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Research Article

ASSESSMENT OF OPTIMAL SOWING TIME BASED ON HEAT INDICES AND ROW SPACING FOR SUMMER GUAR (*CYAMOPSIS TETRAGONOLOBA* [L.] TAUB.)

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ABSTRACT

A field experiment was conducted during summer seasons of 2013–2015 on clayey soil of Junagadh (Gujarat) to ascertain proper time of sowing (4th week of January, 2nd week of February, and 4th week of February) and spacing (30 cm×15 cm, 45 cm×15 cm, and 60 cm×15 cm) in relation to growth and yield of guar (*Cyamopsis tetragonoloba* [L.] Taub.). The results revealed that sowing in the 2nd week of February enhanced growth and yield attributes, namely plant height, pods per plant, and test weight, and ultimately gave higher seed yield (1387 kg/ha) and stalk yield (2846 kg/ha) with higher growing degree days, heliothermal units, photothermal units, and heat use efficiency as well as higher net returns (`42,051/ha) and B: C ratio (2.29) over early (4th week of January) and late (4th week of February) sowing. The results further indicated that 45 cm×15 cm spacing promoted growth and yield attributes, namely plant height, branches per plant, pods per plant, and test weight compared to 30 cm×15 cm and 60 cm×15 cm, which reflected in higher seed yield (1272 kg/ha) and stalk yield (2680 kg/ha) along with higher net returns (`37,154/ha) and B: C ratio (2.03) over 30 cm×15 cm and 60 cm×15 cm spacing. Therefore, sowing in the 2nd week of February (when soil temperature >22.3°C at 5 cm and >23.9°C at 10 cm depth) and spacing of 45 cm×15 cm could be appropriate for maximizing yield and monetary returns from summer guar under south Saurashtra agro-climatic conditions of Gujarat.

Keywords: Summer guar, *Cyamopsis tetragonoloba,* Sowing time, Spacing, Broadcast, Heat indices.

INTRODUCTION

Guar (*Cyamopsis tetragonoloba* [L.] Taub.) is a multipurpose crop. Its green pods are used as vegetable, grains as pulse, and green plants as fodder and for soil manuring purpose. Since it is a leguminous crop, it also has soil enriching and erosion resisting properties. At present, it is grown more for mucilaginous gum production. Guar, a versatile crop with industrial uses and export potential, has transformed economic status of large number of farmers. Low input cost and high returns encourage farmers to cultivate drought tolerant legume guar seed.

Guar is photosensitive crop. It grows in specific climatic condition, which ensures a soil temperature around 25°C for proper germination, long photoperiod with humid air during its growth period, and finally short photoperiod with cool dry air at flowering and pod formation. Accordingly, it is definitely a *kharif* season crop, it also prefers warm climate and grows well in the subtropics during summer.

In arid region, it is grown as a *kharif* crop. However, in semi-arid regions of Saurashtra, occasional heavy rains and temporary waterlogged condition hinder its cultivation in *kharif* season. Moreover, due to low requirement of water, fertilizer and plant protection measure in summer season, a large number of farmers in Saurashtra region are turn toward growing guar as summer crop.

Among crop production factors, sowing time, and spacing contribute much to a proper crop stand establishment in the field. Patel *et al.* (2004) suggested sowing of summer guar ftom the 3rd week of February to the 1st week of March at 45 cm row spacing for higher yield and net returns. Under paucity of research on sowing time and spacing requirement for gum guar, in general, and for summer gum guar, in particular, the present experiment was carried out to ascertain proper sowing time and spacing for summer gum guar.

MATERIALS AND METHODS

A field experiment was carried out at the Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, during summer seasons of 2013–2015. The soil of the experimental plot was clayey in texture and slightly alkaline in reaction (pH 7.9 and EC 0.36 dS/m) as well as low in available nitrogen (262 kg/ha), available phosphorus (26 kg/ha), and high in available potash (325 kg/ha). During the crop period, the range of maximum temperature was 30.3–41.0, 28.1–41.1, and 29.4–42.3°C, average relative humidity was 26–63, 38–69, and 35–60%, and evaporation was 4.5–11.7, 5.1–11.0, and 4.8–11.9 mm/day, respectively, during 2013, 2014, and 2015. The experiment comprising three sowing time (4th week of January, 2nd week of February, and 4th week of February) and three spacing (30 cm×15 cm, 45 cm×15 cm, and 60 cm×15 cm) was laid out in split plot design with four replications. The gross plot size was 6.0 m×3.6 m, while net plot size for 30 cm×15 cm and 60 cm×15 cm spacing was 5.1 m×2.4 m, and for 45 cm×15 cm spacing, net plot size was 5.1 m×2.7 m. The guar variety "Gujarat Guar 2" was sown as per sowing time and spacing treatments using seed rate of 15–30 kg/ha and harvested in May–June during all the 3 years. The crop was fertilized with 20–40 kg N-P_2O_5/ha as basal dose in the form of diammonium phosphate and ammonium sulfate. For weed management, pendimethalin 0.9 kg/ha was applied as pre-emergence supplemented with intercultivation and hand weeding at 30 days after sowing. Irrigations each of 5 cm depth were given at 0.9 IW: CPE ratio. The average daily pan evaporation during the crop period was 8.6, 8.5, and 8.0 mm in 2013, 2014, and 2015, respectively. Various heat indices were worked out as follows:

