Research Article

Effect of Organic and Inorganic Nutrition on Fertility Status of Soil and Yield of Vegetable Cowpea

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Abstract

A field experiment was conducted during *kharif*, 2012 on loamy sand soil, to study the Effect of organic and inorganic nutrition on fertility status of soil and yield of vegetable cowpea [*Vigna unguiculata* (L.) Walp.]. var. RCV-7. The treatments consisted four organic manure (Control, FYM @ 10 t ha^{-1},vermicompost @ 5 t ha^{-1} and poultry manure @ 5 t ha^{-1}) and five levels of inorganic nutrients (Control, Elemental sulphur @ 20 kg ha^{-1}, Elemental sulphur @ 20 kg ha^{-1}+ Ammonium molybdate @ 1.0 kg ha^{-1}, Elemental sulphur @ 20 kg ha^{-1}+ Ammonium molybdate @ 1.0 kg ha^{-1} +Ferrous sulphate@ 50 kg ha^{-1}, Elemental sulphur @ 20 kg ha^{-1}+ Ammonium molybdate @ 1.0 kg ha^{-1} +Ferrous sulphate@ 50 kg ha^{-1} +Zinc sulphate @ 25 kg ha^{-1}) were applied to the vegetable cowpea var. RCV-7. The experiment was laid out in randomized block design and replicated thrice. The available nitrogen, phosphorus, potassium, sulphur, molybdenum, iron and zinc in soil at harvest of crop were recorded significantly maximum with the application of vermicompost @ 5 t ha^{-1}(V_5) over control. While maximum organic carbon in experimental field was recorded with the application of FYM @ 10 t ha^{-1} (F_{10}) and under the treatment level M_3 (S+Mo+Fe). Under mineral nutrients treatments, maximum N, P, K, S, Mo, Fe and Zn were recorded under the application of S+Mo+Fe+Zn. The resulted revealed that the application of vermicompost @ 5 t ha^{-1} and combined application of S+Mo+Fe were found significantly superior in increasing the green pod yield per ha^{-1} over control.

Keywords: Mineral nutrient, organic manure and green pods yield of vegetable cowpea

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Introduction

Organic manure contains both macro and micro nutrients. Improvement in available nutrient status of the soil with the incorporation of FYM alone or in combination with chemical fertilizer could be attributed to the slow decomposition of organic manure producing acids and enhancing soil biological activity. These in turn provides congenial physical condition, conserves soil nitrogen and increases the availability of other nutrients. The mineralization of nutrients in the rhizophere improves crop growth and provides a better source-sink relationship by enhancing synthesis and allocation of metabolites to reproductive organs. Application into soil results in improved soil condition and thereby significantly increases the levels of N fixation. The application of vermicompost not only add plant nutrients and growth regulator to the soil but also increases soil water retention capacity microbial population, humic content of the soil and soil aeration. Incorporation of FYM or poultry manure alone or integration with chemical fertilizer improves available nutrient status of the soil with enhanced soil biological activity which in turn provides a congenial physical condition and improved availability of nutrient in the rhizosphere. The present investigation was undertaken to study the effect of organic and inorganic nutrition on fertility status of soil and yield of vegetable cowpea cv. RCV-7.

Material and Methods

The field experiments were conducted at S.K.N. College of Agriculture, Jobner during 2012-2013 using cowpea Cv.RCV-7. The soil was low in available nitrogen, phosphorus, potassium, sulphur, molybdenum, iron and zinc (134.90, 15.47, 190 kg ha^{-1} and 7.97, 0.12, 5.34 and 0.42 mg kg^{-1}), respectively. The soil was low organic carbon (0.24 %).

