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Quality and economics of cowpea [*Vigna unguiculata* (L.) Walp] as influenced under integrated nutrient management

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Abstract
A field trial was conducted at agronomy farm, S.K.N. Agriculture University, Jobner during *kharif* season of 2019 to study the response of cowpea [*Vigna unguiculata* (L.) Walp] to integrated nutrient management. The experiment comprised of 12 treatments involving control, RDF (20:40), FYM, Poultry Manure and their respective combinations including biofertilizers which was laid out in randomized block design with four replications. Results revealed that the magnitude of protein content was recorded higher under combined application of 50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB (T_{12}) and remained at par on treatment T_{11}, T_{10} and T_9. The application of T_{12} (50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB) gave significantly higher net returns over T_1 to T_4 treatments. However, it remained at par with T_{11}, T_{10}, T_9, T_8, T_7, T_6 and T_5 treatments.

Keywords: Protein content, RDF, FYM, PM, Cowpea

Introduction
Pulses being the important source of dietary protein have unique ability of maintaining and restoring soil fertility through biological nitrogen fixation along with addition of ample amount of plant residues to the soil. In India, the pulses occupy nearly 29.46 million hectare area with a production of 22.95 million tones and productivity of 779 kg/ha (Anonymous, 2019) [1, 2]. In Rajasthan, the overall pulses were cultivated over an area of 3.84 m ha with an year round production of 1.78 mt and an productivity of 463 kg/ha (Anonymous, 2019) [1, 2]. Among all the different pulses, cowpea [*Vigna unguiculata* (L.) Walp] is one of the important crop grown in arid and semi-arid regions of the state. Cowpea belo ngs to the family *Papilionoideae* and commonly referred to as lobia. Cowpea is *kharif* pulse crop grown for vegetable, grain, forage and green manuring. It has good promise as an alternative pulse crop in dry land farming. It also works as smother crop keeping weed infestation low. Being rich in protein and containing many other nutrients, it is also known as vegetable meat. It has long, green or purplish pods to be cooked as vegetable or for dry seeds used as pulse. Its foliage is also used as fodder or green manure.

The nutrient management assumes importance to sustain productivity. Cowpea is highly responsive to fertilizer and manures. The adequate application of fertilizers has played a significant role in providing nutrients for growth and development of cowpea. Regular and judicious use of NPK fertilizers not only help in raising good crop yield on a sustainable basis but can help farmers to gain consistently higher profit. Balanced nutrition is essential for the proper growth and productivity of crops. Application of 20 kg Nitrogen/ha has been found ideal to get better response from the pulses. Application of higher dosage of nitrogen may reduce growth and number of nodules and thus badly affect the nitrogen fixation capacity (Singh and Nair, 1995) [13]. Phosphorus is most important mineral nutrient for pulses as it aids in proper root growth and development and hence, making them more effective in biological nitrogen fixation (BNF). It is an essential constituent of nucleic acid such as ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), adenosine diphosphate (ADP) and adenosine triphosphate (ATP), nucleoprotein, amino acids, proteins, phosphotides, phytin, several coenzymes *viz*. thiamine, pyrophosphate and phyrodoxy phosphite. Application of balanced fertilizers up to 25 kg N and 50 kg P_2O_5 kg/ha recorded higher seed and straw yield of cowpea over no fertilizer (Patel *et al*. 2003) [10].

FYM is rich in plant nutrients and helps to buffer soils against rapid chemical changes. FYM also acts as a source of energy for the growth of soil microbes and improvement in organic carbon, available nitrogen, phosphorus, potassium etc. Poultry manure is a by-product of poultry and is rich in nutrients, which can provide a major source of nitrogen, phosphorus and trace elements for crop production. Poultry manure can also improve physical and biological fertility of soil, making it ideal for land application as a fertilizer. Biofertilizers help in increasing the soil fertility naturally and has no harmful effect on soil like chemical fertilizers. Hence, to increase the productivity of the soil, the use of biofertilizer is must (Schutz *et al.*, 2018) [12]. Biofertilizer also increases fertilizer use efficiency in crops. The seeds inoculated with *Rhizobium* increase the rhizosphere and enhance microbiological activities. They can play a significant role in fixing atmospheric nitrogen and enrich soil fertility. Among these biofertilizers, *Rhizobium* inoculants are specific for different leguminous crops.

