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Effect of date of sowing and nutrient manipulations onyield and quality of summer cluster bean

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Abstract

The response of vegetable cluster bean (*Cyamopsistetragonoloba* L.) was studied with different sowing time under varying nutrient management in summer season. Crop sown on 25th February or 10th March 2010 performed equally good and showed superiority over early sowing on 25th January and 10th February 2010. Maximum yield andnet realization (Rs. 57083 per hectare) with BCR of 3.91 were obtained from 25th February sown crop.Crop receiving either FYM @ 10 t ha^{-1} or biocompost @ 5 t ha^{-1} along with 75% RDF increased green pod yield by 12.41 and 4.54 per cent and stalk yield by 11.91 and 4.56 per cent, respectively over RDF @ 100 %. A remarkable improvement in N and P status in soil was also observed undertreatments having inclusion of organics. Crop fertilized with 75% RDF + FYM @ 10 t ha^{-1} registered maximum net realization of Rs. 52098 ha^{-1} with BCR 3.01, which was closely followed by Rs. 49070 ha^{-1} with BCR 3.18 under 75% RDF + biocompost @ 5 t ha^{-1}.

Keywords: Biocompost; FYM; Integrated Nutrient Management; Non-monetary practice; sowing time

Introduction

Cluster bean [*Cyamopsistetragonoloba* L.] popularly known in India as *Guar*, is an important self pollinated, multipurpose, drought resistant leguminous crop cultivated for grain as well as green vegetable purpose. The origin of cluster bean is in vague and the area under cultivation liesalong India, Africa, Peru,Java and also in the United States. India leads the major cluster bean producing countries of the world contributing around 75 to 80% in the world's total production. Rajasthanis largest guar producing state in the world as it dominates the Indian production scenario contributing around 4.2 lakh tons *i.e.* over 70 % of the total production in India. In India, guar is cultivated on 3.47 million ha with the total production of 1.78 million ton with productivity of 515 kg ha^{-1} of seed (Anon., 2009).

Pulses and legumes are the main constitutes of vegetarian diet, next to cereals. Green and tender pods of cluster bean are the most preferred vegetable in many part of the world. These green pods, when cut and mixed with potato form a delicious dish. The tender pods are dried and eaten after frying in many part of our country. Cluster bean is a rich source of proteins and other minerals, 100g of edible portion contents 81g moisture, 10.8g carbohydrates, 3.2g protein, 0.4g fat, 1.4g minerals, 0.09mg thiamine, 47.0 mg vitamin C and 316 I.U. vitamin A. The plants are cut and fed as green forage to the cattle. Seed coats and cotyledons obtained after processing of cluster bean are used as high protein cattle feed. It has also assume great significance due to its good quality gum content and its derivatives that are widely used in several industries such as food processing, paper, textiles, ceramics, synthetic vaccines, paints, pharmaceuticals and oil industries.

Cluster has been estimated to fix nearly 30 kg N ha^{-1}. Inclusion of cluster bean in cereal based cropping system may lead to increase the yield as well as have significant positive residual effects on the productivity of succeeding cereal crops and also on soil physical properties. Inclusion of legumes in a cropping system play a vital role in improving the soil-health, hence it is high time to think about the management of soil-health to maintain the soil productivity. Cluster bean being a short duration legume with low input requirement can be taken as soil fertility restorer. Its water requirement is about one half and one third as compared to sugarcane and summer rice crop. Similarly, the nutrient requirement is also considerably low.

Cluster bean can successfully cultivated in summer season due to full and clear sunshine. But, sowing of

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the crop at right time ensures better plant growth and also inhibits weed growth. Optimum time of sowing is one of the several cultural, non-monetary manipulations and plays a vital role in boosting up the yield, particularly in Indian sub-continent where the optimum time of sowing varies to great extent due to widely varying agro-climatic conditions. Optimum time of sowing is also decided by several factors in summer *viz*., fluctuation in temperature, relative humidity, etc. during the growth. Still, there is need to understand the crop response to management practices in relation to weather factors, which will help in manipulating crop agronomic practices to suit in varying environmental conditions.

