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Description of cultivar

Tom 3: variety of sweet sorghum for the production of high quality forage in Durango

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Abstract

Sorghum varieties and seed are required to supply the demand for high-quality forage in Durango. The objective was to develop a variety of sorghum adapted to irrigated and rainfed conditions to produce high-quality forage. The variety Tom 3 (OM-1 m-2 m-3 u) was generated by mass selection from the population collected in Otilio Montaño, San Juan del Río, Durango. This variety exceeded the state average yield (32.7 t ha^{-1}), with an average fresh forage yield of 55 t ha^{-1}. The Tom 3 variety, compared to Mercedes (control), had more days to the emergence of the panicle (93 *vs* 81 days after sowing: DAS), height at cut maturity (297 *vs* 256 cm) and very low weight of 1000 seeds (12.8 g *vs* 17.4 g). Tom 3 is recommended for the production of forage (fresh and silage) and bioethanol. The caryopsis is orange in color and shows a very long grain surface covered by the glume. Tom 3 is resistant to ergot (*Claviceps* spp.) and susceptible to lodging (70%) in some cases. Tom 3 is in the process of being validated to establish its adaptability and potential to increase the yield and quality of forage produced in Mexico.

Palabras clave:

Sorghum bicolor, adaptation, attributes, productivity.

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Sorghum cultivation for forage production is an important economic activity in Durango, where the area sown in 2022 was 32 418 ha, with a production of 876 416 t of fresh forage and an average yield of 30 360 kg ha^{-1} (SIAP, 2023). In this state, sweet sorghum varieties are preferred due to low seed cost, local adaptation, and energy-rich forage production.

Farmers have increased the area dedicated to the cultivation of sweet sorghum because they consider it an important productive option, which allowed them to increase the availability and quality of the forage used to feed cattle during the dry season of the year (Jiménez and Rosales, 2014; Domínguez *et al*., 2016). In Durango, the need for sorghum varieties adapted to local production systems has been established in order to avoid the use of expensive commercial hybrids susceptible to ergot.

The sweet sorghum variety Tom 3 was developed, which is in the process of technology transfer to determine its possibilities of adoption in Durango (Jiménez and Rosales, 2014). This is expected to contribute to the supply of forage demand, reduce feeding costs and increase livestock weight gains and economic benefits for agricultural producers.

Origin and selection

The Tom 3 variety was developed by the mass selection method, carried out on the original population collected in Otilio Montaño, Durango. The objective was to select improved sorghum lines that showed broad adaptation, disease resistance, and high forage production. The original population was selected because it showed robust stems and medium height, which was intended to reduce lodging problems.

In the development of Tom 3, outstanding plants were identified in the original heterogeneous population, and then a new population was formed by mass harvesting of panicles among the selected individuals. The selection criteria were: ergot resistance, plant height, panicle morphology, plant robustness, yield, and nutritional quality of the forage.

The original population (OM) was collected in 2008, among individuals varying in plant height, stem thickness, leaf width, panicle morphology and grain color. In 2009, the seed obtained from the original population (OM) was sown in order to multiply it and at the same time, develop mass selection by harvesting a panicle in the plants outstanding for the traits of interest (OM-1m).

In 2010, the population was sown in Durango, Durango, to compare it with commercial hybrids susceptible to ergot. Robust plants, free of ergot symptoms, with high vigor and large panicle were selected to form the select population (OM-1 m-2 m). The seed of the population formed in 2010 was sown in 2011 in Durango, Durango, to carry out mass selection through the harvesting of panicles in robust plants, outstanding for their resistance to diseases and high forage yield.

After selection in two cultivation cycles, uniformity was observed in the population OM-1 m-2 m-3 u, so it was used to start its morpho-agronomic characterization (UPOV, 2015) and it was named Tom 3. In 2013, a commercial lot was sown with Tom 3 at two sites in Durango to carry out the second cycle of morpho-agronomic characterization, increase seed and evaluate the yield of fresh forage.

In 2014, commercial lots were established to validate the forage yield of the Tom 3 variety at four sites in Durango (Colonia Hidalgo, Durango, La Soledad, and La Goma) (Domínguez *et al*., 2016). Between 2013 and 2014, the registration of the sweet sorghum variety Tom 3 was initiated with the National Seed Inspection and Certification Service (SNICS, for its acronym in Spanish), an institution that granted the registration number SOG-256-181114 (SNICS, 2019).

Varietal description

The Tom 3 variety showed panicle emergence 93 days after sowing (DAS), plant height of 252 cm and 105 to 119 days to fresh forage cut. The stigmas are very long, the height of the plant at the cut is 297 cm, the length of the panicle without neck is medium (29.7 cm) and the primary branches of the panicle are long. The caryopsis is orange, with yellow coloration of the vitreous portion of the endosperm, is very small and has medium tannin content.

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The variety Tom 3 (OM-1 m-2 m-3 u) was validated in irrigated environments to establish its level of productivity and forage quality. Tom 3 showed intermediate-late cycle, which limited its escape to the negative effects of low temperatures (frost). It showed tolerance to natural ergot infestation, which is the most important pathogen in Durango and drastically affects commercial hybrids.

