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Evaluation of nutrient content and uptake of summer cowpea (*Vigna unguiculata* L.) in integrated nutrient management under South Gujarat condition

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Abstract
A field experiment entitled "Evaluation of Nutrient Content and Uptake of Summer Cowpea (Vigna unguiculata L.) in Integrated Nutrient Management under South Gujarat Condition" conducted during the summer season of 2016 with 8 treatment combinations replicated thrice in a factorial randomized block design (FRBD) at Navsari. Combinations of two levels of inorganic fertilizers were used as the treatment i.e. 50% RDF (F1) and 100% RDF (F2); two levels organic manures i.e. FYM @ 0 t /ha (O1) and FYM @ 2.5 t/ ha (O2) and two levels bio-fertilizers i.e. No inoculation (B1) and seed inoculation with Rhizobium and phosphate solubilizing bacteria (B2). An application of 100% RDF (F2) showed appreciably higher nitrogen, phosphorus and potassium content and uptake by seed and haulm respectively as compared to F1(50% RDF). An application of FYM @ 2.5 t /ha (O 2) showed appreciably higher nitrogen, phosphorus and potassium content and uptake by seed and haulm respectively as compared with treatment O1 (FYM @ 0 t /ha). There was not significant of organic manures on nitrogen and phosphorus content by haulm.

Keywords: Cow pea, nutrient management, biofertilizers, rhizobium

Introduction
Due to their high protein content, pulses play a significant role in the diet of oriental cuisine. In a nation like India, where most of the population is vegetarian, the significance of pulses is significantly greater. Pulses make up 16–18% of the total protein in the typical Indian diet. With a total yield of 19.25 million tonnes and a productivity of 763 kg/ha, pulses are produced on an area of 25.21 million ha in India. It grew over 0.81 million ha in Gujarat, producing 0.73 million tonnes annually at a productivity of 901 kg/ha (Anonymous, 2014) [1]. The cowpea (*Vigna unguiculata* L.), a warm-season and multifunctional pulse crop, is widely grown throughout India. Other names for it include chowli, lobiya, southern pea, china pea, marble pea, and black eye bean. India and West Africa are the primary production regions for cowpeas. In many different agricultural systems throughout various nations in Africa, Latin America, South East Asia, and the southern United States, cowpea is grown as seed, a green vegetable, and fodder (Singh *et al*., 2012) [7]. Utilising chemical and organic fertilisers in an integrated or balanced manner boosts crop output while also enhancing soil health. The importance of these manures cannot be denied, but their usage is restricted by their scarcity and bulkiness. According to Gaur *et al*. (1990) [2], organic N is slowly mineralized, and the first crop is likely to access roughly 30% N, 70% P_2O_5, and 75% K_2O, whereas successive harvests are likely to access the remaining nutrients. Maintaining sustainable soil quality requires the prudent use of chemical fertiliser and organic manures in a ratio of 1:1 or 7:3 (Shankaram, 1996) [5].

Material and Methods
During the summer of 2016, the experiment was conducted on plot E-23 of the College Farm at the Navsari Agricultural University. The fertility of the test area was pretty homogeneous and level. By its origin, the soil commonly referred to as "Deep Black" soils was an old alluvium of basaltic debris. The experimental field's soil is categorised under the group Ustochrepts, subgroup of Vertic ustochrepts, suborder Orchrepts, and order Inceptisols with Jalalpur series, using the seventh approximation. The soils are deep, fairly drained, and have an excellent ability to retain water. The earth swells when it is moist and cracks severely when it is dry. Montmorillonite is the most dominant clay mineral.

The experiment, which included eight treatment combinations, was set up in a factorial randomised block design with tree replication and was conducted on soils with a pH of 7.8, a low organic carbon content (0.53%), medium availability of available N (197.26 kg/ha), P (30.93 kg/ha, and higher availability of available K (369.80 kg/ha). The experiment comprising eight treatment combinations were laid out in factorial randomized block design with tree replication. The treatment consisted combinations of two levels of inorganic fertilizers i.e. 50% RDF (F1) and 100% RDF (F2); two levels organic manures i.e. FYM @ 0 t /ha (O1) and FYM @ 2.5 t/ ha (O2) and two levels bio-fertilizers i.e. No inoculation (B1) and seed inoculation with Rhizobium and phosphate solubilizing bacteria (B2). A representative sample of the produce from each plot was taken in order to estimate the levels of nitrogen, phosphate, and potash in seeds and plants. The materials were mechanically ground and oven-dried at 65 °C for 24 hours before the nutrients were calculated.

