Progressive Research 5 (Special) : 360-363 (Dec. 2010) *Society for Sci. Dev. in Agric. and Tech.*

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD AND QUALITY OF COWPEA (*Vigna unguiculata* L.)

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ABSTRACT

A field experiment was conducted at Shalimar Campus, SKUAST Kashmir during *Kharif,* 2007 to study the effect of organic and inorganic fertilizer levels on yield and quality of cowpea. The treatments consisted of five organic fertilizers and three inorganic fertilizer levels in a randomized block design replicated thrice. The green and dry fodder yields of cowpea was significantly higher with organic fertilizer combination of FYM and poultry manure (O_3) compared to FYM + biofertilizer (O_5) application. It was also found that both 75 and 100 % RFD at par with one another, recorded significantly higher green and dry fodder yields of cowpea over 50% RFD. Regarding the quality parameters of cowpea it was found that O_3 (5 t FYM/ha + 1 t Poultry manure/ha) recorded significantly higher calcium content than O_5 (5 t FYM/ha + 0.5 kg Azospirillum /ha), whereas different organic fertilizer combinations did not influence the crude protein and ash content of cowpea. The fertility levels 75 and 100% RFD significantly increased calcium, crude protein and ash content of cowpea over 50% RFD.

Key words : *Azospirillum, biofertilizer, cowpea, dry yield, FYM, manure, sheep, vermicompost.*

Cowpea is one of the most important leguminous crop and has unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrient and bringing qualitative changes in soil. Cowpea (*Vigna unguiculata* L.), belongs to the family leguminoceae, chromosome number 2n=22 and originated from Central Africa. Cowpea either utilized for green pods as vegetable or green manuring forms an important component of farming systems from the arid to the humid tropics covering parts of Asia and Oceania, the Middle East, Southern Europe, Africa, Central and South America. It is an annual legume adapted to warm conditions and sensitive to chilling hence, it is cultivated widely in tropics and subtropics during the warm season. Pulses are important source of dietary protein and have unique ability of maintaining and restoring soil fertility through biological nitrogen fixation as well as addition of ample amount of residues to the soil. Pulse crops leave behind reasonable quantity of nitrogen in soil to the extent of 30 kg/ha. Green tender pods contain moisture (84.6%), protein (4.3%), carbohydrate (8.0%), fats (0.2%) and rich source of calcium, phosphorus, iron, etc (Aykroyd, 1963). Cowpea is highly responsive to fertilizer application. The dose of fertilizer depends on the initial soil fertility status and moisture conditions. Although cowpea being a legume is capable of fixing atmospheric nitrogen, it responds to small quantity of nitrogenous fertilizers applied as starter dose (Kimiti *et al.,* 2011). Application of 15-20 kg N/ha has been found optimum to get better response. Application of higher dose of nitrogen may reduce nodule number and growth and thus adversely affects the nitrogen fixation capacity (Singh and Nair, 1995). In terms of significance, phosphorus is most indispensable mineral nutrient for pulse crops as it helps in better root growth and development and thereby making them more efficient in biological nitrogen fixation (BNF). Use of biofertilizers can have a greater importance in increasing fertilizer use efficiency. Indian soils are characterized poor to medium status with respect to nitrogen and available phosphorus. Integrated efforts are required to boost up the yield of cowpea in order to supply a balanced diet to increasing population of our country.

MATERIALS AND METHODS

The experiment was carried out at Shalimar campus, SKUAST-Kashmir, India during the year of 2007-08 and 2008-09. The climate of Kashmir valley is temperate and characterized by Kharif and Rabi seasons. The soil of the experimental field was silty clay loam in texture. The nutrient status of soil at the start of experiment was low in available nitrogen (270.3 kg ha^{-1}), medium in available phosphorus (14.3 kg ha^{-1}) and available potassium (160 kg ha^{-1}) with the pH of 6.6. The organic carbon were analysed and depicts low

Table-1 : Green fodder yield of cowpea as affected by different levels of organic and inorganic fertilizers.

