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Growth, Yield and Econonics of Guar (*Cyamopsis tetragonoloba* L.) Genotypes under Various Sowing Dates in the Coastal Andhra Pradesh

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Abstract A field experiment was conducted to study the effect of different sowing dates on the yield of different varieties of gum guar. The experiment was laid out in factorial randomized block design replicated thrice, six dates of sowing from 15th September to 1st December at fifteen days interval and two gum guar varieties viz. RGC-936 and RGC-1003. Grain yield was significantly influenced by dates of sowing and varieties as well as their interaction. Among dates of sowing the highest grain yield (1568 kg ha^{-1}) was recorded 15th November sowing which was on a par with 1st December sowing. Highest grain yield was recorded with RGC-1003 which was significantly superior to RGC-936. Highest grain yield (1792 kg ha^{-1}) was recorded with 15th November sown RGC-1003 which was on a par with 1st December sowing with same variety. Haulm yield also followed the same trend as grain yield but only dates of sowing had a significant influence on harvest index. Economics were highest with RGC-1003 sown at 15th November, which was at par with 1st December sowing with same variety.

Keywords Economics, Growth, Plant population, Sowing date, Varieties.

Introduction

Clusterbean [*Cyamopsis tetragonaloba* L.] commonly known as guar in one of the important leguminous crop grown in arid and semiarid regions of tropical India. It is very hardy crop and withstands very high temperature as well as severe drought conditions. It is capable of growing under poor fertility and scanty rainfall tracks of India. Among dry land crops,guar occupies an important place in the national cconomy because of its industrial importance mainly due to the presence of gum in its endosperm (35 to 40%). Clusterbean is grown for different purposes from very ancient time viz. vegetable , green fodder, manure and feed. It provides nutritional concentrate and fodder for cattle and adds to the fertility of soil by fixing considerable amount of atmospheric nitrogen. Clusterbean seed is used as a concentrate for animal and for extraction of "gum". Seed of clusterbean contain 28 to 33% gum. Guar gum has its use in several industries viz. textiles, paper, petroleum, pharmaceuticals, food processing cosmetics, mining explosives, oil drilling. India is the largest producer of gum guar

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and contributes to 80% of total guar productiuon in the world. The area, production and productivity of guar in India is 51.52 lakh hectares, 26.61 lakh tonnes and 478 kg ha^{-1} respectively during 2012-13 [1]. It is grown mainly in Rajasthan, Gujarat, Haryana, and Punjab. The grain yield of gum guar in India is extremely low and has been static over the last several decades. This may be due to the fact that efforts have not been made to find out the optimum agronomic requirements of this crop. Among other crop production factors, sowing time contributes a lot towards the yield potential, Therefore, considering the growing export demand and its various industrial uses there is a need to find out suitable sowing date and variety of gum guar to enhance productivity as it is gaining popularity in non-traditional areas.

Materials and Methods

The present investigation was conducted at Agricultural College Farm, Bapatla, Andhra Pradesh during *rabi* of 2014-15. The soil of the experimental site was sandy clayloam in texture, slightly alkaline in reaction and low in organic carbon, available nitrogen and phosphorus and high in available potassium. The experiment was laid out in randomized block design with factorial concept with three replications and consisted of six dates of sowing frm 15th September to 1st December at fifteen days interval and two guar varieties viz. RGC-936 and RGC-1003. The inoculated seeds through *Rhizobium* culture were hand dibbled by adopting a spacing of 45 cm × 10 cm. The crop was supplied with recommended dose of fertilizer i.e. 20 kg N, 40 kg P_2O_5 and 40 kg K_2O ha^{-1} in the form of urea, single super phosfate and muriate of potash respectively. The mean maximum and mean minimum temperatures recorded during crop growth period were 31.1^{0}C and 20.0^{0}C respectively. A total rainfall of 387.3 mm was received in 15 rainy days during the crop growth period.

Results and Discussion

Growth parameters

Plant height was significantly influenced by dates of sowing at all stages of crop growth (Table 1). Sowing of guar on 15th November and 1st December produced higher plant height. In case of varieties, RGC-1003 produced the maximum plant height at all stages of crop growth. Taller plants with 15th November sowing might be due to optimum weather conditions prevailed

Table 1. Growth parameters of gum guar as influenced by sowing dates and varieties.

