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Original Research Article

Effect of Different Dates of Sowing and Nitrogen Levels on Growth, Seed Yield and Quality of Gum Cluster Bean

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A B S T R A C T

A Field trial was conducted at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the *summer* season of year 2014-2015 to study the effect of different dates of sowing and nitrogen levels on growth, seed yield and quality of gum cluster bean. The result revealed that the growth, seed yield and quality parameters were significantly influenced by the sowing date and nitrogen levels. S_3 i.e. delayed planting on 1st February was found significantly superior in respect of plant height (at 30, 60 and 90 DAS), number of branches per plant, leaf area, pod length, number of clusters per plant, number of pods per cluster, number of pods per plant, weight of dry pod per plant, weight of dry pod per plot, weight of dry pod yield per hectare, number of seed per pod, hundred seed weight, seed yield per plant, seed yield per hectare, seed endosperm, protein content and available soil nitrogen after harvesting. Regarding the nitrogen levels, N_3 - 45 kg N /ha was found significantly superior for number of branches per plant, pod length, number of clusters per plant, number of pods per cluster, number of pods per plant, weight of dry pod per plant, weight of dry pod per plot, weight of dry pod yield per hectare, number of seed per pod, hundred seed weight, seed yield per plant, seed yield per hectare and seed endosperm. An interaction effect of different dates of sowing nitrogen levels in respect of growth, seed yield and quality parameters was found significant with treatment combination S_3N_3 (1st February + 45 kg ha^{-1}) except days required to 50 % flowering. The cost economics, the sowing date S_2-15th January and nitrogen level N_4- 60 kg/ha were found to be most remunerative and profitable as per the B:C ratio (1:3.80) for guar gum production under, Akola conditions.

Keywords

Sowing dates, Nitrogen levels, Turmeric, var. guar uday, Growth, Seed yield and quality

Introduction

After exploiting vegetables human diet and for nutritional security, vegetables are now growing for its commercially important bi-products like gum, vegetable pigments as dyes, nutraceuticals, oleoresin and seed oil etc.

Cluster bean or Guar (*Cyamopsis tetragonoloba* (L.) Taub), (2n = 14) is one of the important leguminous vegetables belonging to Family Fabaceae. It is an important legume whose cultivation is mainly concentrated in marginal and sub marginal soils receiving low rainfall. In India, cluster bean occupies an area of 5152 thousand hectares with a production of 2461 tons (Singh, 2014). Guar is mainly cultivated for food, feed and fodder. Its

young pods are used as vegetables and for endospermic gum (30 to 35%).

In past, cluster bean was only used as source of rich protein to feed cattle. Now this has been extensively used as green vegetable in India. After Second World War, there was major shortage of locust bean gum which adversely affected the textile and paper industries. At that time guar gum was found as the most suitable substitute for scarce locust bean gum. In 1953 the extraction technology of guar gum was commercialized in USA and India after decade of period. (Anon., 2011)

India produces 600000 lakh tons of guar annually i.e. the maximum level of production in the world. It contributes to around 80% share in the world's total production. The major producing regions of this crop in India are Rajasthan, Gujarat, Haryana, Punjab, Uttar Pradesh, Madhya Pradesh, Tamil Nadu, Maharashtra, Karnataka and Andhra Pradesh. Rajasthan can be termed as the largest guar producing state in the world as it dominates the Indian production scenario contributing to around 420000 tons of this crop i.e. over 70% of the total production in India. Haryana and Gujarat place themselves at the second and third positions regarding the production in India with 12% and 11% respectively.

In Maharashtra, area under cluster bean is only 4671 hectares with production of 19735 tones having productivity of 4.22 t/ha.

The cluster bean seeds are dehusked, milled and screened to obtain the guar gum. It is typically produced as a free-flowing, pale, off-white colored, coarse to fine ground powder. There are various grades of guar gums pure or derivative. Guar gum is a white to creamy colored, free flowing powder and free from extraneous matter. Gum cluster bean, used as thickener in cosmetics, sauces and salad dressings. Industrially it is used in mining, petroleum drilling and textile manufacturing, paper, textile, oil drilling, and other various industrial applications. At very low concentration, gum cluster bean has excellent settling flocculation properties and it acts as a filter aid (Anon., 2011).

Materials and Methods

A Field trial was conducted at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the *summer* season of year 2014 - 2015 in factorial randomized block design with three replications and twelve treatment combinations with different dates of sowing i.e. 1st January (S_1), 15th January (S_2) and 1st February (S_3). With different nitrogen levels viz. control (N_1), 30 kg N /ha (N_2), 45 kg N / ha (N_3) and 60 kg N/ ha (N_4).

