

Short Communication

Thermal requirements, heat use efficiency and plant responses of gum guar (*Cyamopsistetragonoloba*L.) cultivars under different environment

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Clusterbean, commonly known as guar, is an important leguminous crop of arid and semi-arid regions. The qualities of the crop like high adaptation towards erratic rainfall, multiple industrial uses and its importance in cropping system for factors such as soil enrichment, low input requirement, etc. have made as guar one of the most significant crops for farmers in recent times. Guar seeds possessing galactomannan gum in its endosperm, which constitutes 19 to 43 per cent of the whole seed. The unique binding, thickening and emulsifying quality of guar gum powder obtained from guar seed has made it a much sought after product in international market.

Optimum sowing time and selection of important cultivars play a remarkable role in exploiting the yield potential of the crop under particular agro-climatic conditions. The guar genotypes interacted significantly with the environment in enhancing yield (Henry and Kackar, 2001). Sowing date has been proved to be one of the most non-monetary inputs affecting the yield of clusterbean. Sub-optimal thermal requirement during crop growing season are known to have profound effect on crop productivity. The optimum sowing time is important to exploit the environmental conditions during growth of clusterbean for maximum production. Early sowing causes early maturity resulted in drastic reduction in yield depending on cultivar, sowing time, location and climatic conditions during sowing season. The productivity of clusterbean fluctuates as it responds differently due to their variation in the thermal requirements of given cultivars in particular climatic conditions Khichar *et al.* (2012) and Lakshmi kalyani (2012). Keeping above facts in view, the present investigation was under taken.

The field experiment was conducted at Agricultural College Farm, Bapatla (Lat. 15° 55' N long. 80° 30' E and altitude 4.29 m amsl), Andhra Pradesh, India during *rabi*, 2014-15. The soil of the experimental site was classified as sandy clay loam in texture, slightly alkaline in reaction and low in organic carbon, available nitrogen and phosphorus

and high in available potassium. The mean maximum and mean minimum temperatures recorded during crop growth period were 31.1°C and 19.9°C, respectively. The weather parameters during experiment were recorded at the meteorological observatory of IMD located at the College Farm, Bapatla.

The experiment was conducted in randomized block design with factorial concept with three replications and consisted of six dates of sowing from 15th September to 1st December at fifteen days interval as the first factor and two guar cultivars viz. RGC-936 and RGC-1003 as second factor. The cumulative thermal units (°C) at various phenological stages were determined by summing the daily mean temperature above the base temperature ($T_b = 10^\circ\text{C}$) by using the formula as per (Iwata, 1984). Heat use efficiency (HUE), which is measured of amount of dry matter production per unit of thermal units, was worked as per procedures reported by Haider *et al.* (2003).

Total dry matter accumulation (kg ha^{-1}) varied significantly due to different growing environments at all phenophases (Table 1). Dry matter 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. In case of varieties highest dry matter was recorded with variety RGC-1003, which was significantly superior to RGC-936 at all growth stages.

The November 15th sown crop took longer duration for maturity (112 days) than the early sown crop in both the cultivars. November 15th sown crop recorded the highest 1584 thermal units followed by 1565 with 1st December at harvest. With regards to Varieties, RGC-1003 recorded the mean highest thermal units of 1551 followed by RGC-936 (1480). The highest thermal units accumulated with late sowing compared to early sowing might be due to longer crop duration compared to shorter crop duration with early sowing. Between varieties, RGC-1003 accumulated the highest thermal units which might be due to its higher crop growth days compared to RGC-936.

Table 1: Total dry matter accumulation (kg ha⁻¹), thermal units (°C) and heat use efficiency (kg ha⁻¹°C day) of gum guar as affected by various treatments

Treatments	Dry matter accumulation (kg ha ⁻¹)			Thermal units			Heat use efficiency (kg ha ⁻¹ °C day)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Sowing dates									
Sep. 15 th	94	952	4756	455	895	1429(97)	0.21	1.06	3.33
Oct. 1 st	131	979	5397	458	928	1513(95)	0.29	1.05	3.57
Oct. 15 th	144	1047	558	502	953	1475(101)	0.29	1.10	3.78
Nov. 1 st	267	1312	7011	468	855	1529(106)	0.57	1.53	4.59
Nov. 15 th	357	1384	7849	451	868	1584(112)	0.79	1.59	4.96
Dec. 1 st	331	1331	7352	417	828	1565(108)	0.79	1.61	4.70
SEm±	6.8	40.6	213.6						
CD(P=0.05)	20.1	119.2	626						
Varieties									
RGC-936	206	1081	5872	475	905	1480(101)	0.43	1.19	3.97
RGC-1003	235	1253	6777	475	905	1551(105)	0.49	1.38	4.37
SEm±	3.9	23.5	123.2						
CD(P=0.05)	12	69	362						

Figure in parenthesis are days to maturity

The highest HUE for dry matter was recorded with 15th November followed by 1st December sowing for both varieties. However, 60 DAS December 1st sown crop exhibited higher values of HUE followed by November 15th sowing. At maturity, HUE was recorded the maximum for November 15th (4.96 kg ha⁻¹°C⁻¹ d⁻¹) and the minimum in December 1st (3.33 kg ha⁻¹°C⁻¹ d⁻¹) sown crop. Varietal difference was also found significant at all phenophases of crop growth. Cultivar RGC-1003 recorded higher HUE compared to RGC-936 which might be due to comparatively higher dry matter accumulation. Similar results were also reported by (Jagtape *et al.*, 2011 and Kumar and Rodge, 2012).

Sowing of gum guar during second fortnight of November exhibited significantly higher dry matter due to fulfill of optimum thermal requirements for various plant processes. The thermal unit requirements of gum guar cultivars decreased with early in sowings.

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