Treatments	Plant height (cm)			Number of branches $plant^{-1}$			Drymatter accumulation (kg ha^{-1})		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Dates of sowing									
Sep 15th	21.8	51.4	86.4	1.5	6.6	8.9	94	952	4756
Oct 1st	21.5	53.0	87.9	1.5	6.7	9.4	131	979	5397
Oct 15th	23.9	54.4	88.9	1.7	6.7	10.6	144	1046	5581
Nov 1st	24.4	55.6	92.4	1.7	7.0	11.1	267	1312	7011
Nov 15th	28.9	59.8	104.4	2.1	7.6	14.1	357	1384	7849
Dec 1st	27.0	57.5	102.9	2.0	7.4	12.6	331	1331	7352
SEm ±	0.84	1.9	3.29	0.09	0.25	0.36	6.9	40.6	213.6
CD (p = 0.05)	2.5	5.5	9.7	0.3	0.7	1.1	20	119	626
Varieties									
RGC-936	24.2	54.7	89.9	1.5	6.4	11.1	206	1081	5872
RGC-1003	25,2	55.9	97.7	2.0	7.6	11.2	235	1253	6777
SEm ±	0.48	1.08	1.90	0.05	0.14	0.21	4.0	23.5	123.3
CD (p= 0.5)	NS	NS	5.6	0.1	0.4	NS	12	69	362
Interaction (D × V)									
SEm ±	1.18	2.63	4.66	0.12	0.35	0.51	9.6	57.4	302
CD (p = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Plant stand and yield of guar as Influenced by sowing dates and varieties.

Treatments	Initial plant population (m^{-1})	Final plant population (m^{-2})	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index (%)
Dates of sowing					
Sep 15th	20.3	20	721	3029	19.3
Oct 1st	20.7	20.5	848	3292	20.5
Oct 15th	21	20.7	1079	3580	23.2
Nov 1st	21.3	21.3	1353	3708	26.9
Nov 15th	22	22	1568	3929	28.4
Dec 1st	22	22	1491	3740	28.4
SEm ±	0.23	0.26	46	139	0.9
CD (p = 0.05)	0.7	0.8	135	408	2.6
Varieties					
BGC-936	21.2	21	1071	3263	24.4
BGC-1003	21.3	21.2	1283	3829	24.6
SEm ±	0.14	0.13	26.5	80.2	0.52
CD (p = 0.05)	NS	NS	78	235	NS
Interaction					
SEm ±	0.33	0.36	65	197	1.28
CD (p = 0.05)	NS	NS	150	NS	NS

during its crop growth period, which might have favored rapid cell division and multiplication resulting in elongation of plants. These results are in complete agreement with the work done by Buttar and Kaur [2].

The maximum number of branches per plant was recorded with November 15th sowing and was on a par with December 1st sowing at 30 and 60 DAS. In case of varieties, higher number of branches per plant was recorded with the variety RGC-1003, which was significantly superior to RGC-936 at all growth stages. The maximum number of branches per plant obtained with late sowing might be due to the fact that the crop experienced longer period of vegetative stage coupled with favorable weather conditions like optimum temperature, light, during crop growing period. Higher number of branches per plant recorded with the variety RGC-1003 might be due to genetic character. Similar findings were also observed by Virendar et al. [3] in clusterbean.

Date of sowing had a significant influence on drymatter accumulation at all stages of crop growth. Drymatter accumulation at November 15th sowing was significantly superior to that of all the other sowing dates and it was on a par with December 1st sowing at 60 DAS and harvest. Significantly higher drymatter was recorded with the variety RGC-1003 at all stages of crop growth. A significant increase in drymatter accumulation was observed due to delay sowings at all the stages of crop growth. This might be due to the increased growing degree days (GDDs) experienced by late sown crop when compared to early sowings. Longer the day length during vegetative phase, greater is the drymatter accumulation. In addition, more plant height coupled with increased number of branches $plant^{-1}$ produced with late sowing might have also contributed in higher drymatter accumulation. Similar results of obtaining the maximum drymatter accumulation with November 15th sowing was also reported by Hiremath and Patel [4] in dhaincha. Higher drymatter accumulation recorded with variety RGC-1003 at all the stages of crop growth could be attributed to the cumulative effect of more number of branches, genetic characters and optimum weather conditions prevalied. Similar findings was also observed by Meena et al. [5] in clusterbean.

Initial and final plant population

Table 3. Economics of gum guar as influenced by sowing dates and varieties. D_1 : Sep 15th D_2 :Oct 1st D_3 : Oct 15th D_4: Nov 1st D_5 : Nov 15th D_6 : Dec 1st V_1 : RGC-936, V_2: RGC-1003.