Nutrient management is also considered important input in crop production. Cluster bean being legume crop is a heavy feeder of phosphorus. Though it makes use of atmospheric N through symbiotic fixation to meet a major parts of its nitrogen requirement, it becomes necessary to find out optimum rate of nitrogen and phosphorus especially for heavy textured fertile soil as of South Gujarat. The efficiency of inorganic nutrient source may be increased by the combined application of both inorganic and organic sources. Research evidences clearly indicated that in the presence of organic manures there is a better utilization of chemical fertilizers and plant is fed more steadily and continuously than with chemical fertilizer alone which become available to the plant in rush. Secondly, the nutrient losses from the inorganic fertilizers could also be prevented substantially, if organic manures are added in combination.Thus, to study this non-monetary and monetary practices, agronomic manipulations of those is tried to study herewith.

Material and Methods

The present study was carried out at Instructional Farm, Navsari during Summer, 2010. The experimental material comprising total twenty treatment combinations comprising of four dates of sowing (d_1: 25 January,d_2: 10 February, d_3: 25 February, d_4: 10 March) and five nutrient management treatments (n_1: 100% RDF (*i.e.* 20-40-00 N P_2O_5 K_2O kg ha^{-1}), n_2: FYM @ 10 ton ha^{-1}, n_3: biocompost @ 5 ton ha^{-1}, n_4: 75% RDF + FYM @ 10 ton ha^{-1} and n_5: 75% RDF + biocompost @ 5 ton ha^{-1}). The experimental design for analyzing the data used was factorial randomized block design with three replications. Data collected on analysis of the soil of experimentplotrevealed it as clayey in texture, slightly alkaline in reaction with normal electrical conductivity with nutrient status as low in nitrogen, medium in available phosphorus and fairly rich in available potassium.The analysis of FYM and biocompost for N, P and K content is estimated on dry weight basis as mentioned below in Table 1.

Table 1: N, P and K status of Farm Yard Manure (FYM) and biocompost with the respective methods used for analysis.

Sr No.	Nutrient	Farm Yard Manure	Biocompost	Method used for analysis (Jackson, 1967)
1.	N (%)	0.54	1.33	Modifedkjeldahls method
2.	P (%)	0.28	1.07	Vanadomolybdate phosphoric acid yellow colour method
3.	K (%)	0.49	0.80	Flame photometer method

Results and Discussion

Effect of physiology

Days required to 50 per cent flowering and first picking remarkably varied due to varying sowing time (Table 2). Late sown crop advanced the time of flowering and picking over early sowing in cluster bean. 10th March sowing took minimum days to 50 per cent flowering and first picking, which was comparable with 25th February sowing. Simply the 10th March sowing advanced the flowering and picking in cluster bean by about five and ten days, respectively over early sowing on 25th January. It might be due to the effect of available photoperiod to late sown cluster bean crop at reproductive stage. Similar findings were also reported by Borah (1997) and Singh and Vashist (2005).

Data also revealed that the period for 50 per cent flowering and first picking in cluster bean significantly influenced by different nutrient management systems. Application of organics alone either biocompost @ 5 t ha^{-1} or FYM @ 10 t ha^{-1} were found as good as 100 % RDF through inorganic but better than integrated nutrient management treatments. In general, application of biocompost @ 5 t ha^{-1} advanced the flowering and picking in cluster bean by about four days over application of 75% RDF + FYM @ 10 t ha^{-1}. It is probably due to higher nutrient availability under integrated nutrient management prolonged the vegetative growth of the crop.

Effect on yield and yield attributes

Various yield attributes *viz.,* number of pods $plant^{-1}$, podlength, average green pod yield $picking^{-1}$, green pod and dry stalk yields were significantly influenced under varying sowing time (Table 2). Crop sown either on 25th February or 10th March recorded higher values for almost all the above characters than early sown crop. Better growth of plant in terms of plant height and dry matter accumulation under 25th February and 10th march sowing, reflected into better development of yield

attributes. Moreover, congenial climatic conditions especially at reproductive phase also play vital role in development of yield attributes. These findings are substantiated with those reported by Chovatia*et al.* (1993), Bhingarde and Dumbre (1994) and Chavan*et al.* (1998) with regards to number of pods and pod length.

