha + zinc sulphate @ 25 kg/ha +ferrous sulphate @ 50 kg/ha, elemental sulphur @ 40 kg/ha+ zinc sulphate @ 25 kg/ha +ferrous sulphate @ 50 kg/ha + ammonium molybdate @ 1 kg/ha) were applied to the clusterbean var. RGC-1003. The experiment was laid out in randomised block design and replicated three. The moisture retention, organic carbon, available nitrogen, phosphorus, sulphur, molybdenum, iron and zinc in soil at harvest of crop were recorded significantly maximum with the application of poultry manure @ 4 t/ha over control. Maximum available nitrogen, phosphorus, sulphur, molybdenum, iron and zinc were recorded under the application of S+Zn+Fe+Mo.

Keywords: organic manures, mineral nutrients and soil properties

Introduction
Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] popularly known by its vernacular name 'guar' is an important legume crop mainly grown under rainfed condition in arid and semi-arid regions of Rajasthan during *kharif* season. It is very hardy and drought tolerant crop. Its deep penetrating roots enable the plant to utilize available moisture more efficiently and thus offer better scope for rainfed cropping. The crop also survives even at moderate salinity and alkalinity conditions. There is no other legume crop so hardy and drought tolerant as clusterbean, which is especially suited for soil and climate of Rajasthan. Clusterbean seed is used as a concentrate for animal and for extraction of "gum". Seed of clusterbean contain 28 to 33 per cent gum. Guar gum has its use in several industries viz., textiles, paper, petroleum, pharmaceuticals, food processing cosmetics, mining explosives, oil drilling etc. Clusterbean is leguminous crop and can fix 37-196 kg N/ha per year.

In India, clusterbean is mostly grown in Rajasthan, Haryana, Punjab, Uttar Pradesh and Madhya Pradesh. Total production of guar in India was achieved by 2.46 mt from an area of 5.15 m ha during 2012-13 with productivity of 478 kg/ha. A production of 2.0 mt ha was achieved in our state from an area of 4.5 m ha with productivity of 447 kg/ha. Nearly 90 per cent of the area under guar crop in the country is being contributed almost consistently by Rajasthan state (anonymous, 2012) [1]. Addition of organic material to the soil such as FYM, vermicompost, poultry manure etc. help in maintaining the soil fertility and productivity. These increases soil microbiological activities, plays key role in transformation recycling and availability of nutrients to the crop (Collins *et al.* 1992) [4]. These also improve the physical properties like soil structure, porosity, reduce compaction and crusting, increases water holding capacity of soil. The availability of major and micronutrients from native source also increases with incorporation of organic matter which might be due to release of organic acid (Stevensons, 1982) [13]. Despite the maximum area of clusterbean in Rajasthan, the average productivity is only 0.45 t/ha compared 1.35 and 0.89 t/ha in Haryana and Gujarat (Anonymous, 2012) [1].

Materials and methods

A field experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during *kharif* season of 2013. The details of procedure adopted for raising the crop and criteria adopted for evaluation of treatments during the course of present investigation are described in this chapter. The site is situated 45 km west of Jaipur at 26^0 5' North latitude and 75^0 28 East longitude at an altitude of 427 meters above mean sea level. The place falls under Agro-climatic zone-IIIa (Semi-Arid Eastern Plains), of Rajasthan. The climate of this zone is typically semi-arid characterized by extremes of temperature during both summers and winters. During summers, the temperature may go as high as 48^0C, while, in winters, it may fall as low as -1.0^0C. The rainfall of this tract varies form 450-500 mm, most of which is contributed by south-west monsoon during the months of July and August. In order to determine the physico-chemical properties of soil, soil samples (0-15 cm depth) were collected from different spots of the experimental field prior to sowing and fertilization. The experimental soil was loamy sand in texture with soil was low in organic carbon (2.30 %), low available nitrogen (124.2 kg N ha^{-1}), medium in available phosphorus (16.50 kg P_2O_5 ha^{-1}) and in available potassium (161.90 kg K_2O ha^{-1}) while the soil was deficient in available sulphur (7.45 mg kg^{-1}), available Mo 0.12 (mg kg^{-1}), available DTPA Fe 5.34 (mg kg^{-1}) available DTPA Zn 0.42 (mg kg^{-1}). The soil was non saline with a reaction 8.2. Recommended dose of N and P was applied through urea and DAP as basal at the time of sowing. The FYM @ 10 t ha^{-1}, vermicompost @ 3 t ha^{-1} and poultry manure @ 4 t ha^{-1} were applied uniformly 20 days before sowing and incorporated in soil manually in allocated beds as per treatment. Sulphur was applied through elemental sulphur as per treatment 21 days before sowing through broadcasting. Sulphur received through iron sulphate and zinc sulphate was equated, in sulphur treatment. Mo, Fe and Zn were applied through ammonium molybdate, ferrous sulphate and zinc sulphate. The crop was raised with standard package of practices.