Results and Discussion

Sowing dates and nitrogen levels showed significant influence on different growth, seed yield and quality contributing characters of gum cluster bean. Data regarding growth parameters is presented in table 1. As regards sowing dates, S_3 i.e. 1st February recorded significantly maximum plant height at 30, 60, and 90 DAS (i.e. 13.91 cm, 54.45 cm and 86.49 cm respectively). The maximum height under S_3 (1st February) date of sowing might be due to the fact that plant under this treatment had opportunity to grow for longer duration in favourable climate (hot and dry). Similar results have been reported by Shevgan (1984), Zulfiqar *et al.,* (2003) in cluster bean. Maximum number of branches per plant (6.15), the number of branches per plant were increased with delayed date of sowing might be due to congenial climatic

conditions and favourable higher temperature for growth at later sowings. This is in conformity with the results found by Pandey *et al.,* (1994) in French bean. Delayed planting also exhibited maximum leaf area (20.86 cm^2), this may be due to increased vegetative growth as the sowing delayed which ultimately gave more leaf area. The results are in the conformity with that of Ayoub *et al.,* (2014) in snap bean.

Yield parameters presented in table 2 revealed that the number of days to 50% flowering was found in S_3 – 1st February (41.53). Present findings were supported with that of Ayoub *et al.,* (2014) in snap bean. Significantly maximum number of clusters per plant (10.53), number of pods per cluster (10.69) and number of pods per plant (105.55) were also found in delayed planting the number of pods per cluster, number of pods per plant and pod length were increased with delayed date of sowing might be due to congenial climate conditions and favourable temperature for growth at later sowings. This is in conformity with the results found by Shevgan (1984) in cluster bean.

Pod characters presented in table 2 revealed that, maximum pod length (6.15 cm), weight of dry pod per plant (29.21 g/plant), weight of dry pod per plot (701.22 g/plot), and weight of dry pod yield per hectare (21.63 q/ha) were produced by this may be due to congenial climatic conditions which favour production of significantly more dry pod per plant and more dry pod per hectare in the relative time.

The vegetative growth obtained in the sequence was also more in treatment S_3 which must have produced sufficient carbohydrates for giving more yield. The similar results were found by Shevgan (1984) in cluster bean.

As regards the seed yield parameters presented in table 3, significantly maximum number of seed per pod (7.54) and hundred seed weight (3.46 g) was observed in S_3 planting i.e. 1st February.

The number of seeds per pod and hundred seed weight were increased with delayed date of sowing might be due to congenial climatic conditions and favourable higher temperature for growth at later sowings.

These results are in conformity with the findings of Sharma *et al.,* (2013) in French bean. Seed yield per plant (22.62 g) and seed yield per hectare (16.75 q/ha), the seed yield per hectare was increased with delayed date of sowing might be due to congenial climatic conditions and favourable higher temperature for growth at later sowings.

This is in conformity with the results found by Zulfiqar *et al.,* (2003) in cluster bean.

Quality parameters presented in table 3, revealed that, maximum seed endosperm (38.99 %) and protein content (29.91 mg/g) was also significantly higher in S_3 i.e. 1st February. Present findings are supported with that of Bains and Dhillon (1975) in cluster bean.

Amongst different nitrogen levels, N_3 i.e. 45 kg N/ha recorded significantly maximum number of branches per plant (6.00), number of cluster per plant (9.41), number of pods per cluster (9.69), number of pod per plant (88.71), pod length (6.02 cm), weight of dry pod per plant (29.22 g/plant), weight of dry pod per plot (701.30 g/plot), weight of dry pod yield per hectare (21.64 q/ha), number of seed per pod (7.56), hundred seed weight (3.49 g), seed yield per plant (21.00 g), and seed yield per hectare (15.55 q/ha) and quality parameters like seed endosperm (37.80 %).