Consequently, significantly higher pod yield was recorded under 25th February and 10th March sowing than early sown crop. Crop sown on 25th February increased the pod yield by 7.78, 17.32 and 22.73 per cent, respectively over 10th March, 10th February and 25th January sowings. These results land support to those reported by Chovatia*et al.* (1993), Rajput (1994)and Patel *et al.* (2004).

Similarly, better development of various growth parameters under late sowings reflected into significantly higher stalk yields under 25th February and 10th March compared to early sowings. The crop sown on 25th February increased the stalk yield in cluster bean by 7.21, 17.23 and 23.22 per cent, respectively over 10th March, 10thFebruary and 25th January sowings. Similar findings were also reported by Chovatia*et al.* (1998) and Patel *et al.* (2004).

The maximum value for number of pod plant^{-1} and pod length were recorded in 75% RDF + FYM @ 10 t ha^{-1} (n_4) being at par with 75 % RDF + biocompost @ 5 t ha^{-1} (n_5) and 100 % RDF (n_1). It is evident that better vegetative growth in term of dry matter production with these treatments favors the development of source-sink relationship in terms of yield attributes. This might be due to improvement in soil environment in general and nutrient availability in particular by combine application of organic and inorganic sources of nutrient. The results lend support to the findings of Kumar and Puri (2002) and Singh and Verma (2002) in terms of pods plant^{-1} and Sherin and Anuja (2008) in terms of pod-length.

Yield is function of number of plants per unit area and development of yield attributes. Since the plant population was uniform under all the treatments, various yield attributes*viz.*, number of pods plant^{-1}, pod-length and average green pod yield picking^{-1} played a vital role in increasing the productivity of cluster bean crop. Thus, the overall better growth performance and higher values of most of the yield attributes recorded under integrated nutrient management treatments. Treatments comprising application of either FYM @ 10 t ha^{-1} or biocompost @ 5 t ha^{-1} along with the 75 % RDF (n_4 and n_5) were equally effective in increasing the pod yield over organics (n_2 and n_3) and inorganics alone (n_1). Crop fertilized with FYM @ 10 t ha^{-1} along with 75 % RDF (n_4) increased the pod yield by 8.24, 12.42, 21.22 and 25.37 per cent, respectively over treatments n_5, n_1, n_2 and n_3. These results confirm the findings of Singh and Verma (2002).

Significantly higher stalk yields were achieved under treatment receiving either FYM @ 10 t ha^{-1} and biocompost @ 5 t ha^{-1} along with 75 % RDF (n_4 and n_5) over organics (n_2 and n_3) as well as inorganic alone (n_1). Crop receiving FYM @ 10 t ha^{-1} along with 75 %

Table 2: Days to 50% flowering and first picking; green pod and dry stalk yields (q ha^{-1}) in *Cyamopsistetragonoloba* L. as influenced by sowing time and nutrient management

Treatments	Days to 50% flowering	Days to first picking	Number of pods plant^{-1}	Pod length (cm)	Av. green pod yield picking^{-1} (kg plot^{-1})	green pod yields (q ha^{-1})	dry stalk yields (q ha^{-1})
Sowing time							
d_1 : 25th January	44.86	55.73	44.56	8.12	0.33	39.34	23.21
d_2 : 10th February	43.80	53.93	47.41	8.65	0.36	42.09	25.02
d_3 : 25th February	41.46	47.86	56.28	9.08	0.43	50.91	30.23
d_4 : 10th March	39.60	45.60	52.90	8.78	0.40	46.95	28.05
S. Em. ±	0.77	0.77	1.32	0.14	0.01	1.40	0.83
CD (P=0.05)	2.22	2.22	3.78	0.40	0.03	4.01	2.39
Nutrient management							
n_1 : 100% RDF	42.83	50.91	51.20	8.69	0.38	45.36	26.98
n_2 : FYM @ 10 t ha^{-1}	41.25	49.75	47.06	8.31	0.35	40.80	24.27
n_3 : Biocompost @ 5 t ha^{-1}	40.66	49.25	45.65	8.29	0.33	38.65	22.99
n_4 : 75 % RDF + FYM @ 10 t ha^{-1}	44.16	53.00	54.73	9.15	0.44	51.79	30.63
n_5 : 75 % RDF + Biocompost @ 5 t ha^{-1}	43.25	51.00	52.80	8.86	0.40	47.52	28.27
S. Em. ±	0.86	0.87	1.47	0.15	0.01	1.56	0.93
CD (P=0.05)	2.48	2.49	4.22	0.44	0.03	4.48	2.67
Interaction							
D x F	NS	NS	NS	NS	NS	NS	NS
CV %	7.09	5.94	10.17	6.26	12.10	12.10	12.15