Nutrient content and uptake - For estimation of nitrogen, sulphur, iron, zinc and molybdenum of representative samples of seed and straw were taken at the time of threshing. Samples were washed with tap water followed by washing with 0.1 N HCl and de-ionized water. The samples were air dried and kept in oven at 60 to 70^0C for drying till the constant weight. Each dried sample was ground to a fine powder in a steel Willey Mill used in estimation of nutrient content in seed and straw.

Nutrient uptake - The N and S content in seed and straw was expressed as per cent and its uptake by seed and straw in kg/ha was calculated by using following formula:

$$\text{N \& S uptake (kg/ha)} = \frac{\text{Nutrient content (\%) in seed/ straw} \times \text{Seed/straw yield (kg/ha)}}{100}$$

The Mo, Fe and Zn content in seed and straw was expressed as ppm and its uptake by seed and straw in g/ha was calculated by using following formula:

$$\text{Mo, Fe and Zn uptake (g/ha)} = \frac{\text{Nutrient content (ppm) in seed/straw} \times \text{Seed/straw yield (kg/ha)}}{1000}$$

Results and Discussion

The results obtained from the present investigation are presented in Table 1, 2 and 3

Effect of organic manures

A perusal of data in Table 1 revealed that application of different organic manures significantly decreased the bulk density of the soil. The application of FYM @ 10 t/ha significantly lowered the bulk density and saturated hydraulic conductivity over control, However, vermicompost and poultry manure unable to lowered the bulk density and saturated hydraulic conductivity significantly over control. The table 2 showed that organic carbon content in the soil at harvest stage of the crop increased significantly with application of different level of organic manure. The maximum organic carbon content (2.74 g/kg) was observed under poultry manure applied @ 4 t/ha and the minimum (2.42 g/kg) under control. However, the poultry manure and vermicompost remained equally effective in increasing the organic carbon content of soil. Data given in Table 2 and 3 indicated that application of different organic manures significantly increased the available nitrogen, phosphorus, sulphur, iron, molybdenum and zinc content in soil. Data further indicate that application of vermicompost @ 3 t/ha and poultry manure @ 4 t/ha found equally effective in increasing the phosphorus content in soil. The role of organic manure in improving the physical properties is well known. Soil organic manure imparts desirable physical environment to soil by favourably affecting soil structure expressed through soil porosity, aggregation, bulk density and water storage capacity (Benbi *et al.,* 1998) [2]. Singh *et al.* (2012) [12] who observed decease in bulk density due to increase in organic carbon content of the soil.

Addition of organic manure increased the organic carbon in soil significantly over control. The increase in organic carbon content in the manurial treatment could be attributed to direct incorporation of the organic matter in the soil (Vasanthi and Kumarswamy, 1999) [16]. Similar results were also reported by Yaduvanshi (2000) [18]. Higher organic carbon content of soil with vermicompost and poultry manure application as these easily decomposable because of narrower C:N ratio as compared to other organic manures. The findings are supported by Sukmal *et al.* (2004) [14], Kumawat and Jat (2005) [7] and Singh *et al.* (2012) [12].

Data (Table 2 and 3) showed that application of organic manures significantly influenced the available content of N, P_2O_5, S, Mo, Fe and Zn in soil at harvest of the crop. The significantly maximum content of nutrients (N, P, S, Mo, Fe, Zn) were observed under the application of poultry manure @ 4 t ha^{-1}. The values of available content of these nutrients in soil at harvest of the crop under the treatment T_2 (vermicompost @ 4 t ha^{-1}) and T_3 (poultry manure @ 4 t ha^{-1})

were found statistically at par. The organic materials supplies N besides causing an improvement in the microbial activity, stabilization of soil structure and associated benefits. Moreover, the N released has been reported to get incorporated in the soil humic material thereby accounting for higher total N build-up (Bhandari *et al.,* 2000) [3]. These results corroborate the findings of Gupta *et al.,* (2005) [6]. It is well known that organic manures besides being the direct source of P also solublized the insoluble and fixed P in soil through release of various organic acids. Amending soil with organic manures helps in increasing the P concentration in soil solution through mineralization of native soil P (Pattanayak *et al.*, 2009) [10].

The higher availability of micro nutrients in soil due to application of manures could be ascribed to mineralization of manures, reduction in fixation and complexing properties of decomposition products of manures with micronutrients (Gopal Raddy and Suryanarayan Raddy, 1998) [5]. Higher levels of micro nutrient in poultry manure and vermicompost treated plots could also be attributed due to chelating action of organic compounds released during decomposition of organic manures which protect these cations from fixation, precipitation, oxidation and leaching (Yadav and Kumar, 1998) [17] of nutrient at harvest. The increase in availability of micro nutrients at harvest of the crop may also be due to enhanced microbial activity, nitrogen fixation by the crop, cyclicaly transformation of insoluble micronutrients (Mann *et al.* 1978) [8], enhanced mobility (Varalakshmi *et al.*2005) [15], and solubilization of native forms of nutrients.