Growing degree days (GDD) = $\sum T_{mean}$ - Tb

Where, T_{mean} = daily mean temperature, Tb = base temperature for summer guar taken as 14.6°C (Angus *et al*., 1981)

Heliothermal unit (HTU) = GDD × n

Where, n = daily actual bright sunshine hours.

Photothermal unit (PTU) = GDD × N

Table 4: Thermal requirement of guar under different sowing times

Year	Treatment	GDD (°C day)	HTU (°C day h)	PTU (°C day h)	HUE (kg/ha°C day)
2013	January 4th week	1337	13164	16337	0.573
	February 2nd week	1331	13275	16483	1.228
	February 4th week	1231	12354	15342	1.133
2014	January 4th week	1691	16289	21068	0.560
	February 2nd week	1704	16478	21451	0.774
	February 4th week	1578	15482	20055	0.685
2015	January 4th week	1339	12468	16517	0.643
	February 2nd week	1335	12588	16571	0.908
	February 4th week	1209	11484	15138	0.797
Mean	January 4th week	1456	13980	17975	0.592
	February 2nd week	1457	14114	18168	0.970
	February 4th week	1339	13107	16845	0.872

GDD: Growing degree days, HTU: Heliothermal unit, PTU: Photothermal unit, HUE: Heat use efficiency

spacing. Bhadoria and Chauhan (1994) and Siddaraju *et al.* (2010) also reported analogous results.

Interactions, namely sowing time x spacing, year x sowing time, year x spacing, and year x sowing time x spacing, were found to be non-significant in respect of growth, yield attributes, and yield throughout the results.

Correlation between soil temperature and crop yield

To establish a relationship of soil temperature at sowing under different dates of sowing (Table 2) with germination, seed yield, and stalk yield, the coefficient of correlation (r) was worked out (Table 3). The data indicated that germination percent, seed yield, and stalk yield showed positive and highly significant correlation with soil temperature at 5 and 10 cm depth. The data ultimately suggest that soil temperature of at least 22.3°C (at 5 cm depth) and 23.9°C (at 10 cm depth) seems to be necessary for satisfactory germination and subsequent growth and development of guar crop during summer season.

Heat indices

Various heat indices, namely GDD, HTU, PTU, and HUE, were worked out according to different sowing times (Table 4). The results indicated that the crop accumulated more GDD (1457°C day), HTU (14,114°C day h), and PTU (18,168°C day h) at the 2nd week of February sowing. The HUE in terms of economic yield was the highest (0.970 kg/ha°C day) in the 2nd week of February sowing followed by late sowing (4th week of February). It was the lowest (0.592 kg/ha°C day) in the early date of sowing. Thus, accumulated heat indices utilized by the crop were not constant. This is due to the fact that days required to maturity decreased with the advancement of growing season. This may be attributed to the increase of temperature during the later dates of sowing.

Economics

Sowing in the 2nd week of February gave maximum net returns of `42,051/ha with B: C ratio of 2.29, followed by sowing on the 4th week of February, which recorded net returns of ` 31,648/ha and B: C ratio of 1.73.

Sowing the crop at 45 cm×15 cm spacing accrued maximum net returns of ` 37,154/ha and B: C ratio of 2.03, followed by 30 cm×15 cm spacing by recording net returns of ` 32,341/ha and B: C ratio of 1.72. Patel *et al.* (2004) reported higher seed yield and B: C with sowing of guar in the 3rd week of February at 45 cm row spacing.

It was concluded that higher yield and net returns from summer guar could be achieved by sowing in the 2nd week of February at 45 cm×15 cm spacing under south Saurashtra agro-climatic conditions of Gujarat.

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