RDF (n_4) amplified the stalk yield by 7.70, 11.91, 20.76 and 24.96 per cent, respectively over treatments n_5, n_1, n_2 and n_3. It might be due to application of organics alone can supplied nutrients in limited amount more over it is not readily available to the plant.

Effect on quality

Varying sowing time failed to produce its significant effect on quality in cluster bean in terms of protein content (Table 3). Protein content is the genetically controlled character; therefore it may not be change due to variation in sowing time. So far protein yield is concern, crop sown on 25th February recorded significantly highest protein yield. The increase in protein yield was direct outcome due to higher pod yield that reflected in highest protein yield under this treatment. The results lend support to those reported by Ram and Dixit (2000) and Kumar *et al*. (2009).

Similarly, nutrient management failed to exert any significant effect on protein content, except in protein yield. Significantly highest protein yield in cluster bean recorded in crop receiving 75 % RDF + FYM @ 10 t ha^{-1} (n_4). This is attributed to the higher values of protein content and pod yield of cluster bean under this treatment of nutrient management.

Table 3: Protein measures of crop as influenced by the treatment

Treatment	Protein content (%)	Protein yield (kg ha^{-1})
Sowing time		
d_1	21.25	100.43
d_2	21.56	108.95
d_3	22.13	135.24
d_4	21.79	122.91
S.Em.±	0.23	3.34
CD (P=0.05)	NS	9.57
Nutrient management		
n_1	21.72	118.59
n_2	21.40	104.75
n_3	21.24	98.52
n_4	22.28	138.38
n_5	21.78	124.17
S.Em. ±	0.26	3.73
CD (P = 0.05)	NS	10.70
Interaction		
DxF	NS	NS
CV%	4.24	11.07

Effect on soilnutrient status

So far nutrient status of soil after harvest of crop is concerned, difference in sowing time failed to express any significant effect on organic carbon, available nitrogen, available phosphorus and available potassium status of soil (Table 4).Data on soilnutrientstatus after experimentation clearly indicated that all treatments of nutrient management enrich the soil over its initial status in terms oforganic carbon, available nitrogen and phosphorus. Varying treatment of nutrient management significantly influenced the N and P_2O_5 status in soil after harvest of cluster bean crop. Crop receiving either FYM @ 10 t ha^{-1} or biocompost @ 5 t ha^{-1} along with 75 % RDF (n_4 and n_5) as well as 100 % RDF (n_1) were equally good and significantly better than organics alone. Treatment receiving FYM @ 10 t ha^{-1} along with 75 % RDF (n_4) increased the available nitrogen and phosphorus to the tune of 34.91 and 18.79 percent, respectively over its initial status. Improvement in N and P_2O_5 status

Table 4: Organic carbon content (%) and nutrient status in soil (kg ha^{-1}) after harvest of*Cyamopsistetragonoloba* L. as influenced by sowing time and nutrient management

Treatments	**O.C. content (%)**	**Available N (kg ha^{-1})**	**Available P_2O_5 (kg ha^{-1})**	**Available K_2O (kg ha^{-1})**
Initial value	0.58	174.00	30.92	352.60
Sowing time				
d_1 : 25th January	0.60	211.85	32.64	347.50
d_2 : 10th February	0.62	217.59	33.11	348.43
d_3 : 25th February	0.64	224.54	35.42	353.06
d_4 : 10th March	0.63	221.77	34.30	350.81
S. Em. ±	0.01	3.99	0.75	2.96
CD (P=0.05)	NS	NS	NS	NS
Nutrient management				
n_1 : 100% RDF	0.61	223.76	34.48	348.79
n_2 : FYM @ 10 t ha^{-1}	0.62	206.85	32.00	347.22
n_3 : Biocompost @ 5 t ha^{-1}	0.61	200.83	31.20	345.25
n_4 : 75 % RDF + FYM @ 10 t ha^{-1}	0.64	234.75	36.73	355.96
n_5 : 75 % RDF + Biocompost @ 5 t ha^{-1}	0.63	228.50	34.92	352.53
S. Em. ±	0.01	4.47	0.84	3.31
CD (P=0.05)	NS	12.80	2.43	NS
Interaction				
D x F	NS	NS	NS	NS
CV %	7.71	7.07	8.68	3.28

