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Response of biofertilizer and fertility levels on growth and yield of summer cowpea [*Vigna unguiculata* (L.) Walp.] Under South Gujarat condition

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Abstract
A field experiment entitled "Response of biofertilizer and fertility levels on growth and yield of summer cowpea [*Vigna unguiculata* (L.) Walp.] Under South Gujarat condition" conducted at Navsari with eight treatment combinations replicated thrice in factorial randomized block design during the summer season of 2019. The treatment consisted combinations of two levels of biofertilizers (B_1: Control, B_2: Seed inoculation with *Rhizobium* and *phosphate solubilizing bacteria*) and four levels of inorganic fertilizers (F_0: Control, F_1: 50% RDF, F_2: 75% RDF and F_3: 100% RDF). As regards the growth parameters the higher plant height (cm), number of branches per plant, number of pods per plant, number of seeds per pod, test weight (g), length of pods (cm), seed yield (kg ha^{-1}), haulm yield (kg ha^{-1}) and harvest index (%) were significantly increased to a greater extent by the treatment seed inoculation with *Rhizobium* and *phosphate solubilizing bacteria* (B_2) and 100% RDF (F_3) which was found significantly differ from the others treatments.

Keywords: Cowpea, *Rhizobium*, *phosphate solubilizing bacteria* and RDF

Introduction
Cowpea [*Vigna unguiculata* (L.) Walp.] is a multipurpose *kharif* and warm season pulses crop, commonly cultivated all over India. It is also called as black eye pea, black eye bean, southern pea, china pea, marble pea, chowli and lobiya. West Africa and India are the centers' of diversified for cowpeas. In India, cowpea is cultivated mainly in Rajasthan, Maharashtra, Karnataka, Gujarat, Tamil Nadu, Andhra Pradesh and Madhya Pradesh. Biofertilizers are formulations of beneficial microorganisms, which upon application can increase the availability of nutrients by their biological activity and help to improve the soil health for increasing soil fertility. Among different biofertilizers *Rhizobium* inoculation can increase the grain yield of pulse crops to the tone of 10 to 15 per cent. *Phosphate solubilizing bacteria* (PSB) have the consistent capacity to increase the availability of phosphates to plants by mineralizing phosphorus compounds (Pargi *et al.*, 2018) [8]. The success of pulse production depends on Biological Nitrogen Fixation (BNF) attributes of *Rhizobium*, and efficient nitrogen fixation occurs with development of root efficient nitrogen fixation occurs with development of root nodules which are induced by bacterial symbiont with host plant in a specific manner. The effect of symbiotic performance depends on the host genotype and strain efficiency. The potential of legumes for improved and sustained soil fertility has been known for ages and mixed cropping as well as crop rotations of cereals with pulse crops were employed to capitalize on BNF. Non-legumes deplete the nitrogen content of soil, whereas leguminous crops can restore nitrogen, primarily in organic forms which are not readily leachable (Swarnalakshmi *et al.*, 2016) [9].

Materials and Methods
The experiment was taken up on plot E–17 of the College farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer season of 2019. The experimental field was fairly leveled and uniform in fertility. The soil popularly known as "Deep Black" soils was an old alluvium of basaltic material by its origin. According to the seventh approximation, the soil of the experimental field is classified under the group *Ustochrepts*, sub group of *Vertic ustochrepts*, sub order *orchrepts* and order *inceptisols* with Jalalpur series. Soils are deep, moderately drained having good water holding capacity. The soil crack heavily on drying and expands on wetting. The predominant clay mineral is montmorillonite.

The soil having a 7.96 pH, low in organic carbon content (0.46%), low in available N (198.82), medium in available P (28.05) and higher in available K (412.54). The data were analyzed statistically by adopting the standard procedures described by Panse and Sukhatme (1967) [7]. Observations on growth and yield attributing characters *viz*., plant height (cm), number of branches per plant, number of pods per plant, number of seeds per pod, test weight (g), length of pods (cm), seed yield (kg^{-1}), haulm yield (kg^{-1}) and harvest index (%) were recorded.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Effect of biofertilizer

Data presented in fig. 1&2 revealed that significantly the higher plant height at 60 DAS (45.06 cm) and at harvest (54.16 cm), number of branches per plant at 60 DAS (4.43) and at harvest (4.56), number of pods per plant (12.70), number of seeds per pod (9.65) with an application of seed inoculation with *Rhizobium* and Phosphate solubilizing bacteria (B_2). The test weight (11.69 g) and length of pods (9.49 cm) and harvest index (33.73%) are not affected with an application of seed inoculation with *Rhizobium* and Phosphate solubilizing bacteria (B_2). Significantly higher seed and stover yield of 995 and 1954, kg/ha respectively were also recorded by biofertilizers application of seed inoculation with *Rhizobium* and Phosphate solubilizing bacteria (B_2), which was found significantly differ from the B_1 (no inoculation) treatments which had the lowest seed and stover yield (885 & 1759 kg/ha respectively). These might be due to significant and progressive effect of dual inoculation of *Rhizobium* and Phosphate solubilizing bacteria on yield attributes resulted in higher seed & stover yield. These results are also in agreement with findings of Dekhane *et al.*, (2011) [3], Khan *et al.* (2017) [5], Pargi *et al.* (2018) [8] and Meena *et al.*, (2015) [6].

