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Effect of different sources of nutrient on growth, yield attributes and yield of clusterbean

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Abstract
A field experiment was carried out at the Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *kharif* 2019. The experiment consists of eight treatment combinations comprising of two nitrogen sources (urea and ammonium sulphate), two phosphorus sources (diammonium phosphate and single superphosphate) and two levels of biofertilizer (*Rhizobium* + PSB and no inoculation biofertilizer) were tried in randomized block design with factorial concepts with four replications. Application of nitrogen through ammonium sulphate recorded 6.47% and 7.07% higher seed and stover yield, respectively over urea. Between two phosphorus sources, single superphosphate produced 5.34% and 6.84% higher seed and stover yield, respectively over diammonium phosphate. Seed inoculation with biofertilizer (*Rhizobium* + PSB) gave 16.5% and 15.68% higher seed and stover yield, respectively as compared to no seed inoculation.

Keywords: Ammonium sulphate, urea, diammonium phosphate, single superphosphate, biofertilizer, clusterbean

Introduction
Clusterbean popularly known as guar belongs to the family Leguminosae and sub-family Papilionaceae. Botanically clusterbean is known as *Cyamopsis tetragonoloba* (L.) Taubert. Gillete (1958) [5] pointed out 'Tropical Africa' as its centre of origin. It is an important drought resistant leguminous crop suited to dry farming areas and cannot withstand under excessive moisture or waterlogging conditions. Clusterbean is cultivated in arid and semiarid areas. In India, it is cultivated in 20.1 lakh hectare with production and productivity of 13.3 lakh tonne and 644 kg ha^{-1}, respectively. India accounts for 80 per cent of the total *guar* produced in the world (Anonymous, 2017) [1]. Fertilizer is a kingpin to increase agricultural production. In India, ring past four to five decades, the use of fertilizers has been recognized as most effective input for higher crop production to varieties and irrigation. Optimum fertilizer application is one of the well-established techniques for increasing crop productivity. The nitrogen is a major plant nutrient and plays an important role in plant growth and development although major nitrogen requirement of legumes is met by biological nitrogen fixing *Rhizobium*. Therefore, nitrogen availability to the legumes can be increased either with manual inoculation or with application of commercial nitrogen fertilizer. Ammonium sulphate (N-24%) is an ammonium form of nitrogen; it will not bleed off into the environment. Moreover, ammonium sulphate contains 24% sulphur which is readily available to plant. Phosphorus is second important plant nutrient after nitrogen. Phosphorus is also involved in energy transformation in plants. Phosphorus is also essential for better root development, growth and yield of leguminous crop. Single superphosphate (16% P_2O_5) helps in improving root growth and development which most important for uptake of plant nutrients and water. For Leguminous crops like groundnut, use of SSP ensures a large number of nodules and the roots, which fix atmospheric nitrogen directly into the soil and also increase nitrogen uptake. Moreover, SSP contains 11% S and 21% Ca. *Rhizobium* is an established fact that *Rhizobium* species are important bacteria which are capable of fixing atmospheric nitrogen in association with leguminous crop. Phosphate Solubilizing Bacteria (PSB) plays an important role in the solubilization of soil P through the secretion of various organic acids (formic, acetic, butyric, propionic, citric, glucomic, succinic, oxalic, malic, maleic and lactic acids) and make it available to plant (Kalayu, 2019) [6]. Information are lacking on the effect of different nutrient sources on clusterbean production, the present study was planned to assess the effect of different nutrient sources on productivity of clusterbean.

Materials and Methods

A field experiment was conducted during *kharif* season of 2019 to find out the effect of different nitrogen sources, phosphorus sources and biofertilizer on growth, yield attributes and yield of clusterbean at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar.