in soil after harvest of crop may be due to enrichment of organic matter in soil through addition of organic manures which increase the availability of nutrients from native as well as applied fertilizers. These all might have contributed towards increased availability of nitrogen and phosphorus. The results supported by Dikshit and Khatik (2002).

Effect on economics

Economics is the foremost consideration of the farmer's point of view, while taking a decision to adopt a new technology. The data in Figure 1 indicated that the maximum net realization of Rs. 57083 ha^{-1} was achieved under 25th February sowing, followed by Rs. 51122 ha^{-1} with 10thMarch sowing. Both these treatments also recorded higher BCR of 3.91 and 3.61, respectively. This could be attributed to higher pod yield recorded under 25th February sowing without any additional expenditure. These findings are substantiated with those reported by Patel *et al.* (2004).

Nutrient management heights (Figure 1) revealed that, the treatment 75 % RDF + FYM @ 10 t ha^{-1} (n_4) secured maximum net realization of Rs. 52098 ha^{-1} which was closely followed by Rs. 49070 ha^{-1} under 75 % RDF + biocompost @ 5 t ha^{-1} (n_5). But in case of BCR value the 100 % RDF (n_1) rank first with a value of 3.26 and treatment 75 % RDF + biocompost @ 5 t ha^{-1} (n_5) rank second with a value of 3.18. These results are in conformity with those reported by Singh and Verma (2002) and Dikshit and Khatik (2002) with respect to net realization.Going through the figure it is visible that once the graph of net realization seems to have raised (d_3) above all and also has the minimum cost of cultivation among the all treatments. Thus, showing that date of sowing of a crop is truly a non-monetary agronomic practice that should be evaluated regionally to obtain maximum monetary returns. On the basis of results obtained in this agronomic investigation, it can be concluded that maximum and profitable yield of summer cultivated *C. tragonoloba*can be secured by sowing cluster bean during 25th February to 10th March along with manuring practices either with FYM @ 10 t ha^{-1} or biocompost @ 5 t ha^{-1} in conjunction with 75 % RDF (*i.e.* 15-30 kg NP ha^{-1}) to sustained crop productivity, soil properties and to gain higher net returns.

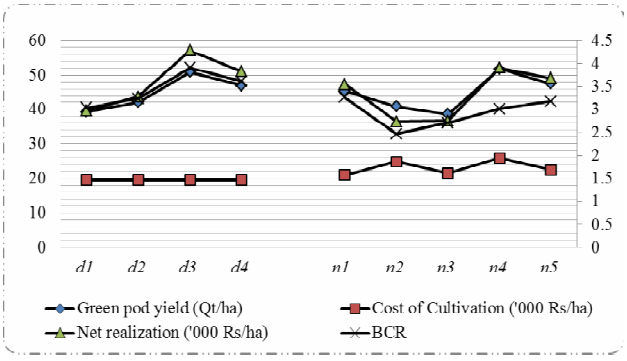

Fig. 1: Economical description of experiment in alliance with grain yield of *Cyamopsistetragonoloba* L.

