Description of cultivar

VCS-Diamante: cultivar of white sorghum for the state of Sinaloa

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Abstract

The new VCS Diamante sorghum variety was developed in the Valley of Culiacan Experimental Field (CEVACU) of INIFAP and registered with the number SOG-282-231117 and breeder's title number 1892, in the National Catalog of Plant Varieties (CNVV) of the SINCS from Mexico. This variety is adapted to sorghum-producing areas for the state of Sinaloa. VCS Diamante is a variety of intermediate vegetative cycle, cream or amber, is recommended for irrigation and temporary conditions. The average yield of the variety is 3 310 kg ha^{-1} of grain and 27 105 kg ha^{-1} of green forage, superior on average 15.4 and 25.47% respectively, to the performance of commercial hybrids, which are grown in the region under the same conditions in temporary. VCS-Diamante has, like commercial hybrids, acceptable bromatological quality in forage, with 6.21% protein and 78.66% digestibility. It is tolerant to diseases that occur in the region, such as: ergot (*Claviceps africana*), anthracnose (*Colletotrichum graminicola*), blight of the panicle (*Fusarium moniliforme*) and carbonaceous rot of the stem (*Macrophomina phaseolina*), it has tolerance to the yellow aphid sorghum (*Melanaphis sacchari Zehntner*). VCS-Diamante has a grain size of 4.61, 4.35 and 2.8 mm, length, width and thickness and a chemical composition of proteins, lipids, ashes and carbohydrates of 14.95, 3.93, 2.04 and 79.08%, respectively.

Keywords: *Sorghum bicolor* L., forage, grain, resistance to diseases.

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The state of Sinaloa occupies the third national place in area planted with sorghum (*Sorghum bicolor* L. Moench), in 2017 it was 109 382 ha, more than 72% of this area is cultivated under rainy season conditions, corresponding to the spring cycle summer (SIAP, 2018). Among the main problems facing sorghum cultivation in Sinaloa, are the drought, caused by the erratic distribution of rainfall (from 450 to 600 mm, during the period from July to November), as well as the scarce use of conservation practices and use of moisture. However, in the center and south of Sinaloa, commercial hybrids are predominantly sown under seasonal conditions susceptible to diseases and to the lodging of the plants, making impossible the mechanical harvesting and the loss in the yield of grain.

In recent years, it has been possible to identify new genotypes with greater tolerance to diseases than commercial hybrids, the new variety VCS-Diamante has greater tolerance to: ergot caused by *Claviceps african*, anthracnose caused by *Colletotrichum graminícola*, panicle blight caused by *Fusarium moniliform* and carbonaceous rot of the stem caused by *Macrophomina phaseolina* (Velázquez *et al*., 2001; González *et al*., 2005; Williams-Alanis *et al*., 2009). It was evaluated visually, using a scale from 1 to 5, where 1 is the most tolerant and 5 is the most susceptible. The VCS Diamante variety presented tolerance (scale 2) in the field to this complex variation of diseases, in addition to presenting greater adaptation to adverse conditions than commercial hybrids.

In studies conducted in Sinaloa, VCS-Diamante was reported as one of the most tolerant to *Macrophomina phaseolina*, considering it for the formation of tolerant parents and hybrids to *M. phaseolina* (Moreno-Gallegos *et al*., 2017), currently at VCS- Diamante is still evaluating its tolerance to the yellow aphid of sorghum (*Melanaphis sacchari Zehntner*) where this aphid has presented a certain tolerance, considered one of the main pests in the sorghum crop, which has registered losses between 30 and 100% of the lots commercial due to the severe infestation of aphids (Maya and Rodríguez, 2014).

Registration of the VCS Diamond variety

It is owned by the National Institute of Forestry, Agriculture and Livestock Research (INIFAP) and is registered in the National Catalog of Plant Varieties (CNVV) of the National Service of Inspection and Certification of Seeds (SNICS) with the definitive registration number SOG-282-231117 and breeder's title number 1892.

Origin

The VCS-Diamante sorghum variety was developed in the Sorghum Genetic Improvement Program of the Valley of Culiacan Experimental Field (CEVACU) (INIFAP), which was obtained through genetic recombination and selection. The germplasm that gave origin to this variety was introduced during 1986 to CEVACU, from the International Institute for the Improvement of Crops of the Semi-Arid Tropics International Crops Research Institute for the Semiarid Tropics, (ICRISAT), Hyderabad, India. His progenitor lines were an androsterile female and a male restorer of fertility, of unknown genealogy; to the cross was assigned the denomination M-16 (Mazatlan-16).

The selection of the segregating material of the cross M-16, began from the F2 generation, by the groove method per panicle or pedigree for seven generations. In this way, the advanced uniform line was obtained that gave rise to 'VCS-Diamante', whose pedigree is: M16-1-M-1-1-2-2-M-M.

Variety description

The description of the variety was made using the descriptors of the union of producers and breeders of varieties (UPOV). During the spring-summer cycle under rainfed or dry conditions, the VCS-Diamante variety behaves like an intermediate vegetative cycle, with 63 to 67 days at flowering and 110 to 115 days at harvest, it has a plant length of 2.20 m, light green leaves, medium texture, without anthocyanins; it presents eight internodes at maturity and a concentration of soluble solids in juice of 14 to 16 ºBrix, when the plants have the doughy milky grain. It has medium spikes (24 cm), compact, with good excersion (20 cm) and glumes without anthocyanins in flowering; the grain is cream or amber, circular and semi-flat, with a crystalline testa and endosperm, and medium texture (Figure 1 and 2). The characteristics of plant length, panicle length and exceeding length of VCS Diamante, during the autumn winter cycle, under irrigation conditions, tend to have lower values than those that occur in the rainy season.

