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EFFECT OF ORGANIC MANURES AND PHOSPHORUS LEVELS ON GROWTH, YIELD AND ECONOMICS OF VEGETABLE COWPEA

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ABSTRACT

Field experiment was conducted during *kharif* 2017 and 2018 at Tirupati, Andhra Pradesh to evaluate the effect of organic manures and phosphorus levels on growth, yield and economics of vegetable cowpea. Three levels of organic manures (no organic manure, FYM @ 5 tonnes ha^{-1} and poultry manure @2 tonnes ha^{-1}) and 3 phosphorus levels (0, 40 and 60 kg P_2O_5 ha^{-1}) applied to vegetable cowpea. Yield attributes and yield of cowpea varied with manures and phosphorus levels. Poultry manure application @ 2 tonnes ha^{-1} resulted in higher number of pods $plant^{-1}$ (7.28), seeds pod^{-1} (8.47), green pod yield (2796 kg ha^{-1}), haulm yield (12150 kg ha^{-1}) and net returns (51520 ₹ ha^{-1}) which was statistically on par with application of FYM @ 5 tonnes ha^{-1}. Among the phosphorus levels, application of 60 kg P_2O_5 ha^{-1} resulted in higher green pod yield (2720 kg ha^{-1}) and net returns (47892 ₹ ha^{-1}) which was on par with that of 40 kg P_2O_5 ha^{-1}.

KEY WORDS: Vegetable cowpea, FYM, poultry manure and phosphorus levels.

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp] is of immense importance, as it is a multipurpose grain legume extensively cultivated in arid and semiarid tropics. The cowpea is used as grain, green pods and fodder. Cowpea is grown as a catch crop, weed smothering crop, intercrop, mixed crop and green manure crop. It has ability to fix atmospheric nitrogen in soil at the rate of 56 kg per hectare in association with symbiotic bacteria under favorable conditions (Yadav, 1986).

India grows 252.7 lakh hectares of pulses with an annual production of 188.4 lakh tonnes with an average productivity of 745 kg ha^{-1}. In Andhra Pradesh, it is cultivated in 12.7 lakh hectares with a production of 10.6 lakh tonnes at a productivity of 835 kg ha^{-1} (Annual Report, 2017-18). In Chittoor District of Andhra Pradesh, cowpea is cultivated in an area of 1,848 hectares with a production of 1752 tonnes with productivity of 948 kg ha^{-1} (CPO, 2018).

Organic manures although, not useful as sole sources of nutrients, are however, good complementary sources with inorganic fertilizers (Chaudhary *et al*., 2004). Organic manures play a vital role in maintenance of physical, chemical and biological environment of soil and supply macro and micronutrients to crops, besides maintaining humic substances in soil (Sharma, 1992). The judicious combination of organic manures and fertilizers should be used for improving crop productivity and maintaining soil fertility.

Phosphorus is the second most critical plant nutrient over all, but for pulses it assumes primary importance owing to its important role in root proliferation and there by atmospheric nitrogen fixation. Phosphorus (P) is one of the most needed elements for pulse production. Phosphorus, although not required in large quantities, is critical to cowpea yield because of its multiple effects on nutrition. All growing plants require P for growth and development in significantly large quantity. Role of phosphorus is well documented that it increases root formation, number of nodules and in turn yield. The present study was taken up to study the influence of organic manures and phosphorus at different levels on yield and economics of vegetable cowpea in Southern Zone of Andhra Pradesh.

MATERIAL AND METHODS

The field experiment was conducted during *kharif* 2017 and 2018 at S.V. Agricultural college farm, Tirupati of Andhra Pradesh. Geographically, the experimental field is located at longitude 79.5° East and latitude 13.5° North at an altitude of 182.9 m above the mean sea level. Soil

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Table 1. Growth parameter of vegetable cowpea at harvest as influenced by organic manures and phosphorus levels

Treatments	Plant height (cm)		Leaf area plant^{-1} (cm^2)		Dry matter production (kg ha^{-1})	
	kharif, 2017	*kharif,* 2018	*kharif,* 2017	*kharif,* 2018	*kharif,* 2017	*kharif,* 2018
Organic manures						
M_1 : Control (No manures)	56.9	48.3	1171	1065	2417	2468
M_2 : FYM @ 5 t ha^{-1}	57.9	51.6	1231	1214	3193	3147
M_3 : Poultry manure @ 2 t ha^{-1}	58.7	52.4	1280	1256	3242	3196
SEm ±	0.80	0.57	21.8	25.9	31.5	33.3
CD (P=0.05)	NS	2.3	NS	104	127	134
Phosphorus levels						
P_1 : Control (No phosphorus)	56.0	48.7	1086	986	2405	2368
P_2 : 40 kg P_2O_5 ha^{-1}	58.4	51.4	1282	1253	3166	3178
P_3 : 60 kg P_2O_5 ha^{-1}	59.1	52.1	1314	1296	3280	3265
SEm ±	0.70	0.48	20.9	28.6	38.4	36.9
CD (P=0.05)	2.2	1.4	65	89	119	114
Interaction						
P at M						
SEm ±	1.36	0.99	37.8	11.9	54.6	57.7
CD (P=0.05)	NS	NS	NS	NS	NS	NS
M at P						
SEm ±	1.28	0.88	36.8	48.0	62.9	61.9
CD (P=0.05)	NS	NS	NS	NS	NS	NS