Treatment	Cowpea (q/ha)	
	2007-08	2008-09
O1 (10 t FYM/ha)	38.01	36.48
O2 (5 t FYM/ha + 1 t Vermicompost/ha)	38.41	37.35
O3 (5 t FYM/ha + 1 t Poultry manure/ha)	39.48	39.24
O4 (5 t FYM/ha + 2.5 t Sheep manure/ha)	37.11	36.15
O5 (5 t FYM/ha + 0.5 kg Azospirillum/ha)	36.33	34.51
SE m±	0.96	0.99
CD (p = 0.05)	2.74	2.85
F1 (50% RFD)	33.51	32.10
F2 (75% RFD)	38.88	38.40
F3 (100% RFD)	40.86	39.27
SE m±	0.74	0.77
CD (p = 0.05)	2.12	2.21

* RFD = 90, 45 and 20 kg N, P_2O_5 and K_2O/ha, respectively.

Table-2 : Dry fodder yield of cowpea as affected by different levels of organic and inorganic fertilizers.

Treatment	Cowpea (q/ha)	
	2007-08	2008-09
O1 (10 t FYM/ha)	12.67	12.16
O2 (5 t FYM/ha + 1 t Vermicompost/ha)	12.97	12.45
O3 (5 t FYM/ha + 1 t Poultry manure/ha)	13.34	13.08
O4 (5 t FYM/ha + 2.5 t Sheep manure/ha)	12.37	12.05
O5 (5 t FYM/ha + 0.5 kg Azospirillum/ha)	12.11	11.51
SE m±	0.38	0.44
CD (p = 0.05)	1.08	1.25
F1 (50% RFD)	11.17	10.70
F2 (75% RFD)	13.06	12.80
F3 (100% RFD)	13.72	13.09
SE m±	0.29	0.34
CD (p = 0.05)	0.83	0.97

* RFD = 90, 45 and 20 kg N, P_2O_5 and K_2O/ha, respectively.

rating (0.37 %). The field experiments were laid out in randomized block design with two factors (organic and inorganic fertilizers) and three replications. The first factor comprised of five organic treatments in cowpea viz. FYM @ 10 t/ha (O_1);FYM @ 5 t/ha + Vermicompost @ 1 t/ha (O_2); FYM @ 5 t/ha + Poultry manure @ 1 t/ha (O_3); FYM @ 5 t/ha + Sheep manure @ 2.5 t/ha (O_4); FYM @ 5 t/ha + Azospirillum @ 0.5 kg/ha (O_5) and the second factor comprised of three fertilizer levels in cowpea viz. 50% Recommended dose of NPK (F_1); 75% Recommended dose of NPK (F_2); 100% Recommended dose of NPK (F_3). The recommended dose of fertilizer (RDF) adopted for cowpea was 90:45:20 kg N, P_2O_5 and K_2O ha^{-1}. Seeds of cowpea, var. Bundel, were sown on 6th June 2007 and 7th June 2008 on flat bed measuring 3.2 m x 4.2 m at the spacing of 60 × 10 cm^2 and irrigated timely according to the need of crop. To keep the crop free from weeds,Atrazine @ 3.5 g/liter of water was drenched in the soil of each of each plot. Observations on yield parameters were recorded at the time of harvesting. Quality parameters viz Calcium content, Protein content and Ash content were determined by Dry Ashing Method, Modified Kjeldahl's Method" (Jackson, 1967) and AOAC (1975) respectively. The analysis of variance was carried out using the randomized complete block design (Gomez and Gomaz, 1984).

RESULTS AND DISCUSSION

Fresh fodder yield of cowpea : The fresh fodder yield of cowpea as influenced by different treatments is presented in Table 1.During the years of 2007-08 and

Table-3 : Calcium, crude protein and ash content of cowpea as affected by different levels of organic and inorganic fertilizer.

Treatment	Calcium (%)		Crude protein (%)		Ash (%)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Organic fertilizer level (t/ha)						
O_1 (10 t FYM/ha)	0.90	0.90	17.5	17.3	4.54	4.53
O_2 (5 t FYM/ha + 1 t Vermicompost/ha)	0.88	0.89	17.4	17.3	4.53	4.54
O_3 (5 t FYM/ha + 1 t Poultry manure/ha)	0.92	0.90	17.5	17.4	4.54	4.54
O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha)	0.88	0.87	17.4	17.2	4.52	4.53
O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha)	0.72	0.70	17.3	17.2	4.51	4.50
SE m±	0.06	0.06	0.12	0.11	0.04	0.04
CD (p = 0.05)	0.18	0.16	NS	NS	NS	NS
Inorganic fertilizer level (kg/ha)						
F_1 (50% RFD)	0.76	0.75	16.8	16.6	4.47	4.46
F_2 (75% RFD)	0.90	0.88	17.6	17.4	4.55	4.56
F_3 (100% RFD)	0.94	0.93	17.9	17.8	4.56	4.57
SE m±	0.05	0.04	0.13	0.09	0.03	0.03
CD (p = 0.05)	0.14	0.12	0.27	0.24	0.08	0.08

* RFD = 90, 45 and 20 kg N, P_2O_5 and K_2O/ha, respectively.

