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‘TAMG 101’ and ‘TAMG 102’: New Organic Guar for the Southern United States

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Guar [*Cyamopsis tetragonoloba* (L.) Taub] is a diploid annual summer legume ($2n = 2x = 14$) that belongs to the family *Fabaceae* (Kumar and Rodge 2012). This legume is drought- and heat-tolerant and is adapted to water-constrained environment (Ravelombola et al. 2021). Guar is a multipurpose legume. Guar seeds are consumed as food and provide nutrients that are essential to human health, and guar immature pods are edible and consumed as vegetables (Ravelombola et al. 2021). Guar can also be used as summer forage or green manure increasing microbial biomass and activities (Rahina et al. 2020). Guar seeds contain galactomannan, which is known as guar gum (Chudzikowski 1971). This product has pharmaceutical applications and is used as food ingredients including ice cream, processed cheeses, and salad dressing, among others. (Morris 2010). Guar gum is also used as thickening agent that is essential in the oil hydraulic fracturing industry (Mudgil et al. 2014).

The United States is the world largest market of guar and imports more than $1 billion of guar products annually (Ravelombola et al. 2021). This provides an economic opportunity for US farmers. In addition, guar can enhance and sustain the rapidly growing organic agriculture in the southern United States (Ravelombola et al. 2021). Guar is a legume that can fix atmospheric nitrogen through symbiosis with soilborne rhizobia bacteria, thus increasing soil fertility (Morris 2010). The availability of organic guar is also essential because the demand for organic food products using guar ingredients has increased by at least 4 times in the past decade (Ravelombola et al. 2021). Organic ‘TAMG 101’ and ‘TAMG 102’ were developed to provide farmers with more options to diversify sources of organic legumes and specialty crops that are essential to the sustainability of organic farming system in the southern United States.

Origin

‘TAMG 101’ and ‘TAMG 102’ resulted from a selection of individual plants from ‘Kinman’, which is a variety released by Texas A&M AgriLife in 1976 (Stafford et al. 1976). Two single plants with exceptional pod set and higher lowest pod placement were noted from a ‘Kinman’ field, which might have resulted from natural mutations. These two plants were named ‘TAMG 101’ and ‘TAMG 102’, respectively. The seed increase of the selected lines was conducted for further field trials, and seeds were stored at the Texas A&M AgriLife Foundation Seed in Vernon, USA.

Description

Field trials of organic ‘TAMG 101’ and ‘TAMG 102’ were conducted on organic plots at the Texas A&M AgriLife—Vernon, TX, USA and on organic farmer collaborators’ plots in Lubbock, TX, USA. For both locations, the experiments were conducted over 3 years (2021–23) (Figs. 1 and 2). At each location, the study was organized in a randomized complete block design (RCBD) with four blocks. ‘Kinman’ was used as check. The experimental unit was defined as a four-row 10-m-long plot, with 1-m row spacing and ∼10 cm plant spacing within each row. Cattle manure was applied to field plots at a rate of 60 kg/ha 1 month before planting. Weeds were removed mechanically using a cultivator sweep. Data consisting of grain yield, 1000-seed weight, plant height, maturity, and seed protein were collected. Data were analyzed using the analysis of variance and run in JMP Genomics® 7 (SAS Institute, Inc., Cary, NC, USA). Mean separation analysis was conducted using Fisher’s protected least significant difference at $\alpha = 0.05$ and run in JMP Genomics 7 (SAS Institute, Inc.).

‘TAMG 101’ is a determinate, erect plant characterized by a strong main stem with some lateral branches. Its leaves are subhastate, large, and glabrous. The flowers are purple and have green sepals. Mature pods are golden and slightly curved. Seeds are kidney shaped, and their color varies from beige to brown (Fig. 1). ‘TAMG 102’ is semierect with multiple lateral branches. Leaves are small, subhastate, and glabrous. Mature pods are slightly curved and golden. Seed shape varies from oblong to kidney type and mature seeds are beige (Fig. 2).

Grain yield. Grain yield of organic ‘TAMG 101’ and ‘TAMG 102’ were significantly higher than the check in all locations and years (Supplemental Table 1). The average grain yield for ‘TAMG 101’, ‘TAMG 102’, and ‘Kinman’ were 2242.2 kg·ha^{-1}, 2076.9 kg·ha^{-1}, and 1432.1 kg·ha^{-1}, respectively. The highest grain yield was recorded for ‘TAMG 101’ (2795.2 kg·ha^{-1}) on the organic plot at Vernon in 2022 (Supplemental Table 1). The lowest yield was recorded for the check (1138.4 kg·ha^{-1}) on the organic plot at Lubbock in 2022 (Supplemental Table 1).

Fig. 1. Plants and seeds of organic ‘TAMG 101’.

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Fig. 2. Plant and seeds of organic 'TAMG 102'.

The results also indicated that the average yield of organic 'TAMG 101' and 'TAMG 102' were 56.6% and 45.1% higher than the check, respectively.

1000-seed weight. Data on 1000-seed weight can indicate seed size potential and is an important trait for the marketability of guar. The results showed that 1000-seed weight of organic 'TAMG 101' and 'TAMG 102' are not significantly different from that of 'Kinman' for all environments where these lines were tested. This indicates that these new organic guar varieties can compete with the commercial check in terms of seed size. The average 1000-seed weight for organic 'TAMG 101', 'TAMG 102', and 'Kinman' were 29.8, 29.6, and 29.8 g, respectively (Supplemental Table 1).

Plant height. The average plant height of organic 'TAMG 101', 'TAMG 102', and 'Kinman' were 45.8, 43.8, and 42.5 cm, respectively (Supplemental Table 1). A variation in plant height was found for these varieties for the Vernon location. For example, 'TAMG 101' (44.2 cm) was significantly taller than the check (40.1 cm) in 2021 for the Vernon location. However, plant height was not significantly different between the varieties for the Lubbock location.

Maturity. The average maturity of organic 'TAMG 101', 'TAMG 102', and 'Kinman' were 157, 157, and 155 d, respectively (Supplemental Table 1). These data indicate that the new varieties can be harvested as early as the check.

Seed protein content. A 20-g dry seed sample (~10% moisture) from each experimental unit was used for seed protein content evaluation. Guar seeds were ground using a Thomas-Wiley Laboratory Mill Model 4 grinder (Arthur H. Thomas Company, Philadelphia, PA, USA) to pass a 2-mm sieve. Ground samples were analyzed for nitrogen combustion to obtain total nitrogen content (N%). This analysis was conducted at the Texas A&M AgriLife Extension Service Soil, Water, and Forage Testing Laboratory in College Station, TX, USA. Total seed protein content was calculated using the following formula: Protein Content (%) = N% × 6.25 (Moore et al. 2010). The average total seed protein content of organic 'TAMG 101', 'TAMG 102', and 'Kinman' were 25.5%, 24.9%, and 23.0%, respectively (Supplemental Table 1). Overall, seed protein content of organic 'TAMG 101' and 'TAMG 102' was significantly higher than that of 'Kinman' (Supplemental Table 1). For example, seed protein content of 'TAMG 101' and 'TAMG 102' were 25.3% and 25.8% for the Lubbock location in 2021. However, the seed protein content of the check of 22.4% for the similar location and year.

Availability

Seed request or prospective licensees request should be addressed to Dr. Richard Vierling (Email: Richard.Vierling@ag.tamu.edu).

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