of the experimental site was sandy loam in texture with neutral in reaction (6.94), low organic carbon (0.39%) and available N (168.5 kg ha^{-1}) medium in P_2O_5 (18.8 kg ha^{-1}) and available K_2O (161.3 kg ha^{-1}). The experiment was laid out in split plot design with three replications. The treatments consisted of three organic manures, *viz.*, control, (M_1) FYM @ 5 t ha^{-1} (M_2) and poultry manure @ 2 t ha^{-1} (M_3) as main plot treatments and three phosphorus levels, *viz.*, 0 (P_1), 40 kg P_2O_5 ha^{-1} (P_2) and 60 kg P_2O_5 ha^{-1} as sub- plot treatments. As per treatments, FYM and poultry manure were incorporated 15 days before sowing and phosphorus was applied at basal to cowpea during both the years. The test crop was cowpea (TPTC-29) apart using a seed rate of 20 kg ha^{-1}. Recommended dose of phosphorus fertilizer was applied as per as the treatments. Single super phosphate was used as a source of phosphorus. Other normal operations or management practices were done as per the general recommendations for the crop. Observations on growth parameters, *viz.*, plant height, dry matter and yield parameters and yields, were recorded at physiological maturity. The data recorded for different parameters were analyzed using analysis of variance (ANOVA) technique for a split plot design and results are presented at 5% level of significance (P = 0.05).

RESULTS AND DISCUSSION

Effect of organic manures

Significantly taller plant height (52.4 cm), higher leaf area (1256 cm^2) and dry matter (3219 kg ha^{-1}) at harvest was obtained with the incorporation of poultry manure @ 2 t ha^{-1} (M_3), however, it was on par with application of FYM @ 5 t ha^{-1} (M_2) and both were superior to no manure application (M_1) (Table 1). Dry matter production is the prerequisite for higher yields, which is an indication of the biosynthetic processes associated with the crop growth and development. This could be mainly due to increased plant height and higher leaf area maintained throughout the crop period resulting in enhanced carbohydrate synthesis, which ultimately led to higher dry matter production. These findings were in agreement with Rao *et al.* (2013) and Singh *et al.* (2015). Organic matter addition through organic manures might had prominent beneficial effect on soil properties that promoted crop growth. Similar results were perceived by Dosani *et al.* (1999). Number of pods $plant^{-1}$ (7.28), seeds pod^{-1} (8.47), green pod yield (2796 kg ha^{-1}), haulm yield (12150 kg ha^{-1}) and net returns (51520 ₹ ha^{-1}) of cowpea (Table 2) was higher with incorporation of poultry manure @ 2 t ha^{-1}, however, it was on par with those resulted due to FYM (5 t ha^{-1}) incorporation and both were significantly superior to no manure application during both the years of study. This might be due to the fact that organic manures supplied balanced nutrition to the crop, improved soil condition and there by resulting in better growth and development leading to higher yield attributes and yield. The same was obvious through the findings of Yadav *et al.* (2007), Rao *et al.* (2013) and Singh *et al.* (2015). Numerically higher values of gross (69898 ₹ ha^{-1}) and net returns (51520 ₹ ha^{-1}) was recorded with application of poultry manure @ 2 t ha^{-1} (M_3) followed by application of farm yard manure @ 5 t ha^{-1} (M_2).

Effect of phosphorus levels

Among phosphorus levels, during both the years of study, application of 60 kg P_2O_5 ha^{-1} (P_3) resulted in taller plant height (55.6 cm), higher leaf area (1305 cm^2) and significantly higher dry matter (3272 kg ha^{-1}) which was comparable with 40 kg P_2O_5 ha^{-1} (P_2) and both were significantly superior to no phosphorus (P_1) (Table 1). The higher dry matter production with higher doses of Phosphorus might be attributed to enhanced carbohydrate metabolism, enzymatic activity and an essential constituent of majority of enzymes which have great importance in the transformation of energy required in cell division, ATP activation of amino acids for synthesis of protein and in carbohydrate metabolism might have to lead to more dry matter production. These results are in conformity with the results of Pal and Jana (1991) and Kumar and Singh (2011). Number of pods $plant^{-1}$ and seeds per pod^{-1} showed increased trend with application of increased P levels. Similarly, successive increase in P levels had positive effect on pod as well as haulm yield over their preceding level. Application of 60 kg P_2O_5 ha^{-1} recorded significantly higher green pod yield and haulm yield as compared to control, but which was comparable with that of 40 kg P_2O_5 ha^{-1} (Table 2). Application of phosphorus might have resulted in increased energy transfer as phosphorus is constituent of many enzymes and their remobilization to reproductive parts of the plants. This might have resulted in increased flowering, fruiting and seed formation and ultimately higher pod yield. These results are in conformity with the findings of Kumawat (2006). Among the phosphorus levels, application of 60 kg P_2O_5 ha^{-1} (P_3) registered with higher gross (68002 ₹ ha^{-1}) and net returns (47892 ₹ ha^{-1}) but in parity with 40 kg P_2O_5 ha^{-1}(P_2) (Table 3).

