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Correlation studies in clusterbean as influenced by varieties and foliar appplication

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Abstract
A field experiment was conducted during the rainy season 2014-15 to assess effect of foliar application of iron and to evaluate performance of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] varieties. The twenty treatment combinations consisting of five clusterbean varieties (RGC-986, RGC-1003, RGC-1033 RGC-1055 and RGC-1066) and foliar sprays treatment of 0.5% FeSO4 (control branching, flowering and branching + flowering) were tested in randomized block design with three replications. Results revealed that variety RGC-1033 proved significantly superior and economically profitable compared to rest of varieties in respect of dry matter accumulation, growth indices like CGR, RGR and LAI, pods/plant, seeds/pod and test weight. Similar, the seed yield (1816 kg/ha), stover yield (3787 kg/ha) and biologicalyield (5602 kg/ha) were also significantly higher with variety RGC-1033. Among the correlation studies the maximum correlation found between N uptake and seed yield.

Keywords: Correlation, Clusterbean, Varieties, Iron, Yield.

1. Introduction
Cluster bean, also known as guar, is a arid legume crop that is cultivated mostly in the arid and semi arid areas as it is drought resistant. The word "guar" represents its derivation from sanskrit word "Gauaahar" which means cow fodder or otherwise fodder of the livestock. There is no other legume crop so hardy and drought tolerant as clusterbean, which is especially suited for soils and climate of Rajasthan.The popular guar gum (28 to 32%), which is used in mining, petroleum drilling and textile manufacturing sectors, is obtained from the endosperm of the seed of the plant. Many genotypes for different agro-ecological situations of arid and semi-arid have been released. The newly developed varieties are superior under particular situation.

Micronutrients have played vital roles in the growth, yield and quality of legumes crops. Hallock (1978) [3] observed that foliar application of micronutrient is better than soil application for increasing yield. Iron being an essential micronutrient takes active part in the metabolic activities of the plant. It acts as an activator of dehydrogenase, proteolase and peptidases enzymes and involved directly or indirectly in the synthesis of carbohydrates and proteins. Iron being a structural component of porphyrin molecules, cytochromes, heams, hematin, ferrichrome and leg–heamoglobin is involved in oxidation-reduction reactions. Therefore, the present investigation was carried out to identify response of different varieties with foliar application of iron in clusterbean.

2. Material and methods
The experiment was conducted at the Agronomy farm, Sri Karan Narendra Agriculture University, Jobner ($26^0$05' N, $75^0$28' E) in Agroclimatic zone III A (Semi-arid Eastern Plain Zone) of Rajasthan. The soil was loamy sand in texture, alkaline in reaction (P^H value 8.2), poor in organic carbon (0.14%) with low available nitrogen (130 kg/ha) and medium in phosphorus and potassium content 18.9 and 175.6 kg/ha respectively. The rainfall received during the period (June to October) was 251 mm. The Twenty treatment combinations consisting of five clusterbean varieties (RGC-986, RGC-1003, RGC-1033 RGC-1055 and RGC-1066) and four foliar spray treatment of 0.5 % $FeSO_4$ (control, branching, flowering and branching +flowering) were tested in randomized block design with three replications. The seed was sown manually on 10 July 2014 maintaining spacing of 30 cm x 10 cm, with 20 kg/ha seed rate. Each plot consisted gross dimension of 4.0 m x 3.0 m and net area 3.0 m x 1.8 m. Thinning was carried out 20 DAS to maintain required plant population. Net return and benefit: cost ratio were calculated on the basis of prevailing market prices of seed of clusterbean varieties. Leaf-area index, crop-growth rate (CGR), relative growth rate (RGR) were worked out by using standard method for analysis and formula.

3. Results

Effect of varieties

Results revealed that at harvest 'RGC-1066' (Table 1) attained maximum plant height over RGC-1003 and RGC-1033 remained statistically at par with RGC-986 and RGC-1055. The increase in plant height due to RGC-1066 was to the magnitude of 9.4, 7.7 respectively, over RGC-1003 RGC-1033 at harvest. However 'RGC-1033' produced highest dry matter at harvest over other varieties. The maximum leaf area index was obtained with RGC-1033 (5.24) which was significantly higher over RGC-1066, RGC-1003 and remained at par with RGC-986 and RGC-1055. It indicated an increase of 13.5 % over variety RGC -1066. The highest CGR and RGR from 60 days after sowing to harvest obtained by RGC -1033 which was significantly over RGC-1066, RGC-1003 and RGC-986, RGC-1055 and took highest yield compared to the other varieties consequently produced highest pods/plant, seeds/pod over rest of varieties and test weight remained at par with RGC- 1055. Under present investigation all varieties were grown under identical conditions; however, marked variation in quality, growth parameter and yield could be ascribed on account of genetic capablities to exploit avaliable resources for their growth and development. The better performance of 'RGC- 1033' seems to be on account of higher growth attributes Choudhary *et al*. (2004) [1]. The maximum seed yield and test weight has been provided by RGC-1033 (Sharma and Ratnoo 2014) [8]. Kumar and Kaushik (2014) [5] and Rawat *et al.* (2015) [7] at different locations also reported differential growth behaviour of clusterbean varieties in terms of plant height, number of branching and dry matter accumulation. Further, RGC-1033 produced significantly higher seed yield and stover yield over RGC-1066, RGC-1003 and RGC-986, RGC-1055. The harvest index of variety RGC-1033 remained at par with RGC-1055 (Table 1). This subscribes to the view that there was adequate supply of metabolites under RGC-1033 compared to other varieties for growth and development of reproductive structures (Kalyani and Lakshmi, 2012) [4]. 'RGC- 1033' also proved most efficient in realizing highest net returns and benefit:cost ratio, which were significantly higher over rest of the varieties. The next best variety in order of superiority of growth and yield and economic was 'RGC-1055'.