Materials and Methods

An attempt was made to study response of cowpea [*Vigna unguiculata* (L.) Walp] to integrated nutrient management. Field experiment was conducted during *kharif* season of 2019 at agronomy Farm, SKN Agriculture University, Jobner (Rajasthan). The soil was loamy sand with pH 8.2, available N 121.7 kg/ha (Subbiah and Asija, 1956) [14], P 16.12 kg/ha (Olsen *et al*., 1954) [9], K 153.24 kg/ha (Jackson, 1967) [5] and 0.21% organic carbon (Jackson, 1973) [6]. The twelve treatments comprised of control, RDF (20:40), FYM, Poultry Manure and their respective combinations including biofertilizers were laid out in Randomized Block Design with four replications. The treatments were derived on keeping the base of nitrogen in FYM and poultry manure. Recommended dose of fertilizer was applied @ 20 and 40 kg N and P_2O_5 /ha, respectively, as per treatment through DAP. *Rhizobium* and PSB inoculation was done with 30 g of jaggery was boiled in one half litre water and then cooled, 50 g of culture was mixed in jaggery solution. The required quantity of seed was thoroughly mixed with the paste of culture to inoculate them with *Rhizobium*/ PSB and then the seeds were allowed to dry in shade. The treated seeds were sown as per treatments. Well decomposed farm yard manure and poultry manure were applied as per treatment at the time of sowing and thoroughly incorporated in soil with the help of spade. Seeds were inoculated with *Rhizobium* and PSB culture as per treatments. The seeds were sown by 'kera' method with row spacing of 30 cm by hand plough at a depth of 5 cm using a seed rate of 20 kg/ha. The variety RC-19 of cowpea was used as the test crop and the sowing was done on 20 July 2019. The experimental data recorded for quality and economics were subjected to statistical analysis in accordance with the "Analysis of Variance" technique suggested by (Fisher, 1950). Appropriate standard error for each of the factor was worked out. Significance of differences among treatment effects was tested by "F" test. Critical difference (CD) was worked out, wherever the difference was found significant at 5.0 or 1.0 per cent level of significance.

Results and Discussion

Protein content

Results (Table 1) indicated that all the treatments of integrated nutrient management (T_7, T_8, T_9, T_{10}, T_{11} and T_{12}) gave significantly higher protein content in seed of cowpea as compared to control. The treatment T_{12}, (50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB) resulted in maximum protein content in seed. However, this treatment remained at par with T_{11}, T_{10} and T_9 treatments and registered an increase of 31.3, 25.6, 24.1, 22.3, 20.1 and 18.7 per cent, respectively, over T_1, T_2, T_3, T_4, T_5 and T_6 and treatments. It may be due to increased total uptake of nitrogen, potassium and phosphorus by plants. Nitrogen is an integral part of protein and phosphorus is structural element of many co-enzymes which is involved in protein synthesis. The primary component of amino acids which constitute the basis of protein is N and consequently higher N content in grain is directly responsible for higher protein. These outcomes are in close conformity with the conclusion of Vikram and Hamzehzarghani (2008) [15] and Yadav *et al.* (2009) [16] in cowpea.

Table 1: Effect of integrated nutrient management on protein content in cowpea

Treatments	Protein content (%)
T_1 -Control	16.29
T_2 -100% RDF (20:40)	17.03
T_3 -FYM @ 8 t/ha	17.24
T_4 -PM @ 4 t/ha	17.49
T_5 -50% RDF + FYM @ 4 t/ha	17.81
T_6 -50% RDF + PM @ 2 t/ha	18.02
T_7 -50% RDF + FYM @ 4 t/ha + *Rhizobium*	18.41
T_8 -50% RDF + PM @ 2 t/ha + *Rhizobium*	18.69
T_9 -50% RDF + FYM @ 4 t/ha + PSB	20.08
T_{10} -50% RDF + PM @ 2 t/ha + PSB	20.58
T_{11} -50% RDF + FYM @ 4 t/ha + *Rhizobium* + PSB	21.07
T_{12} -50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB	21.39
S.Em+	0.63
CD (P=0.05)	1.88
CV (%)	6.74

Table 2: Effect of integrated nutrient management on net returns and B:C ratio in cowpea

Treatments	Net returns (Rs/ha)	B:C Ratio
T_1 -Control	27850	2.69
T_2 -100% RDF (20:40)	50520	3.89
T_3 -FYM @ 8 t/ha	54225	4.00
T_4 -PM @ 4 t/ha	54825	3.84
T_5 -50% RDF + FYM @ 4 t/ha	55700	4.13
T_6 -50% RDF + PM @ 2 t/ha	58220	4.17
T_7 -50% RDF + FYM @ 4 t/ha + *Rhizobium*	57995	4.26
T_8 -50% RDF + PM @ 2 t/ha + *Rhizobium*	58405	4.17
T_9 -50% RDF + FYM @ 4 t/ha + PSB	57895	4.25
T_{10} -50% RDF + PM @ 2 t/ha + PSB	58960	4.20
T_{11} -50% RDF + FYM @ 4 t/ha + *Rhizobium* + PSB	59775	4.35
T_{12} -50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB	61220	4.36
S.Em+	1868	0.14
CD (P=0.05)	5597	0.41
CV (%)	7	6.80

