

## Mercedes: a sorghum variety for the production of high-quality forage in Durango, Mexico

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### Abstract

Agricultural production constantly requires low-priced sorghum seed to reduce costs in forage production. The objective was to develop a sorghum variety adapted to irrigation and rainfed conditions to produce high-quality forage. The Mercedes variety (LAM-1m-2m-3u) was developed by mass selection from a heterogeneous population collected in Las Mercedes, Durango. This variety exceeded the state average yield ( $32.7 \text{ t ha}^{-1}$ ), with an average production of fresh forage under irrigation of  $42.1 \text{ t ha}^{-1}$ . The Mercedes variety, compared to TOM 3, showed fewer days to the emergence of the panicle (81 vs 93 days after sowing: DAS), cut height (256 vs 297 cm), and greater grain weight (17.4 g/1 000 seeds vs 12.8 g/1000 seeds). Mercedes is mainly recommended for producing forage (fresh and silage). The caryopsis is red-orange and shows a long grain surface covered by the glume. Mercedes showed resistance to ergot (*Claviceps* spp.) and tolerance to lodging. The process of technological transfer of the Mercedes variety is advanced, and the values of yield and quality of forage were corroborated.

### Keywords:

Sorghum bicolor, adaptability, rated seed, yield.

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The area cultivated with sorghum for forage has increased considerably in Durango. In 2022, the area sown was 32 418 ha, with a total production of 876 417 t of fresh forage and an average yield of 30 360 kg ha<sup>-1</sup> (SIAP, 2023). Producers require sorghum varieties of high quality and low price compared to commercial hybrids (Montes *et al.*, 2010) to decrease production costs. Sorghum provides silage that is used to feed cattle during the year's dry season (Domínguez *et al.*, 2016). Although care must be taken with sorghum forage to avoid excessive generation of effluents.

Sorghum improvement programs have developed varieties that meet the required quality and productivity. With this, progress is made towards the constant availability of forage to meet the nutritional needs of cattle and ensure the availability of dairy and meat products. Sorghum is tolerant to water stress (drought), soils with low fertility, high incidence of diseases and pests, and low use of inputs (fertilizers). It is advisable to expand the area cultivated with sweet sorghum under irrigation conditions and use other technological options to increase the yield and nutritional quality of the forage.

Three varieties of sweet sorghum (Lico, Mercedes, and TOM 3) were developed in the Valle del Guadiana Experimental Field, and these have gone through the process of validation and technology transfer to determine their possibilities of adoption in Durango. The use of the Mercedes variety represents a source of forage available in just over 100 days after sowing.

## Origin and selection

The Mercedes sorghum variety originated from the mass selection carried out in a population collected in the locality of Las Mercedes, municipality of Cuencamé, Durango. The objective of the process was to select sorghum lines capable of adapting to rainfed conditions, with disease resistance (ergot: *Claviceps* spp. and anthracnose: *Colletotrichum graminicola*) and high forage yield. In the development of Mercedes, the method of genetic improvement of mass selection was used, which includes obtaining outstanding plants in a heterogeneous population to then form a new population through the mass harvest of the selected individuals.

The selection criteria were disease resistance, plant height, panicle morphology, and plant robustness, then forage yield and nutritional quality were included. The original population was collected in 2008 with individuals varying in plant height, stem thickness, panicle morphology, and grain color. In 2009, the seed obtained from the original sweet sorghum (LAM) population was sown to multiply it and develop the process of mass selection by harvesting a panicle in the plants outstanding for the characters of interest.

During 2010, the population selected in 2009 (LAM-1 m) in Durango, Durango, was sown in lots paired with commercial hybrids susceptible to ergot. The above in order to perform mass selection based on the plant's vigor, disease resistance, and large panicle size (LAM-1 m-2 m). Robust plants, free of the symptoms of ergot and with high vigor were selected to increase the possibilities of generating lines with high forage production in relation to the state yield, which fluctuated between 23.3 and 37.2 t ha<sup>-1</sup> in the period 2013-2022 (SIAP, 2023).

The seed from selected panicles and plants was harvested in mass form and sown again in 2011 in Durango, Durango, to carry out the second cycle of mass selection in the population formed in 2010 (LAM-1 m-2m). Alternate strips of commercial hybrids highly susceptible to ergot were included, and panicles from robust, disease-resistant, and high-forage-yielding plants were harvested.