Effect of foliar application of iron

A foliar application of 0.5% $FeSO_4$ at branching+ flowering stage significantly enhance growth parameters viz., plant height, dry matter, LAI, CGR, RGR. The foliar application of 0.5% $FeSO_4$ (branching, flowering, branching+flowering) significantly increased yield attributes viz., pods/plant, seeds/pod and test weight over control (Table 1). But in case of seed, stover and biological yield a single spray of 0.5% $FeSO_4$ at branching stage also recorded at par yield with spray at branching+ flowering stage and increase over control. Interaction between varieties and foliar application of 0.5 % $FeSO_4$ was non significant. The foliar application of 0.5 % $FeSO_4.7H_2O$ was found to increase pod yield, haulm yield and shelling percentage of groundnut than control (Guruprasad *et al.* 2009) [2]. Zeidan *et al* [9]. (2010) in wheat also observed remarkable improvement in yield attributes and yields due to application 0.1 % $FeSO_4$. A significantly increased growth with both 25 Kg $FeSO_4$/ha as basal dose and foliar spray of 0.5% $FeSO_4$ at 25 and 40 DAS in comparison to control in mungbean (Meena *et al.* 2013) [6].

4. Correlation studies

The relationship between the seed yield of clusterbean and other important growth and yield attributes was studied. The data on correlation coefficient (r), coefficient of determination (R^2), regression coefficient (b) and intercept (a) are furnished in Table 2. Results revealed that plant height at harvest, dry matter accumulation at harvest, number of pods/plant, number of seeds/pod, seed yield and straw yield, test weight and total nitrogen, phosphorus, potassium and iron uptake showed positive and significant correlation with seed yield of clusterbean. The correlation between seed yield and Fe uptake was the highest (0.973) followed by total number of pods/plant at harvest (0.893), seeds/pod (0.803), test weight (0.828) N uptake (0.968), P uptake (0.930), K uptake (0.950) which attributed correspondingly 73.1, 79.8, 90.3, 79.8, 92.8, 86.7 and 94.8 % variation in seed yield of clusterbean. These findings are more or less related with reported by Govindaraj *et al.* (2009).

5. Conclusion

On the basis of one year study it may be concluded that variety 'RGC-1033' attain highest yield over all the varieties of clusterbean appear suitable for cultivation in semi-arid Rajasthan along, foliar spray of 0.5% $FeSO_4$ at branching stage.

Table 1: Yield attributes and yield parameters as influenced by varieties and foilar applications on iron

Treatments	pods/ plant	Seeds/ pod	Test weight	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Varieties						
RGC -986	38.0	7.60	26.4	1353	3423	28.9
RGC-1003	35.7	7.46	25.3	1325	3234	29.2
RGC-1033	42.3	8.16	28.8	1816	3787	32.4
RGC-1055	39.1	7.91	27.0	1569	3580	30.6
RGC-1066	33.8	7.36	23.3	1187	3028	28.2
SEm +	0.81	0.15	0.49	39	110	0.76
CD (P=0.05)	2.31	0.43	1.41	111	314	2.18
FeSO4 application						
Control	34.2	7.12	23.5	1310	3129	29.4
0.5 % FeSO4 at branching	39.3	7.74	25.6	1506	3569	30.0
0.5 % FeSO4 at flowering	36.3	7.81	27.0	1433	3320	29.5
0.5 % FeSO4 at branching + flowering	41.4	8.11	28.7	1550	3624	30.1
SEm +	0.72	0.13	0.44	35	98	0.68
CD (P=0.05)	2.06	0.38	1.27	99	281	NS
CV (%)	7.39	6.69	6.55	9.26	11.1	8.85

Table 2: Intercept (a), regression coefficient (b), orrelation coefficient (r) and coefficient of determination (R2) of seed yield (dependent variable Y) with individual growth and yield attributes (independent variables Xi)

Xi	Independent variables	A	B	r	R^2
X_1	Number of pods per plant	-504.120	51.66	0.893**	0.798
X_2	Number of seeds per pod	- 1570.651	392.122	0.803**	0.903
X_3	Test weight (g)	-425.832	71.685	0.828**	0.798
X_4	Total N uptake	108.280	14.632	0.963**	0.928
X_5	Total P uptake	503.925	93.293	0.930**	0.867
X_6	Total K uptake	-465.668	42.668	0.950**	0.948
X_7	Total Fe uptake	177.57	0.540	0.973**	0.731

** = Significant at 1 per cent level of significance

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