Table.1 Effect of different dates of sowing and nitrogen levels on growth parameters of gum cluster bean

Treatments	Plant height (cm)			Number of branches per plant	Leaf area (cm^2)
	30 DAS	60 DAS	90 DAS		
Sowing dates					
S_1- 1st January	6.16	33.99	74.03	4.43	15.39
S_2-15th January	8.76	44.59	76.21	5.26	19.86
S_3-1st February	13.91	54.45	86.49	6.15	20.86
SE(m)±	0.09	0.48	0.34	0.13	0.07
CD at 5%	0.29	1.41	1.00	0.40	0.21
Nitrogen levels (kg/ha)					
N_1- Control	7.19	39.65	75.00	4.23	16.51
N_2- 30 kg/ha	9.16	43.56	78.31	4.95	15.95
N_3- 45 kg/ha	10.9	46.38	80.61	6.00	20.83
N_4- 60 kg/ha	11.18	47.79	81.72	5.93	21.53
SE(m)±	0.11	0.55	0.39	0.15	0.08
CD at 5%	0.33	1.62	1.16	0.46	0.24
Interaction levels					
$S_1 N_1$	5.08	27.55	71.11	3.77	12.76
$S_1 N_2$	6.75	34.64	74.93	3.90	13.49
$S_1 N_3$	5.57	35.45	74.38	5.27	16.55
$S_1 N_4$	7.26	38.34	75.71	4.79	18.76
$S_2 N_1$	6.14	41.07	70.19	5.30	19.33
$S_2 N_2$	8.08	43.25	74.26	5.60	15.55
$S_2 N_3$	9.30	45.55	78.23	4.34	21.19
$S_2 N_4$	11.55	48.51	82.17	5.83	23.37
$S_3 N_1$	10.36	50.34	83.71	3.64	17.44
$S_3 N_2$	12.68	52.80	85.75	5.38	18.82
$S_3 N_3$	17.85	58.14	89.23	8.41	24.75
$S_3 N_4$	14.76	56.54	87.30	7.19	22.46
SE(m)±	0.19	0.96	0.68	0.27	0.14
CD at 5%	0.58	2.82	2.01	0.80	0.42

Table.2 Effect of different dates of sowing and nitrogen levels on yield parameters and pod characters of gum cluster bean

Treatments	Days to first flowering	Days to 50% flowering	Number of clusters / plant	Number of pods/ Cluster	Number of pods / plant	Pod length (cm)	Wt. of dry pod/plant (g/plant)	Wt. of dry pod/plot (g/plot)	Wt. of dry pod yield/ha (q)
Sowing dates									
S_1- 1st January	33.61	45.69	8.14	7.93	64.44	5.37	26.08	626.06	19.31
S_2-15th January	32.56	43.16	8.34	8.85	73.6	5.45	28.16	675.98	20.85
S_3-1st February	31.86	41.53	10.53	10.69	105.55	6.15	29.21	701.22	21.63
SE(m)±	0.48	0.75	0.08	0.17	1.32	0.12	0.15	3.65	0.11
CD at 5%	-	2.22	0.25	0.50	3.89	0.36	0.44	10.71	0.33
Nitrogen levels (kg/ha)									
N_1- Control	31.09	41.98	8.39	8.09	66.13	5.35	25.94	622.66	19.21
N_2- 30 kg/ha	32.3	42.53	9.11	9.19	83.76	5.56	27.4	657.68	20.29
N_3- 45 kg/ha	33.44	43.37	9.41	9.69	88.71	6.02	29.22	701.3	21.64
N_4- 60 kg/ha	33.87	45.95	9.12	9.65	86.18	5.70	28.72	689.36	21.27
SE(m)±	0.55	0.87	0.10	0.19	1.53	0.14	0.17	4.21	0.12
CD at 5%		2.56	0.29	0.58	4.49	0.42	0.51	12.36	0.38
Interaction levels									
$S_1 N_1$	31.46	47.37	7.14	7.03	50.20	4.80	24.56	589.44	18.19
$S_1 N_2$	34.39	44.97	9.89	8.30	82.08	4.99	26.81	643.44	19.85
$S_1 N_3$	34.57	42.89	8.66	7.05	61.08	5.64	25.34	608.16	18.77
$S_1 N_4$	34.03	47.52	6.89	9.35	64.43	6.08	27.63	663.20	20.46
$S_2 N_1$	34.12	40.30	7.48	7.59	56.85	4.92	25.65	615.68	19.00
$S_2 N_2$	34.87	41.56	8.21	8.66	71.15	6.23	26.76	642.24	19.82
$S_2 N_3$	29.82	43.56	9.72	7.87	76.50	5.50	30.61	734.56	22.66
$S_2 N_4$	31.45	47.22	7.97	11.29	89.94	5.18	29.64	711.44	21.95
$S_3 N_1$	27.70	38.26	10.55	9.66	91.36	6.34	27.62	662.88	20.45
$S_3 N_2$	27.66	41.07	9.23	10.62	98.08	5.49	28.64	687.36	21.21
$S_3 N_3$	35.93	43.67	9.86	14.15	128.57	6.92	31.72	761.20	23.49
$S_3 N_4$	36.15	43.11	12.51	8.33	104.19	5.86	28.89	693.44	21.40
SE(m)±	0.96	1.51	0.17	0.34	2.65	0.24	0.30	7.30	0.22
CD at 5%	2.83	-	0.51	1.00	7.78	0.73	0.89	21.42	0.66