Treatment consisting of 20 combination of four levels of organic nutrition (control, FYM 10 t ha^{-1}, vermicompost 5 t ha^{-1} and poultry manure 5 t ha^{-1}) and five levels of inorganic nutrition (control, Elemental sulphur @ 20 kg ha^{-1}, Elemental sulphur @ 20 kg ha^{-1}+ Ammonium molybdate @ 1.0 kg ha^{-1}, Elemental sulphur @ 20 kg ha^{-1}+ Ammonium molybdate @ 1.0 kg ha^{-1} +Ferrous sulphate@ 50 kg ha^{-1}, Elemental sulphur @ 20 kg ha^{-1}+ Ammonium molybdate @

1.0 kg ha^{-1} +Ferrous sulphate@ 50 kg ha^{-1} +Zinc sulphate @ 25 kg ha^{-1}) were replicated thrice and laid out in Randomized Block Design and recommended dose of nitrogen @ 20 kg ha^{-1} and phosphorus @ 40 kg ha^{-1} were applied at sowing time.

The green pod yield of each plot was computed by totaling of yield and of pod per plot of all picking and recorded as pod yield q ha^{-1} and converted in term of pod yield q ha^{-1}. To assess the fertility status of soil, the soil sample (0-15 cm depth) from each plot at harvest of the crop was taken. The samples were passed through 2 mm plastic sieve to avoid metallic contamination. The recommended dose of N, P and K was applied in the whole of the field prior to sowing. Whereas sulphur and FYM were applied about three weeks (21 days) before sowing of the crop. The vermicompost and poultry manure were applied through mixed manually spread in the randomly selected beds just before sowing. Mo, Fe and Zn were applied through ammonium molybdate, ferrous sulphate and zinc sulphate respectively through broadcasting as per treatment in randomly selected beds.

Results and Discussion

Effect of organic nutrition on soil available nutrient status of N P K S, Mo, Fe, Zn

The application of organic manures significantly influenced the available content of N P K S, Mo, Fe, Zn in soil at harvest of the crop (Table 1). The significantly maximum content of nutrients (N P K S Mo Fe Zn) were observed under the treatment level P_5 (poultry manure @ 5 t ha^{-1}). The treatment V_5 also found statistically at par with the treatments V_5 (vermicompost @ 5 t ha^{-1}).

The higher availability of mineral nutrients in soil due to application of manures (vermicompost) could be ascribed to mineralization of manures, reduction in fixation and complexing properties of decomposition products of manures with micronutrients [1]. Higher levels of mineral nutrient in 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 [2] of nutrient at harvest. The increase in availability of nutrients at harvest of the crop may also be due to enhanced microbial activity and nitrogen fixation by the crop, cyclicaly transformation of insoluble micronutrients [3], enhanced mobility [4], solubilization of native formes of nutrients.

Table 1 Effect of organic and inorganic nutrition on available status of N, P, K and S in of soil at harvest of the crop

Treatments	**Available content (kg ha^{-1})**			
	N	**P_2O_5**	**K_2O**	**S**
Organic				
C_0(control)	135.01	15.45	152.60	7.78
F_{10} (FYM 10 t ha^{-1})	147.08	18.06	174.25	8.25
V_5 (vermicompost 5 t ha^{-1})	158.4	20.10	190.25	8.65
P_5 (poultry manure 5 t ha^{-1})	162.01	20.85	195.40	8.78
SEm±	3.35	0.66	5.56	0.12
CD (P=0.05)	9.58	1.88	15.93	0.33
Inorganic nutrients				
M_0(control)	129.91	14.67	150.41	7.72
M_1(S)	140.48	17.17	164.35	8.18
M_2 (S +Mo)	152.43	19.33	185.24	8.28
M_3 (S+Mo+Fe)	163.66	21.31	204.02	8.39
M_4 (S+Mo+Fe+Zn)	166.64	21.11	209.11	8.51
SEm±	3.74	0.73	6.22	0.13
CD (P=0.05)	10.80	2.12	17.96	0.37

Effect of mineral nutrition on soil available nutrient status of N P K S, Mo, Fe, Zn

The application of mineral nutrient significantly increased the available content of soil at harvest of the crop. The maximum content of N P K and Fe were recorded under the treatment M_3 whereas S, Mo and Zn were recorded significantly maximum recorded under the treatment M_1, M_2, M_4 respectively. The improvement in status of soil may be ascribed to more biomass (leaves, roots and dead cell of microbes) added by short during legumes [5] 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 fields of the experimental crop. Synergism

between nitrogen and iron, phosphorus and molybdenum positive interaction between Mo and Zn may also be responsible for increase in available content of these nutrients. Similar finding [6] and [7].