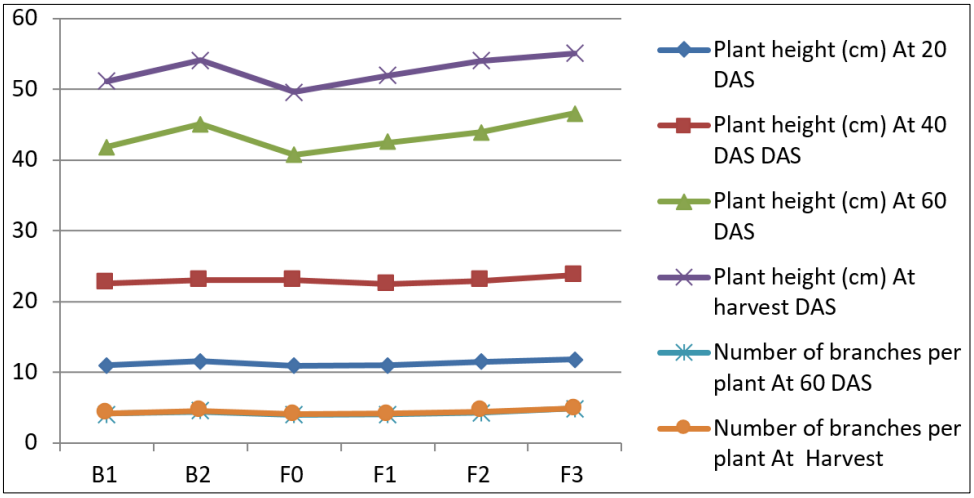

Fig 1: Plant height and number of branches of cowpea as influenced by effect of biofertilizers and fertility levels

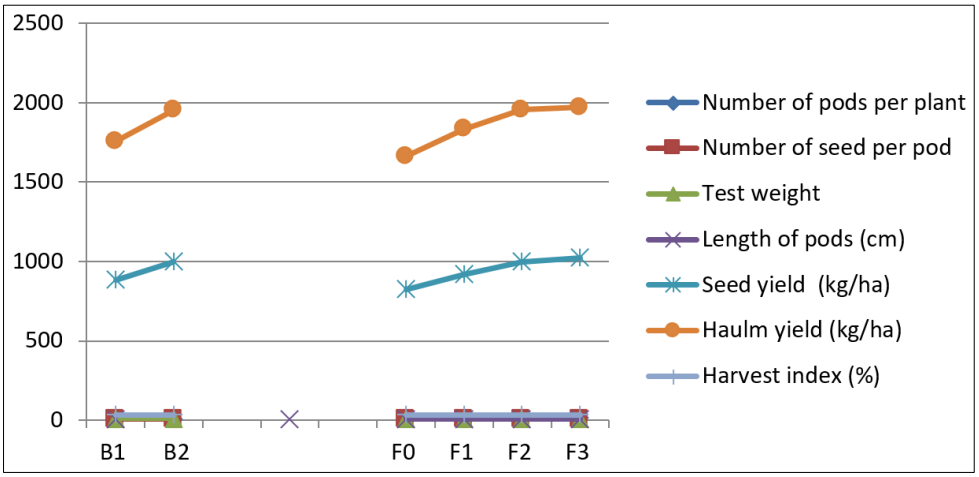

Fig 2: Yield parameters of cowpea as influenced by biofertilizers and fertility levels.

Effect of inorganic fertilizer

Data presented in fig.1&2 revealed that significantly the higher plant height recorded at 60 DAS (46.63 cm) which was at par with F_2 (75% RDF) and at harvest (55.10 cm), which was at par with F_2 (75% RDF) and F_1 (50% RDF), number of branches per plant at 60 DAS (4.84) and at harvest (4.87), number of pods per plant (13.11), which was at par with F_2 (75% RDF), number of seeds per pod (9.98) with an application of 100% RDF (F_3), which was at par with F_2 (75% RDF). The test weight (11.98 g) and length of pods (9.51 cm) and harvest index (34.07%) are not affected with an application of F_3 (100% RDF). Significantly higher grain and stover yield of 1023 and 1974 kg/ha respectively were recorded by application of F_3 (100% RDF), but which was at

par with F_2 (75% RDF) and F_1 (50% RDF). The improvement in seed yield, stover yield and harvest index were mainly on account on yield attributes of cowpea due to increasing in rate of inorganic fertilizer. These results are also in agreement with findings of Abayomi *et al*. (2008) [1], Ayyadurai *et al*. (2017) [2], Dekhane *et al*. (2011) [3], Khan *et al*. (2017) [5] and Pargi *et al*. [8].

Interaction effect

Interaction effect of biofertilizer and fertility levels was found non- significant for all the parameters obtained with the application of Seed inoculation with Rhizobium + phosphate solubilizing bacteria and 100% RDF. These results are also in agreement with findings of Gorade *et al*., (2014), Pargi *et al*. (2018) [8].

Conclusion

From the experimental results it is concluded that seed treatment of *Rhizobium* and *Phosphate solubilizing bacteria* biofertilizers (10 ml/kg each) and 100% RDF (20:40:00 NPK kg/ha) found better for getting higher yield & net return of cowpea (cv. GC-4) in South Gujarat heavy rainfall Agro-ecological situation III (AES-III).

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