After the selection in two sowing cycles, uniformity could be observed in the population coded as LAM-1 m-2 m-3 u, so it was used to perform the morpho-agronomic characterization of the variety (UPOV, 2015) and at the same time, the commercial name of Mercedes was assigned. In 2013, a commercial lot was sown with the Mercedes sorghum variety in two sites in Durango in order to carry out the second cycle of morpho-agronomic characterization, increase seed, and evaluate the yield of fresh forage.

In 2014, commercial lots of one hectare were established to validate the Mercedes variety and determine forage yield at four sites in the state of Durango (Domínguez *et al.*, 2016). Between

2013 and 2022, the process of registration of the Mercedes variety before the SNICS (National Seed Inspection and Certification Service) began, which granted it the definitive registration number SOG-258-181114 (SNICS, 2019). In 2022, the varietal description was updated, and in June 2023, the Mercedes sorghum variety received the breeder's title 3152 and was recognized as intellectual property in the name of INIFAP.

## Varietal description

The Mercedes variety begins with the emergence of the panicle at 81 days after sowing (DAS), with a plant height of 207 cm. Harvest is carried out 97 to 110 DAS when the plant has an average height of 256 cm. The stigmas of the panicles are long, the length of the panicle without neck is medium (24.6 cm), and the branches in the middle third of the panicle have a medium length (8.5 cm). The caryopsis is red-orange after threshing, with violet coloration of vitreous albumin and the grain weights  $17.4 \text{ g } 1\ 000 \text{ seeds}^{-1}$ , with a very high content of tannins.

Mercedes has been validated under irrigation conditions to establish its level of adaptation and forage quality (Nava *et al.*, 2017) in environments with high productivity. It showed tolerance to natural ergot infestation and early cycle (97 to 110 DAS), which allowed it to escape the negative effects of water stress and low temperatures.

## Yield

The Mercedes variety showed a high yield in most of the plots that were established under irrigation conditions between 2010 and 2014 (Domínguez *et al.*, 2016). The average yield of fresh forage was  $42.1 \text{ t ha}^{-1}$  (Table 1), ranging from  $36.5 \text{ t ha}^{-1}$  to  $57.5 \text{ t ha}^{-1}$ .

**Table 1. Fresh and dry forage yield in two sorghum varieties evaluated in different production environments in Durango.**

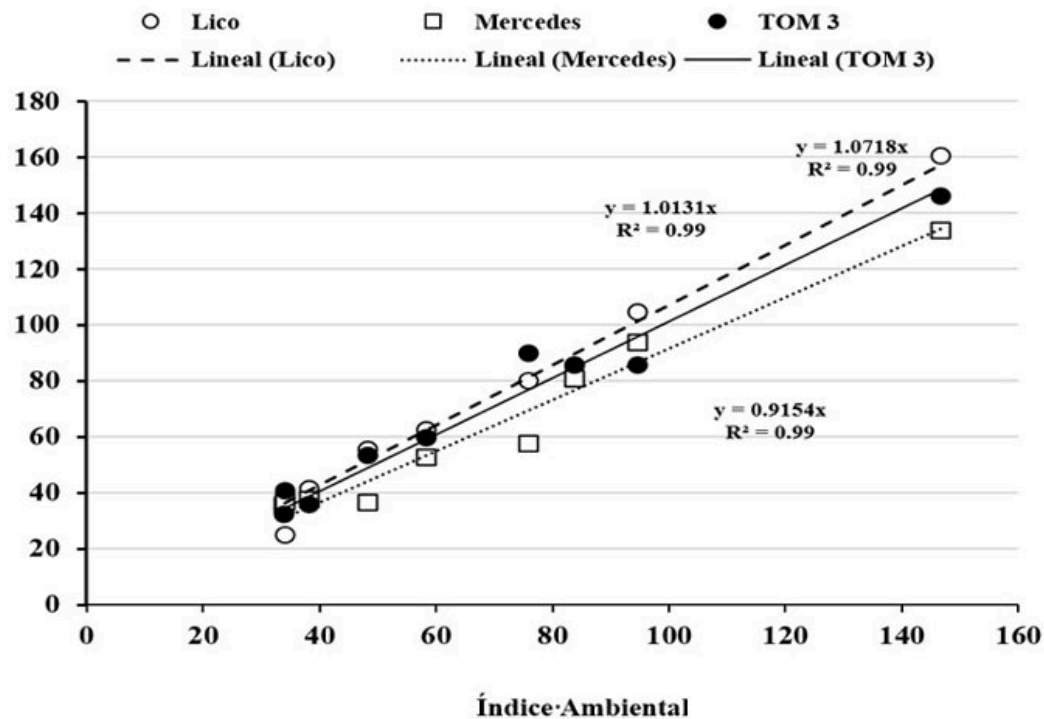
Locality	Year	Yield FF ( $\text{t ha}^{-1}$ )		Yield DF ( $\text{t ha}^{-1}$ )	
		TOM 3	Mercedes	TOM 3	Mercedes
Colonia Hidalgo	2014	35.8	37.5	5.8	6.1
Durango, Durango	2014	89.9	57.5	14.7	9.4
La Soledad, Durango	2014	53.3	36.5	8.7	6
La Goma, Durango	2014	40.9	36.8	6.7	6
Average		55	42.1	9	6.9