The interaction of organic manures and phosphorus levels could not exert any significantly effect on growth parameters, yield attributes, yield and economics of cowpea, during both the years of experimentation.

CONCLUSION

The experimental results concluded that, incorporation of poultry manure @ 2 t ha^{-1} along with 40 kg P_2O_5 ha^{-1} is recommendable for higher growth, yield and better monetary returns of vegetable cowpea.

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Table 2.Yield attributes and yield of vegetable cowpea as influenced by organic manures and phosphorus levels

Treatments	No. of pods plant^{-1}			No. of seeds pod^{-1}			Green pod yield (kg ha^{-1})			Haulm yield (kg ha^{-1})		
	***kharif*, 2017**	***kharif*, 2018**	**Pooled**	***kharif*, 2017**	***kharif*, 2018**	**Pooled**	***kharif*, 2017**	***kharif*, 2018**	**Pooled**	***kharif*, 2017**	***kharif*, 2018**	**Pooled**
Organic manures												
M_1 : Control (No manures)	5.01	4.98	5.00	6.16	7.03	6.60	1771	1916	1844	9600	8414	9007
M_2 : FYM @ 5 t ha^{-1}	6.79	6.81	6.80	7.89	8.86	8.37	2607	2754	2681	12703	10794	11749
M_3 : Poultry manure @ 2 t ha^{-1}	7.26	7.30	7.28	7.93	9.01	8.47	2719	2872	2796	13162	11137	12150
SEm ±	0.157	0.224	0.239	0.156	0.245	0.198	50.3	66.3	58.3	118.9	110.0	67.9
CD (P=0.05)	0.63	0.90	0.96	0.62	0.98	0.79	203	267	235	479	443	274
Phosphorus levels												
P_1 : Control (No phosphorus)	5.42	5.12	5.27	6.09	6.94	6.52	1964	2094	2029	10061	8053	9058
P_2 : 40 kg P_2O_5 ha^{-1}	6.56	6.72	6.64	7.77	8.73	8.25	2492	2650	2571	12571	10954	11762
P_3 : 60 kg P_2O_5 ha^{-1}	7.08	7.25	7.17	8.12	9.21	8.67	2641	2798	2720	12833	11339	12086
SEm ±	0.244	0.237	0.311	0.134	0.196	0.161	70.3	71.0	70.4	146.6	158.2	122
CD (P=0.05)	0.75	0.73	0.96	0.41	0.61	0.50	219	221	219	456	492	381
Interaction												
P at M												
SEm ±	0.272	0.388	0.414	0.270	0.425	0.34	87.2	114.8	101.0	205.9	190.5	117
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
M at P												
SEm ±	0.379	0.403	0.500	0.245	0.371	0.30	111.4	120.3	115.4	239.0	249.3	185
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Gross returns, net returns and returns per rupee invested of vegetable cowpea as influenced by organic manures and phosphorus levels

Treatments	Gross returns (₹ ha^{-1})		Net returns (₹ ha^{-1})		Returns per rupee invested	
	kharif, 2017	*kharif*, 2018	*kharif*, 2017	*kharif*, 2018	*kharif*, 2017	*kharif*, 2018
Organic manures						
M_1 : Control (No manures)	44286	47905	28308	31928	2.75	2.98
M_2 : FYM @ 5 t ha^{-1}	65183	68869	44206	47892	3.09	3.27
M_3 : Poultry manure @ 2 t ha^{-1}	67986	71811	49608	53433	3.69	3.89
SEm ±	1259	1657	1259	1657	0.087	0.112
CD (P=0.05)	5077	6682	5077	6682	0.35	0.45
Phosphorus levels						
P_1 : Control (No phosphorus)	49113	52355	32753	35994	2.98	3.18
P_2 : 40 kg P_2O_5 ha^{-1}	62300	66266	43439	47406	3.28	3.50
P_3 : 60 kg P_2O_5 ha^{-1}	66041	69963	45931	49853	3.27	3.47
SEm ±	1758	1775	1758	1775	0.122	0.124
CD (P=0.05)	5478	5531	5478	5531	NS	NS
Interaction						
P at M						
SEm ±	2181	2871	2181	2871	0.151	0.194
CD (P=0.05)	NS	NS	NS	NS	NS	NS
M at P						
SEm ±	2787	3008	2787	3008	0.193	0.208
CD (P=0.05)	NS	NS	NS	NS	NS	NS

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