Table.3 Effect of different dates of sowing and nitrogen levels on seed yield and quality parameters of gum cluster bean

Treatments	Number of seed per pod	Hundred seed weight (g)	Seed yield / plant (g/plant)	Seed yield / hectare (q)	Seed endosperm (%)	Seed protein (mg/g)
Sowing dates						
S_1- 1^{s}January	6.99	3.21	17.98	13.31	34.31	26.28
$S_2$15thJanuary	6.97	3.04	19.26	14.26	36.88	27.11
$S_3$1stFebruy	7.54	3.46	22.62	16.75	38.99	29.91
SE(m)±	0.13	0.07	0.17	0.13	0.18	0.20
CD at 5%	0.39	0.23	0.51	0.38	0.55	0.59
Nitrogen levels (kg/ha)						
N_1- Control	6.95	3.09	19.02	14.08	35.00	26.34
N_2- 30 kg/ha	7.01	3.11	19.39	14.36	36.35	27.71
N_3- 45 kg/ha	7.56	3.49	21.00	15.55	37.8	28.46
N_4- 60 kg/ha	7.14	3.25	20.42	15.12	37.77	28.55
SE(m)±	0.15	0.09	0.20	0.15	0.21	0.23
CD at 5%	0.45	0.27	0.59	0.44	0.63	0.69
Interaction levels						
S_1 N_1	6.93	3.23	18.29	13.55	34.71	25.65
S_1 N_2	7.59	3.24	18.52	13.71	33.67	28.25
S_1 N_3	7.00	3.33	17.48	12.94	33.97	24.56
S_1 N_4	6.44	3.04	17.66	13.08	34.93	26.67
S_2 N_1	8.08	3.17	18.77	13.90	34.56	25.85
S_2 N_2	7.35	2.49	19.56	14.48	36.89	27.46
S_2 N_3	6.30	3.29	18.27	13.53	37.78	28.61
S_2 N_4	6.19	3.23	20.48	15.16	38.30	26.56
S_3 N_1	5.86	2.89	20.00	14.81	35.74	27.55
S_3 N_2	6.12	3.60	20.11	14.89	38.49	27.45
S_3 N_3	9.40	3.87	27.26	20.19	41.67	32.23
S_3 N_4	8.81	3.50	23.13	17.13	40.08	32.44
SE(m)±	0.26	0.15	0.35	0.26	0.37	0.40
CD at 5%	0.78	0.46	1.02	0.76	1.10	1.19

This might be due to the application of higher amount of nitrogen resulted in better growth, increase in number of branches per plant and increase in number of pods per plant which resulted into the maximum seed yield per hectare.

Similar results have been reported by Muhammad *et al.,* (2009) in cluster bean.

The interaction effect of date of sowing and nitrogen levels was found significant. S_3 i.e. 1st February and nitrogen levels N_3 i.e. 45 kg N/ha was found significant for producing maximum plant height (17.85, 58.14 and 89.23 cm at 30, 60 and 90 DAS), number of branches per plant (8.41), leaf area (24.75 cm^2), length of pod (6.92 cm), number of pods per cluster (14.15), number of pods per

plant (128.57), weight of dry pod per plant (31.72 g), weight of dry pod per plot (761.20 g), weight of dry pod yield per hectare (23.49 q), number of seed per pod (9.40), hundred seed weight (3.87 g), seed yield per plant (27.26 g), seed yield per hectare (20.19 q) and seed endosperm (41.67 %) of gum cluster bean in summer season except days required to first flowering, number of clusters per plant. These results are in agreement with the findings of Yadav *et al.,* (2012) in vegetable pea and wheat.

Maximum gross returns (Rs 78978 ha^{-1}), net returns (Rs 57480 ha^{-1}) were recorded with treatment of S_3N_3 i.e. (1^{st} February + 45 kg/ha) however, maximum B: C ratio (3.80) was recorded with treatment of S_2N_4-(15^{th} January + 60 kg/ha). Higher B: C ratio obtained when the crop was grown with treatment of S_2N_4-(15^{th} January + 60 kg/ha) due to considerable reduction in the cost of nitrogen levels coupled with high yields.

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