Economics

Net returns

A perusal of data (Table 2 Fig. 1) revealed that application of different integrated nutrient management treatments significantly increased the net returns of cowpea over control. The highest net returns recorded under 50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB followed by T_{11}(50% RDF + FYM @

4 t/ha + *Rhizobium* + PSB), T_{10}(50% RDF + PM @ 2 t/ha + PSB), T_9(50% RDF + FYM @ 4 t/ha + PSB), T_8(50% RDF + PM @ 2 t/ha + *Rhizobium*) and T_7 (50% RDF + FYM @ 4 t/ha + *Rhizobium*) and were significantly higher as compared to rest of the treatments. The income accrued under these treatments was higher than the additional costs which led to more returns under these treatments. These results are in close vicinity with findings of Kumawat *et al.* (2010) [7], Gupta and Ganagwar (2012) [4], Meena and Chand (2014) [8] and Rajkhowa *et al.* (2000) [11] in cowpea.

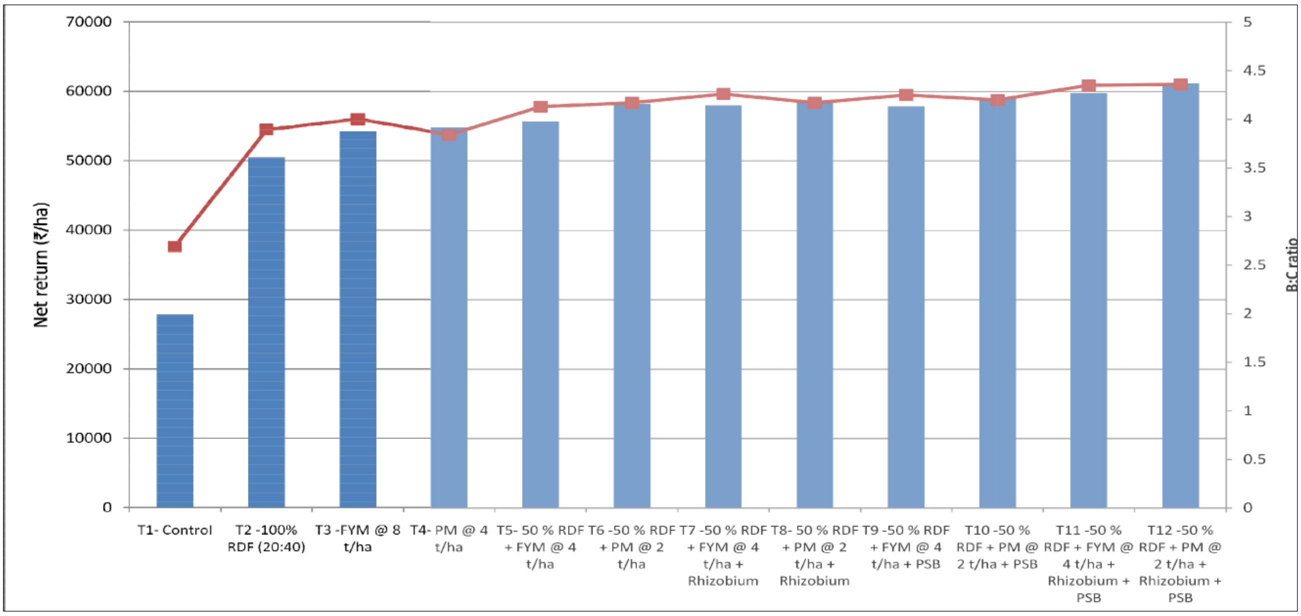

Fig 1: Effect of integrated nutrient management on net return and B:C ratio

Benefit: Cost ratio

The data presented in table 2 and fig. 1 showed that B:C ratio was significantly increased due to integrated nutrient management over control. The treatment, T_{12} (50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB) registered higher B:C ratio of 4.36 which was significantly higher to control (2.69) and T_2 (3.89). However, it was at par with T_{12}, T_{10}, T_9, T_8, T_7, T_6, T_5, T_4 and T_3 registering an increase of 62.08 and 12.08 per cent, respectively, over control and T_2 treatment (100% RDF).

Conclusion

On the basis of one year experimentation, it may be concluded that application of 50% RDF + PM @ 2 t/ha + *Rhizobium* + PSB was found the most superior treatment combination for obtaining higher quality and profitability in cowpea.

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