सारांश

सब्जी वाली ज्वार (साइमोरिसस टेट्रागोनोलोबा एल.) पर विभिन्न पोषक तत्व प्रबन्धन के साथ बुआई के समय अध्ययन ग्रीष्म काल में किया गया। बीज की बुआई 25 फरवरी और 10 मार्च, 2010 में किया गया और बराबर निष्पादन क्षमता का प्रदर्शन किया तथा अगेती बुआई पर उत्कृष्टता 25 जनवरी व 10 फरवरी पर पायी गयी। अधिकतम उपज तथा कुल लाभ (रू. 57083/प्रति हेक्टेयर के साथ लाभ लागत अनुपात 3.91 सामान्यतः 25 फरवरी की बुआई फसल से प्राप्त हुई। जिस फसल में गोबर की खाद 10 टन/हेक्टेयर की दर से या बायो कम्पोस्ट 5 टन/हेक्टेयर की दर के साथ 75 प्रतिशत उर्वरक की संस्तुत मात्रा देने से हरी फली उपज 12.41 एवं 4.54 प्रतिशत तथा भूसा उपज 11.91 एवं 4.56 प्रतिशत क्रमशः 100 प्रतिशत संस्तुत उर्वरक की मात्रा पर पायी गयी। नत्रजन एवं फास्फोरस की मृदीय स्थति में अच्छी सुधार देखी गयी जिनमें कार्बनिक शोधन घटक सम्मिलित था। जिस फसल में 75 प्रतिशत संस्तुत उर्वरक की मात्रा + गोबर की 10 टन/हेक्टेयर खाद से लाभ रु. 52098/– प्रति हेक्टेयर के साथ लाभ लगात अनुपात 3.01 पाया गया जो निकटतम रु. 49070/– प्रति हेक्टेयर के साथ लाभ लागत अनुपात 75 प्रतिशत संस्तुत उर्वरक की मात्रा + बायोकम्पोस्ट 5 टन/हेक्टेयर की दर पर था।

References

Anonymous (2009).Department of Agriculture and Cooperation Ministry of Agriculture, Government of India (http://www.agricoop.nic.in).

Bhingarde MT and Dumbre AD (1994).Effect of sowing dates and seed size on seed yield and quality in mungbean under summer conditions.Journal of Maharashtra Agricultural University 19 : 410-412.

Borah HK (1997). Yield variation in summer greengram with respect to effective flower production in different dates of sowing. Madras Agricultural Journal 84 : 588-590.

ChavanSP,Jadhav SN and More VG (1998).Effect of date of sowing and irrigation schedule on soybean during summer season. Journal of Maharashtra Agricultural University 23: 76-77.

Chovatia PK,Ahlawat RPS and Trivedi SJ (1993).Growth and yield of summer green gram (*Phaseolusradiatus*) as affected by different dates of sowing, *rhizobium* inoculation and levels of phosphorus. Indian Journal of Agronomy 38: 492-494.

Dikshit PR and Khatik SK (2002). Influence of organic manures in combination with chemical fertilizers on production, quality and economic feasibility of soybean in typichaplustert of Jabalpur. Legume Research25: 53-56.

Jackson ML (1967). Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi. pp. 183-192.

Kumar P and Puri UK (2002). Response of frenchbean (*Phaseolus*

vulgaris L.) varieties to phosphorus and farmyard manure application. Indian Journal of Agronomy 47 : 86-88.

KumarR,Nandan R, Kumar V, Prasad S and Singh D (2009).Response of summer mungbean (*Vigna radiata* L. *Wilczek*) cltivars to sowing time and seed rate. Indian Journal of Agricultural Sciences79 : 309-312.

Patel IC, Patel MM, Patel AG and Tikka SBS.(2004). Response of summer cluster bean (*Cyamopsistetragonoloba* (L.)Taub.)varieties to time of sowing and row spacing on yield under north Gujarat agro climatic condition. Journal of Arid Legumes 1 : 24-26.

Rajput AL (1994). Response of cowpea (V*igna unguiculata*) to *rhizobium* inoculation, date of sowing and phosphorus. Indian Journal of Agronomy 39 : 584-587.

Ram SN and Dixit RS (2000).Effect of phosphorus on nodulation, uptake of nutrients and yield of summer greengram (*Vigna radiata* L. *Wilczek*).Crop Research 19 (3): 414-417.

Sherin S and Anuja S (2008). Effect of organic and inorganic fertilizers on yield and yield attributes of cluster bean. Advances in Plant Science 21: 461-465.

Singh H and Vashist, KK (2005).Sowing time of summer mungbean under Panjab conditions. Indian Journal of Pulses Research 18 : 36-37.

Singh, NB and Verma KK (2002). Response of frenchbean (*Phaseolusvulgaris* L.) to application of organics and inorganics in eastern Uttar Pradesh. IndianJournal of Agronomy 47 : 563-566.