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Nutrient	Method
Nitrogen	Modified Kjeldahl's method (Jackson,1974) [3]
Phosphorus	Wet digestion (Diacid) Vanadomolybdo phosphoric acid yellow colour method (Jackson,1974) [3]
Potash	Flame photometric method (Jackson, 1974) [3]

Nutrient uptake (kg/ha)

The uptake of nutrients by plant and seed was calculated by using the following formula:

$$\text{Nutrient uptake (\%)} = \frac{\text{Nutrient content (\%) X seed/haulm yield (kg/ha)}}{100}$$

Table 1: Effect of Integrated Nutrient Management on Nutrient Content of Cowpea

Treatments	Seed (%)			Haulm (%)		
	N	P	K	N	P	K
(A) Inorganic Fertilizer						
F_1 -50% RDF	3.10	1.69	1.24	0.61	0.21	0.80
F_2 - 100% RDF	3.22	1.71	1.26	0.62	0.22	0.83
S.Em. ±	0.02	0.01	0.01	0.00	0.00	0.01
C.D. at 5%	0.07	0.02	0.02	NS	0.01	0.03
(B) Organic manures						
O1 - 0 t ha-1	3.12	1.69	1.24	0.62	0.22	0.81
O2 - 2.5 t ha-1	3.21	1.72	1.27	0.62	0.23	0.84
S.Em. ±	0.02	0.01	0.01	0.00	0.00	0.01
C.D. at 5%	0.07	0.02	0.02	NS	NS	0.02
(C) Bio-fertilizers						
B_1	3.13	1.70	1.25	0.61	0.21	0.82
B_2	3.19	1.71	1.26	0.63	0.23	0.83
S.Em.±	0.02	0.01	0.01	0.00	0.00	0.01
C.D. at 5%	NS	NS	NS	0.011	0.012	NS

Table 2: Effect of Integrated Nutrient Management on Nutrient Uptake of Cow pea

Treatments	Uptake by seed (Kg/ha)			Uptake by haulm (Kg/ha)		
	N	P	K	N	P	K
(A) Inorganic Fertilizer						
F_1 -50% RDF	25.46	13.88	10.19	12.27	4.30	15.95
F_2 - 100% RDF	29.55	15.70	11.58	13.87	5.04	17.95
S.Em. ±	0.83	0.49	0.36	0.46	0.19	0.49
C.D. at 5%	2.52	1.51	1.11	1.40	0.60	1.50
(B) Organic manures						
O1 - 0 t ha-1	25.51	13.81	10.13	12.15	4.29	15.48
O2 - 2.5 t ha-1	29.51	15.78	11.64	14.00	5.06	18.42
S.Em. ±	0.83	0.49	0.36	0.46	0.19	0.49
C.D. at 5%	2.52	1.51	1.11	1.40	0.60	1.50
(C) Bio-fertilizers						
B_1	25.77	13.94	10.25	12.38	4.32	16.32
B_2	29.55	15.64	11.52	13.77	5.03	17.58
S.Em.±	0.83	0.49	0.36	0.46	0.19	0.49
C.D. at 5%	2.52	1.51	1.11	1.40	0.60	NS

Nutrient content

All nutrient management methods tend to greatly increase nitrogen (N), phosphorus (P), and potassium (K) by seed and haulm (Table 1).

Nutrient uptake

The highest nutrient uptake was observed among inorganic fertilizer F_2 - 100% and among organic manures O2 - 2.5 t /ha and among bio-fertilizers B_2 - Seed inoculation with *Rhizobium* and *Phosphate solubilizing bacteria* (Table 2).

Discussion

There is an increase of nutrients content (N, P and K%) and uptake by seed and haulm with organic manures up to 2.5 t /ha might be due to favorable effects of nutrient on growth parameters and yield attributes which ultimately resulted in highest seed and haulm yields and consequently more nutrient content and uptake by the crop. The findings are in accordance with those of Singh *et al.* (2005) [8], Subbarayappa *et al*. (2009) [9], and Shete *et al.* (2010) [6], Kumar *et al.* (2010) [4].

Conclusion

1. An application of 100% RDF (F_2) showed appreciably higher N, P and K content and uptake by seed and haulm respectively as compared to F_1 (50% RDF).
2. An application of FYM @ 2.5 t/ha (O_2) showed appreciably higher N, P and K content and uptake by seed and haulm respectively as compared with treatment O_1 (FYM @ 0 t/ha). There was not significant of organic manures on nitrogen and phosphorus content by haulm.
3. An application of Seed inoculation with *Rhizobium* and *phosphate solubilizing bacteria* (B_2) showed appreciably higher N, P and K content and uptake by seed and haulm respectively over the treatment B_1 (no inoculation). There was not significant of bio-fertilizers on N, P and K content by seed.

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