Eight treatment combinations comprising of two level of nitrogen sources: nitrogen through urea and ammonium sulphate (AS), two level of phosphorus sources: phophorus through diammonium phosphate (DAP) and single super phosphate (SSP) and two level of biofertilizer; seed treatment with biofertilizer (*Rhizobium* + PSB) and without biofertilizer treatment were laid out under randomized block design (RBD) with factorial concept with four replications. The soil of experimental field was loamy sand in texture, slightly alkaline in reaction and soluble salt content under safe limit. It was low in available N, medium in available P_2O_5 and high in K_2O content. Clusterbean variety Gujarat Clusterbean 2 was used as a test crop. A uniform dose of N and P_2O_5 @ 20 kg/ha and 40 kg/ha were applied through different sources as per the treatments. The seed were treated with rhizobium and PSB culture @ 5 ml/kg seed each as per treatments. Clusterbean crop was sown in first week of July-2019 using the recommended seed rate (17.5 kg/ha) and keeping the 45 cm distance between two rows. Other agronomic management practices were followed as per the standard recommendations. Five random plants were selected from each plot excluding the border row for taking observation on growth and yield attributes. The seed and stover yield were recorded from the net plot. Data was statistically analyzed by the procedure suggested by Steel and Torrie (1980) [17].

Result and Discussion

Effect of different nitrogen sources

Different nitrogen sources did not produced significant effect on plant population at 30 DAS and at harvest, pod length and number of seed pod^{-1}(Table 1). Application of nitrogen through ammonium sulphate gave significantly highest plant height (98.03 cm), number of branches plant^{-1}(5.89) and number of pods plant^{-1} (30.04) over urea. This might be due to more NH_4 volatilization losses were occurred with urea and sulphur addition through ammonium sulphate helped in the better growth of plant. The above results are in accordance with those reported by Gendy *et al.* (2013) [4] in clusterbean, Marwa *et al.* (2018) [9], and Ramdevputra *et al.* (2010) [12] in cowpea. Application of nitrogen through ammonium sulphate significantly increased the 100 seed weight (2.85 g), seed (873 kg ha^{-1}) and stover yield (1424 kg ha^{-1}) over urea. Application of nitrogen through ASP recorded 6.47% and 7.07% higher seed and stover yield, respectively over urea. This might be due to more availability nitrogen with ammonium sulphate and sulphur played important role in energy transformation, activation of number of enzymes and also in carbohydrate metabolism. These finding in accordance with the finding of Marwa *et al.* (2018) [9] in cowpea and Gendy *et al.* (2013) [4] in clusterbean.

Table 1: Growth, yield attributes and yield of clusterbean as influenced by nutrient sources and biofertilizer

Treatments		Plant population per meter row length		Plant height (cm)	No. of branches plant^{-1}	Pod length (cm)	No. of pods plant^{-1}	Number of seeds pod^{-1}	100 seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
		30 DAS	At harvest								
Nitrogen sources (N)											
Urea		9.97	8.54	92.92	5.54	5.48	28.14	6.08	2.80	820	1330
Ammonium sulphate		10.13	8.85	98.03	5.89	5.57	30.04	6.20	2.85	873	1424
S.Em.±		0.17	0.15	1.65	0.10	0.1	0.54	0.10	0.01	14	31
CD (P = 0.05)		NS	NS	4.85	0.31	NS	1.60	NS	0.04	40	91
Phosphorus sources (P)											
Diammonium phosphate		10.01	8.56	93.14	5.56	5.45	28.20	6.10	2.80	824	1331
Single superphosphate		10.10	8.82	98.09	5.87	5.60	29.98	6.17	2.85	868	1422
S.Em.±		0.17	0.15	1.65	0.10	0.10	0.54	0.10	0.01	14	31
CD (P = 0.05)		NS	NS	4.85	0.31	NS	1.60	NS	0.04	40	91
Biofertilizer (B)											
With biofertilizer		10.31	8.94	99.92	6.08	5.71	30.21	6.29	2.86	911	1476
Without biofertilizer		9.80	8.45	91.31	5.35	5.34	27.97	5.98	2.79	782	1277
S.Em.±		0.17	0.15	1.65	0.10	0.10	0.54	0.10	0.01	14	31
CD (P = 0.05)		0.51	0.45	4.85	0.31	0.29	1.60	0.29	0.04	40	91
Interaction											
N x P	S.Em.±	0.24	0.22	2.33	0.15	0.14	0.77	0.14	0.02	19	44
N x B	CD (P=0.05)										
P x B		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
N x P x B	S.Em.±	0.35	0.31	3.30	0.21	0.20	1.08	0.20	0.02	27	62
	CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %		6.90	7.04	6.90	7.28	7.14	7.46	6.53	2.16	6.14	8.95