2008-09, O_3 (5 t FYM + 1 t poultry manure/ha) recorded significantly higher fresh fodder yield of cowpea over rest of the treatments with a yield superiority of 8.67 and13.71 per cent, respectively. The results revealed that green fodder yield of cowpea recorded with O_2 (5 t FYM/ha + 1 t Vermicompost/ha), O_1 (10 t FYM/ha), O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha) and O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha) was statistically similar during both years of experimentation. Amongst inorganic fertilizer levels, both F_3 (100% RFD) and F_2 (75% RFD) statistically similar with one another produced significantly more fresh yield of cowpea than F_1 (50% RFD) with a superiority of 21.93 and 16.02 per cent, respectively during 2007-08 and 22.33 and 19.62 per cent, respectively during 2008-09. Similar findings have also been made by Bali *et al.* (2003). Sujata *et al.* (2008) and Sawargaonkar *et al.* (2008) also reported significant increase in the fodder yield with 100% RFD compared to 75% RFD.

Dry fodder yield of cowpea : The data on dry fodder yield of cowpea are presented in Table 2. It was observed from the results that O_3 (5 t FYM + 1 t poultry manure/ha) produced significantly more dry fodder than O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha) and other treatments, thereby registering yield superiority of 12.34 and 8.55 per cent over O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha) during 2007-08 and 2008-09, respectively. The data also revealed that the inorganic fertilizer levels F_3 (100% RFD) and F_2 (75 % RFD), at par with one another, recorded significantly higher fodder yield of cowpea than F_1 (50 % RFD) by registering yield superiority of 22.82 and 16.12 per cent and 22.33 and 19.62 per cent during 2007-08 and 2008-09, respectively. Iqbal *et al.* (2006) also reported that cowpea produced significantly highest mixed forage yield when fertilized with 150, 100 and 100kg N, P and K/ha, respectively compared to 150 kg N and 100 kg P/ha or 150 kg N/ha alone.

Quality parameters : The study revealed that the calcium content of cowpea remained highest with O_3 (5 t FYM/ha + 1 t Poultry manure/ha) though this treatment was statistically similar with O_1 (10 t FYM/ha), O_2 (5 t FYM/ha + 1 t Vermicompost/ha) and O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha) but significantly superior to O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha) (Table 3). It was also found that crude protein content and ash per cent of cowpea remained unaffected by different organic fertilizer combinations. As regards the effect of fertility levels the study revealed a significant increase in the calcium content of fodder cowpea with increase in the levels of fertility up to 75% RFD (Table 3), whereas the crude protein content of cowpea showed significant improvement with increase in the fertility level up to F_2 (75 % RFD). Increase in the crude protein content of cowpea can be attributed to the higher nitrogen content in the legume. Earlier Krishna *et al.* (1998) have also reported significant increase in the crude protein content of cowpea with increasing rates of fertility. The study further revealed that the ash content of cowpea recorded with F_3 (100 % RFD) and F_2 (75 % RFD) was

significantly higher than F_1 (50% RFD). The increase in the ash content of fodder with increasing levels of fertility could be attributed to the fact that ash content is positively correlated with crude protein content (Ajeigbe *et al.,* 2008). The lower values of ash content of cowpea is because cowpea being highly succulent contains higher moisture content.

CONCLUSION

Both fresh and dry fodder yield of cowpea was significantly higher with application of 5t FYM + 1t poultry manure/ha (O_3) compared to organic fertilizer combination of FYM and biofertilizer (O_5). Calcium content in cowpea was significantly higher in FYM + poultry manure combination (O_3) but crude protein content and ash content did not show any significant variation amongst the treatments. The fresh and dry fodder yields of cowpea recorded with F_3 (100% RFD) and F_2 (75% RFD) were significantly higher than F_1 (50% RFD) during both years of investigation. It was also found that calcium content in cowpea increases significantly with increase in the level of fertility from 50 % RFD (F_1) to 75 % RFD (F_2). Both crude protein and ash content also followed similar trend as that of calcium content.

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