Mineral nutrients

The effect of mineral nutrients application on bulk density, saturated hydraulic conductivity and organic carbon were found non significant. Further reference to data in Table 2 and 3 revealed that the effect of mineral nutrients on available nitrogen, phosphorus, sulphur, iron, molybdenum and zinc content of soil were found significant. The maximum available nitrogen, phosphorus, sulphur, iron, molybdenum and zinc content of soil were observed under treatment M_4 and the minimum under M_0.

Data presented in table 1, 2 and 3 showed the application of mineral nutrient significantly increased the available content of soil at harvest of the crop. The maximum content of N, P_2O_5, S, Mo and Fe under the treatment M_4 (S+Zn+Fe+Mo), respectively. The improvement in status of soil may be ascribed to more biomass (leaves, roots and dead cell of microbes) added by legumes (Hedge and Saraf, 1978) and increase in symbiotic nitrogen fixation, increase in soil biomass and microbial activity. The increase in available content of the nutrients may also be due to direct addition of these nutrients in the experimental soil. Synergism between nitrogen and iron, phosphorus and molybdenum and Mo and Zn may also be responsible for increase in available content of these nutrients. Similar results were also reported by Mishra *et al.* (2011) [9] and Sharma and Jain (2012) [11].

Conclusion

The organic carbon, available nitrogen, phosphorus, sulphur, molybdenum, iron and zinc in soil at harvest of crop were recorded significantly maximum with the application of poultry manure @ 4 t/ha over control. While, saturated hydraulic conductivity increased significantly with the application of FYM @ 10 t/ha. Maximum available nitrogen, phosphorus, sulphur, molybdenum, iron and zinc were recorded under the application of S+Zn+Fe+Mo.

Use of poultry manure @ 4 t ha^{-1} or vermicompsot @ 3 t ha^{-1} or as combined application of S+Zn+Fe+Mo resulted in significantly higher nutrient content, uptake and availability compromising on soil fertility maintenance. However, these results are only indicative and require further experimentation for confirmation before making final recommendation to the farmers.

Table 1: Effect of organic manures and mineral nutrients on bulk density and saturated hydraulic conductivity of soil at harvest stage

Treatments	Bulk density (Mg/m^3)	Saturated hydraulic conductivity (cm/h)
Organic manures		
Control (T_0)	1.55	5.19
FYM (T_1)	1.45	7.15
Vermicompost (T_2)	1.48	6.33
Poultry manure (T_3)	1.47	6.73
SEm±	0.03	0.12
CD at (P=0.05)	0.08	0.35
Mineral nutrients		
Control (M_0)	1.52	6.42
Elemental sulphur (M_1)	1.49	6.32
S +Zn (M_2)	1.49	6.35
S + Zn + Fe (M_3)	1.48	6.34
S + Zn + Fe + Mo (M_4)	1.48	6.32
SEm±	0.03	0.14
CD at (P=0.05)	NS	NS

Table 2: Effect of organic manures and mineral nutrients on organic carbon, available N, P_2O_5 and S content of soil at harvest

Treatments	OC (g/kg)	N (kg/ha)	P_2O_5 (kg/ha)	S (mg/kg)
Organic manures				
Control (T_0)	2.42	125.00	16.62	7.75
FYM (T_1)	2.55	129.86	18.02	8.94
Vermicompost (T_2)	2.65	131.81	19.10	9.42
Poultry manure (T_3)	2.74	136.00	20.33	9.92
SEm±	0.05	2.99	0.37	0.18
CD at (P=0.05)	0.14	8.55	1.06	0.52
Mineral nutrients				
Control (M_0)	2.55	125.64	16.37	7.83

Elemental sulphur (M_1)	2.57	129.04	17.74	8.43
S +Zn (M_2)	2.60	130.85	18.12	9.01
S + Zn + Fe (M_3)	2.61	132.53	19.49	9.59
S + Zn + Fe + Mo (M_4)	2.61	135.28	20.87	10.17
SEm±	0.06	3.34	0.41	0.20
CD at (P=0.05)	0.16	9.56	1.18	0.58

Table 3: Effect of organic manures and mineral nutrients on available Fe, Mo and Zn content of soil at harvest