Effect of different phosphorus sources

The data (Table 1) showed that different phosphorus sources did not produce significant effect on plant population at 30 DAS and at harvest, pod length and number of seed pod^{-1}. Application of phosphorus through single superphosphate recorded significantly higher Plant height (98.09 cm), number of branches plant^{-1} (5.87) and number of pods plant^{-1} (29.98) over DAP. The superiority of single superphosphate over DAP could be due to presence of more Ca and sulphur content and better water solubility of phosphorus compound. These results are in accordance with the results of Khaswa *et al.* (2014) [7] in soybean, Nadeem *et al.* (2017) [10] in cowpea and Singh *et al.* (2015) [15] in mungbean. Significantly maximum 100 seed weight (2.85 g), seed yield (868 kg ha^{-1})

and stover yields (1422 kg ha^{-1}) were recorded with application phosphorus through single superphosphate. Between two phosphorus sources, single super phosphate produced 5.34% and 6.84% higher seed and stover yield, respectively over diammonium phosphate. It may be due to better growth and development of crop plants due to more phosphorus and sulphur supply and their uptake might have increased the supply of assimilates to seed, which ultimately gained more weight. This result is accordance the resources of Devi *et al.* (2012) [3] in soybean and Singh *et al.* (2015) [15] in mungbean.

Effect of biofertilizer

Seed inoculation with biofertilizer (*Rhizobium* + PSB) recorded significantly higher plant population at 30 DAS and at harvest, plant height (99.92 cm), number of branches per plant^{-1} (6.08), number of pods plant^{-1} (30.21), pod length (5.71 cm) and number of seeds pod^{-1} (6.29) over without inoculation of biofertilizer (Table 1). *Rhizobium* has the capacity to fixed nitrogen from environment and PSB may be attributed to several mechanisms especially growth hormones production, improving the efficiency of roots and increasing phosphorus availability. The above results are in accordance with those reported by Rathore *et al.* (2007) [13], Patel *et al.* (2010) [11] and Kumhar *et al.* (2012) [8]. One hundred seed weight (2.86 g), Seed yield (911 kg ha^{-1}) and stover yield (1476 kg ha^{-1}) of clusterbean was significantly increased due to biofertilizer (*Rhizobium* + PSB). Seed inoculation with biofertilizer (*Rhizobium* + PSB) gave 16.5% and 15.68% higher seed and stover yield, respectively as compared to no seed inoculation. It might due to this pivotal role in regulating the metabolic and enzymatic processes including photosynthesis, respiration and legume *Rhizobium* symbiotic nitrogen fixation which was ultimately reflected in increase seed weight, seed yield and stover yield. The results are in agreement with the finding of Rathore *et al.* (2007) [13], Kumhar *et al.* (2012) [8], Singh *et al.* (2014) [16], Brar and Singh (2016) [2], Singh *et al.* (2016) [14] and Sharma *et al.* (2018) in clusterbean.

Effect of interaction

The interaction of different nitrogen sources, different phosphorus sources and biofertilizer levels was found non significant for plant population (at 30day and harvest), plant height, Number of branches plant^{-1}, number of pod plant^{-1}, pod length, number of seed pod^{-1}, 100 seed weight, seed yield and strover yield of clusterbean

Conclusion

Based on the results of the present study, it can be concluded that higher yield and net realization can be secured from *kharif* clusterbean crop by application of recommended dose of nitrogen through ammonium sulphate; phosphorus through single superphosphate and seed inoculation with biofertilizer (Rhizobium + PSB).

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