Table 2 Effect of organic and inorganic nutrition on available status of Fe, Mo, Zn and OC of soil at harvest of the crop

Treatments	Available content			
	Fe (mg kg^{-1})	Mo (mg kg^{-1})	Zn mg kg^{-1})	OC (%)
Organic				
C_0(control)	5.99	0.121	0.495	0.241
F_{10}(FYM 10 t ha^{-1})	6.68	0.128	0.535	0.269
V_5(vermicompost 5 t ha^{-1})	7.28	0.138	0.570	0.277
P_5(poultry manure 5 t ha^{-1})	7.41	0.142	0.585	0.278
SEm±	0.20	0.003	0.011	0.004
CD (P=0.05)	0.58	0.008	0.032	0.011
Inorganic nutrients				
M_0(control)	5.35	0.120	0.458	0.211
M_1 (S)	6.21	0.127	0.498	0.225
M_2 (S +Mo)	7.02	0.142	0.547	0.240
M_3 (S+Mo+Fe)	7.76	0.144	0.600	0.256
M_4 (S+Mo+Fe+Zn)	7.85	0.148	0.669	0.273
SEm±	0.23	0.003	0.012	0.004
CD (P=0.05)	0.66	0.009	0.036	0.013

Effect of organic manure and mineral nutrients on organic carbon content of soil

The application of organic manures and mineral nutrients significantly increased the carbon content of the soil. The significantly maximum organic carbon was recorded in the levels of fields received FYM @ 10 t ha^{-1} and mineral nutrient level M_4.

The significant increase in organic carbon content in the manurial treatment could be attributed to direct incorporation of the organic matter in the soil (Table 2) [8].

The level of built up of microbial biomass depends on available organic carbon, nutrient and other soil characteristics. Supplementation of nutrients in a nutrient deficient soil like as that of present experimental soil is likely to respond to applied nutrients to have high biomass as well as biomass C,N,P and S i.e. higher available nutrients biomass C N P S and nutrient availability are positively correlated. Similar finding were also reported by [9] and [10].

Effect of organic manure on yield

The sole application of organic manures (FYM @ 10 t ha^{-1}, vermicompost @ 5 t ha^{-1}, poultry manure @ 5 t ha^{-1}) and of inorganic sources (S, Mo, Fe and Zn) significantly increased the green pod yield. The highest significantly green pod yield 190.09 and 195.85 q ha^{-1} were recorded under treatment P_5 (poultry manure @ 5 t ha^{-1}) and conjoint application of sulphur, molybdenum, iron and zinc (M_4). Treatment P_5 V_5 and M_4 M_3 were also recorded statistically at par.

The higher increase in the yield has been reported to be associated with the release of macro and micronutrients during the course of microbial decomposition [11]. The beneficial effects of FYM/ Vermicompost addition are also related to improvement in soil physical properties [12]. The beneficial response of vermicompost to yield of pods might also be attributed to the availability of sufficient amounts of readily usable form of plant nutrients throughout the growth period and specially at critical growth periods of crop resulting in better uptake, plant vigour and superior yield attributes [13] and [14]. These finding corroborates with the results of several other workers [15], [16], [17] and [18].

Effect of mineral nutrient on yield

The application of multinutrients combination significantly increased the yield of green pods of vegetable cowpea. The significant improvement in vegetable cowpea was noticed under the treatment level M_3 (S+Mo+Fe) and the

treatment level M_3 remained at par with the treatment M_4. The application of mineral fertilizers alone might supply one or two nutrients only but conjoint use of macro and micro nutrient fertilizers and organic manure would provide all the essential nutrients in proper ratio to plant and soil and also reduces the possibilities of multiple micronutrients deficiencies in particular. It is well established fact that pulse crops require 15-20 kg N, 40-60 kg P_2O_5 and 20 kg S ha^{-1} for successful production. The responses of some of the micronutrients *viz*, Mo, Fe and Zn have also been found promising in increasing the productivity of the soils [19]. Significant response of pulses to mineral nutrients has also been reported by several workers [20] and [21].

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