Treatments	Fe (mg/kg)	Mo (mg/kg)	Zn (mg/kg)
Organic manures			
Control (T_0)	6.00	0.122	0.50
FYM (T_1)	6.50	0.132	0.54
Vermicompost (T_2)	6.90	0.139	0.57
Poultry manure (T_3)	7.31	0.145	0.60
SEm±	0.14	0.003	0.01
CD at (P=0.05)	0.40	0.008	0.03
Mineral nutrients			
Control (M_0)	5.76	0.115	0.48
Elemental sulphur (M_1)	6.19	0.125	0.51
S +Zn (M_2)	6.68	0.134	0.55
S + Zn + Fe (M_3)	7.14	0.145	0.59
S + Zn + Fe + Mo (M_4)	7.62	0.153	0.62
SEm±	0.16	0.003	0.01
CD at (P=0.05)	0.44	0.009	0.04

Reference

1. Anonymous. Vital statistics, Government of Rajasthan, 2012.
2. Benbi DK, Biswas CR, Bawa SS, Kumar K. Influence of farm yard manure, inorganic fertilizers and weed control practices on some soil physical properties in long- term experiment. Soil Use and Management. 1998; 14:52-54.
3. Bhandari AL, Walia SS, Singh T. Production sustainability of Maize-Wheat system in a Typic Ustipsamment soil as influenced by integrated nutrient sources. Proc. Intern. Conf. on Managing Natural Resources for Sustainable Agriculture Production in the 21th Century, New Delhi. 2000; 3:889-890.
4. Collins HP, Rasmussen PE, Doughlas CL. crop rotation and residue management effect on soil and microbial dynamics. Soil Science Society of America Journal. 1992; 56:783-788.
5. Gopal Reddy B, Suryanarayana Reddy. Effect of organic manures and nitrogen levels on soil available nutrient status in Maize-Soybean cropping system. Journal of the Indian Society of Soil Science. 1998; 46:474-476.
6. Gupta RK, Sharrma KN, Singh B, Singh Y, Arora BR. Effect of urea and manure addition on changes in mineral N-content in soil profile at various growth stages of wheat. Journal of the Indian Society of Soil Science. 2005; 53:74-80.
7. Kumawat PD, Jat NL. Effect of organic manure and nitrogen fertilization on productivity of barley (Hordium valgare). Indian Journal of Agronomy. 2005; 50:200-202.
8. Manna MS, Takkar PN, Bansal RL, Randhawa NS. Micronutrient status of soil and yield of maize and wheat as influenced by micronutrient and farm Yard manure application. Journal of Indian Society of Soil Science. 1978; 28:208-214.
9. Mishra PK, Bisht SC, Pooja Ruwari Joshi, Singh G, Bisht JK, Bhatt JC. Bioassociative effect of cold tolerant Pseudomonas spp. and Rhizobium leguminosarum-PR1 on iron acquisition, nutrient uptake and growth of lentil (Lens culinaris L.). European Journal of Soil Biology. 2011; 47:35-43.
10. Pattanayak SK, Sureshkumar P, Tarafdar JC. New vista in phosphorus research. Journal of the Indian Society of Soil Science. 2009; 57:536-545.
11. Sharma SK, Jain NK. Effect of balanced fertilization on productivity and soil fertility status of clusterbean, Legume Research. 2012; 35(1):32-35.
12. Singh A, Singh VK, Chandra R, Srivastava PC. Effect of the integrated nutrient management on pigeonpea based intercropping system and soil properties in Mollisols of the tarai region. Journal of the Indian Society of Soil Science. 2012; 60:38-44.
13. Stevensons FJ. Organic matter and nutrient availability in non-symbiotic nitrogen fixation and organic matter in the tropics. Symposia paper. 12th International Congress of Soil Science, held at New Delhi on, 1982; 2:3-16.
14. Sukmal C, Anwar M, Patra DD, Khanuja SPS. Effect of mint distillation waste on soil microbial biomass in a mint-mustard cropping sequence. Soil Science and Plant Analysis. 2004; 35:243-254.
15. Varalakshmi LR, Srinivasamurthy CA, Bhaskar S. Effect of integrated use of organic manures and inorganic fertilizers on organic carbon, available N, P and K in sustaining productivity of groundnut-finger millet cropping system. Journal of the Indian Society of Soil Science. 2005; 53:315-318.
16. Vasanthi D, Kumarswamy. Efficacy of vermicompost to improve soil fertility and rice yield. Journal of the Indian Society of Soil Science. 1999; 47:268-272.
17. Yadav DS, Kumar A. Integrated use of organic and inorganic in Rice, Wheat cropping system for sustained production In: Long term soil fertility management through integrated plant nutrient supply. Eds. A. Swarup, D. Damodar Reddy and R.N. Prasad. Indian Institute of Soil Science, Bhopal, 1998, 247-255.
18. Yaduvanshi NPS. Sustainability of rice- wheat system in gypsum treated alkali soils through organic and inorganic fertilizer. Proc. International conference. Managing natural Resources for Sustainable Agricultural Production in the 21st Century, New Delhi, 2000; 3:1261-1262.