Yield

The Tom 3 variety showed high yields in irrigated conditions and different localities in Durango between 2010 and 2014 (Jiménez and Rosales, 2014; Domínguez *et al*., 2016). The average yield of fresh forage was 55 t ha^{-1} (Table 1), fluctuating between 35.8 t ha^{-1} and 89.9 t ha^{-1} . In most of the sites, Tom 3 outperformed the Mercedes variety (control), except for La Colonia Hidalgo where the control showed higher yields (Table 1). The mean value for forage dry weight was higher in Tom 3 (9 t ha^{-1}) compared to the Mercedes variety (6.9 t ha^{-1}).

Table 1. Yield of fresh (FF) and dry forage (DF) in two sorghum varieties evaluated in various environments in Durango.

Locality	Year	FF yield (t ha^{-1})		DF yield (t ha^{-1})	
		Tom 3	Mercedes	Tom 3	Mercedes
Colonia Hidalgo	2014	35.8 a	37.5 a	5.8 a	6.1 a
Durango	2014	89.9 a	57.5 b	14.7 a	9.4 b
La Soledad	2014	53.3 a	36.5 b	8.7 a	6 b
La Goma	2014	40.9 a	36.8	6.7 a	6 a
Average		55	42.1	9	6.9
CV (%)		15.4		15.4	
$LSD_{0.05}$		4.8		0.8	

Different literals in the same row represent significant differences (Tukey; $p< 0.01$) between varieties. CV (%)= coefficient of variation (Nava *et al*., 2017).

The results show that Tom 3 achieved acceptable yields across cultivation environments, compared to the Lico and Mercedes varieties (Figure 1). In addition, it showed high potential for forage production in high productivity environments, Durango, Durango, 2013, in which yields of up to 180.5 t ha^{-1} were recorded.

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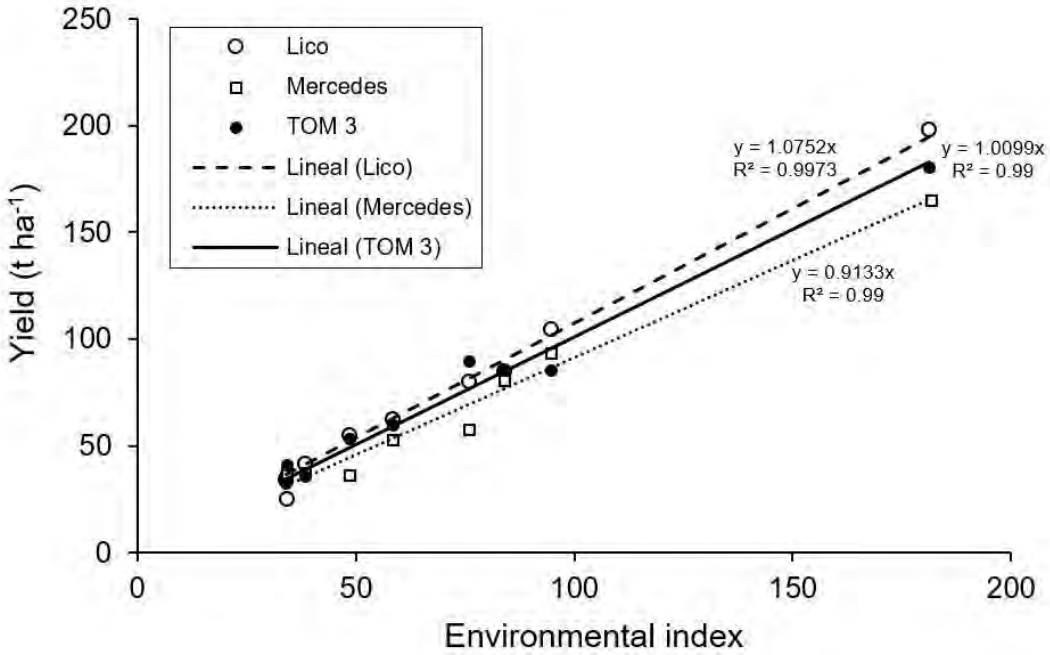
Figure 1. Response of three varieties of sweet sorghum for the production of fresh forage in several environments in the state of Durango.



It was possible to detect genetic progress for yield and tolerance to diseases through mass selection carried out in sweet sorghum populations collected in Durango. Yield gene expression was higher in late-cycle varieties, such as Tom 3, especially in irrigation and frost-free crop cycles.

The morpho-agronomic description of the Tom 3 variety was updated in 2022 and received the breeder's title 3153 in June 2023. Once recognized as a commercial variety, it can be sown in Durango and other states with similar climates. It adapts to soils with different textures, preferably well-drained and with a pH of 6.5 to 7.5. It is recommended to grow it under irrigated conditions and with an average annual temperature of 17 to 26 °C, with minimum levels of 13 °C.

In the Valle del Guadiana Experimental Field of INIFAP, located in Durango, Durango, there is original Tom 3 seed, which can be used in the production of basic seed to offer it to grain and seed producing companies, as well as to producer associations interested in producing certified and registered seed.

Conclusions

The Tom 3 variety showed possibilities for commercial use in commercial sowing of sweet sorghum in Durango, based on its agronomic response and high forage yield under irrigated conditions. The technology transfer process will be strengthened to establish the possibilities for adoption of this variety by agricultural producers and traders. It was considered that this type of variety will diversify the production of forage in Durango and at the same time, will contribute to the reduction of the deficit of feed for cattle.

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