FF= fresh forage and DF= dry forage.

In most sites, Mercedes was surpassed by TOM 3, used as a reference; nevertheless, in La Colonia Hidalgo, the Mercedes variety showed the highest yield under water stress conditions at the end of the crop cycle, compared to intermediate and late cycle materials (Table 1). The mean value for forage dry weight was higher in TOM 3 ( $9 \text{ t ha}^{-1}$ ) compared to the Mercedes variety ( $6.9 \text{ t ha}^{-1}$ ).

The results show that Mercedes achieved acceptable yield among cultivation environments compared to other varieties such as Lico and TOM 3 (Figure 1). In favorable environments (Durango, Durango, 2013), up to  $133.6 \text{ t ha}^{-1}$  can be obtained, while in unfavorable sites (F. I. Madero, Durango, 2012), it is possible to harvest up to  $35.4 \text{ t ha}^{-1}$ .

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



Mercedes sorghum was recognized as a commercial variety and can be sown in Durango and other states with similar climates. It adapts to well-drained soils, different textures, and pH between 6 and 7.8. For best results, Mercedes should be sown under irrigation conditions when the minimum temperature reaches 13 °C.

## Conclusions

The Mercedes variety has potential for use in commercial sorghum sowings in Durango, where it shows an acceptable agronomic response and high fresh forage yield under irrigated conditions. With this variety, it is possible to obtain from 6 to 9 t of dry matter ha<sup>-1</sup> at 97 to 110 days after sowing. To maximize the yield, it is recommended to apply irrigation, sow in periods where the temperature ranges from 13 to 28 °C, accumulated rain during the cycle (> 450 mm), use fertilization (120-60-00; N-P2O5-K2O), and timely control of pest insects.

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## Bibliography

- 1 Domínguez, M. P. A.; Jiménez, O. R.; Rosales, S. R.; Galindo, V. C. F. y Santana, E. S. 2016. Estabilidad del rendimiento forrajero de tres variedades de sorgo dulce. AGROFAZ. 16(2):27-33.

- 2 Montes, G. N.; Williams, A. H.; Arcos, C. G.; Medina, G. S.; Palacios, V. O.; Moreno, G. T.; Cisneros, L. M. E. y Pecina, Q. V. 2010. RB Paloma: variedad de sorgo *Sorghum bicolor* (L.) Moench de grano blanco para riego y buen temporal. INIFAP-CIRNE-Campo Experimental Río Bravo. Río Bravo, Tamaulipas, México. 1 p.
- 3 Nava, B. C. A.; Rosales, S. R.; Jiménez, O. R.; Carrete, C. F. O.; Domínguez, M. P. A. y Murillo, O. M. 2017. Rendimiento y valor nutricional de tres variedades de sorgo dulce cultivadas en cuatro ambientes de Durango. Rev. Mex. Cienc. Pec. 8(2):147-155.
- 4 SIAP. 2023. Servicio de Información Agroalimentaria y Pesquera. Anuario estadístico de la producción agrícola. <https://nube.siap.gob.mx/cierreagricola/>.
- 5 SNICS. 2019. Servicio Nacional de Inspección y Certificación de Semillas. Catálogo nacional de variedades vegetales Núm. 16. SNICS-SADER. Coyoacán, Ciudad de México. 107 p.
- 6 UPOV. 2015. Unión Internacional para la Protección de las Obtenciones Vegetales. Directrices para la ejecución del examen de la distinción, la homogeneidad y la estabilidad. Sorgo. Ginebra, Suiza. 35 p.



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