Treatments	Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	Returns per rupee investment
D_1V_1	34,050	22,490	11,560	0.51
D_1V_2	38,050	22,490	15,560	0.69
D_2V_1	39,850	23,077	16,773	0.73
D_2V_2	45,000	23,077	21,923	0.95
D_3V_1	49,400	22,886	26,514	1.16
D_3V_2	58,500	22,886	35,614	1.56
D_4V_1	64,800	22,196	42,604	1.92
D_4V_2	70,500	22,196	48,304	2.18
D_5V_1	67,250	20,976	46,274	2.21
D_5V_2	89.600	20,976	68,624	3.27
D_6V_1	65,950	20,776	45,174	2.17
D_6V_2	83,200	20,776	62,424	3.00

The data reveal that the maximum number of 22 plants m^{-2} was obtained with 15th November sowing which was on a par with 1st November and with 1st December sowing (Table 2). Lowest plant population (20 plants m^{-2}) was recorded with 15th September sowing as the crop suffered inundation due to heavy rains. Optimum plant population with delay in sowing might be due to congenial weather conditions prevailed.

Yield

The maximum grain yield (1568 kg ha^{-1}) was recorded with 15th November sowing which was on a par with 1st December sowing (1491 kg ha^{-1}). There was a significant increase of 54% grain yield with delay in sowing over 15th September sowing (721 kg ha^{-1}). Between varieties, the highest grain yield was recorded with RGC-1003 which was significantly superior to RGC-936. The interaction between dates of sowing and varieties was significant for grain yield. Highest grain yield (1792 kg ha^{-1}) was recorded with 15th November sown RGC-1003 which was on a par with 1st December sowing with same variety (1664 kg ha^{-1}). The improvement in the growth characters will show direct impact on yield components, which in turn, decide the grain yield. Late sowing of gum guar in mid-November recorded significantly higher grain yield when compared to early sowing which might be due to increase in growth and yield as well as favorable weather conditions that prevailed during grain filling and maturity stages of the crop growth. The present results are also in accondance with [6] who reported reduction in grain yield due to early sowing. Highest grain yield was recorded with RGC-1003 which was significantly superior to that of RGC-936. The better performance of cultivar RGC-1003 over RGC-936 might be due to higher number of pods per plant, number of seeds per pod and test weight. These results are in accordance with those reported by Kumar and Rodge [7] and Lakshmi [8] who reported an increase in grain yield was due to different varieties obtained in their research trials. The increase in grain yield due to cultivar RGC-1003 over RGC-936 was 17%.

The highest haulm yield was obtained with gum guar sown on 15th November followed by 1st December, 1st November and 15th October, However, 15th October sowing was on a par with 1st October and proved significantly superior to remaining dates of sowing in respect of haulm yield. There was a gradual increase in haulm yield with delayed sowing from 15th September to 15th November. Significant difference was observed between varieties. Highest haulm yield was recorded with variety RGC-1003 which was significantly superior to RGC-936. The percent increase due to November 15th, December 1st and November 1st sowing over September 15th was 22.9, 19.0 and 18.3% respectively. Similarly the cultivar RGC-1003 recorded 14.8% increase over the cultivar RGC-936. Haulm yield also showed similar trend as that of grain yield. Higher haulm yield recorded with late sown gum guar was significantly superior to early sowing. Higher haulm yield recorded with RGC-1003 might be due to cumulative effect of taller plants and more drymatter production. These results are in concurrence with the findings of Buttar and Kaur [2].

Harvest index

The highest harvest index (28.4%) was recorded with November 15th and 1st December sowings which were on a par with that of 1st November (26.9%) sowings. There was a significant increase in harvest index with delay in each sowing from 15th September to 1st December with 19.3 to 28.4% respectively. Harvest index of gum guar was higher with late sowing as com-

pared to early sowing. This might be due to comparatively more grain yield with late sowing. Present findings are in conformity with those of Lakshmi [8].

Economics

The data economics of gum guar revealed that guar sown on 15th November and 1st December with RGC-1003 variety recorded the maximum gross returns, net returns and returns per rupee investment over the rest of the sowing dates (Table 3). Similarly, the maximum grain yield recorded with late sowings resulted in more net income and returns per rupce investment. Similar results were also reported by Deshmukh et al. [9] and Singh et al. [10].

From the above results it can be concluded that, late sown gum gure during second fortnight of November with RGC-1003 variety was found optimum for getting higher grain yield and economic returns under Bapatla conditions.

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