Figure 1. VCS-Diamond sorghum plant.

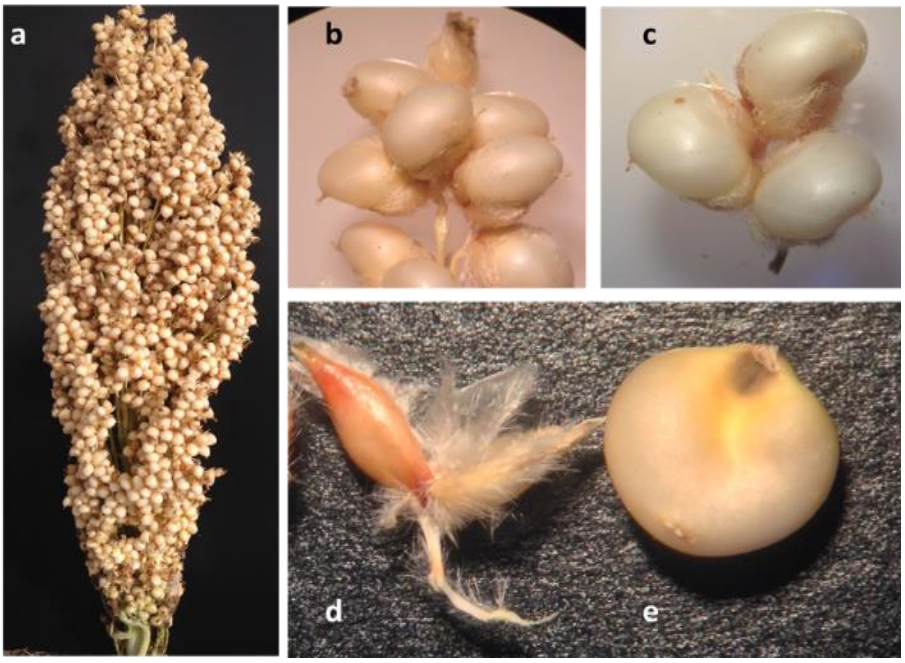

Figure 2. Panoramic VCS-Diamond sorghum. Panicle complete (a); terminal spike (b); triad of spikelets with seed (c); coriaceous glumes (d); and naked caryopsis (e).

In evaluations conducted under rainfed conditions in the southern and central zone of Sinaloa, VCS Diamante presented a similar behavior to commercial witnesses. In yield trials conducted over a period of six years (1999 to 2005) during the spring-summer cycle under temporary, VCS Diamante presented average yields of 3 310 kg ha^{-1} of grain higher than 15.4% to the average of three commercial controls.

Williams-Alanis *et al*. (2009); Montes-García *et al*. (2012) report, to the variety VCS Diamante (Mazatlan-16) with an average yield of 2 389 and 4 023 kg ha^{-1} respectively, which differs with the results obtained in the present study. It has been reported that the differences between grain yield results are due to several factors such as different climatic conditions, drought, rainfall, temperature, planting dates and adaptation (Singh *et al*., 1990; Cloud *et al*., 1994).

During the spring-summer cycles from 2006 to 2012, the forage production was evaluated in the localities of San Ignacio, Elota, Mazatlan, Concordia, Cosala and Culiacan of the state of Sinaloa, established under temporary, VCS Diamante presented average yields of 27 105 kg ha^{-1} of green fodder, superior in 25.47% to the average of the commercial control.

The bromatological quality of the forage under irrigation, during the autumn-winter cycles of 2006 to 2012, was 78.66% of digestibility and 6.21% of protein, superior in digestibility and in content of protein to the commercial control with 12.66 and 0.41%, respectively. The level of yield and the bromatological quality of forage places the VCS-Diamante variety as a double-purpose material, whose potential can be used for silage; strategic activity of forage conservation that contributes to the solution of the main problem of seasonal livestock in Sinaloa: the lack of forage during the dry season of the year (Hernández-Espinal *et al*., 2010).

On the other hand, physical and chemical analysis of sorghum grains found that the physical dimensions of this variety (length, width and thickness) were 4.61, 4.35 and 2.8 mm, respectively, it has been reported that sorghum grains typically they are round, although most have a flattened part (Reichert *et al*., 1988), commercial varieties and hybrids have shown that sorghum grains have on average values of 4, 2.5 and 2 mm in length, width and thickness, respectively (Rooney and Serna-Saldivar, 2000). Meanwhile, the weight of 1000 grains of the VCS Diamante variety is 38.99 ±0.18 g. Due to genetic diversity, sorghum grains can vary in shape and size, Rooney and Serna (2000) report that the weight of 1 000 grains of sorghum can vary from 30 to 80 g depending on the cultivar and the climatic conditions where they were grown. cultivated. It has a hectoliter weight of 821.02 ±8.1 g hL^{-1} above that reported by Pérez and Serna (2007) (765.2 g hL^{-1}) for regular white sorghum grains.

The chemical composition of the grains of sorghum VCS Diamond presents a percentage of content of proteins, lipids, ashes and carbohydrates of 14.95, 3.93, 2.04 and 79.08%, respectively, several researches have reported that sorghum contains a range of proteins of 10.4 a 12.41%, as well as lipid ranges from 3.1 to 3.6% and ranges from 1.5 to 1.7% of ashes (Rooney and Serna, 2000).

Availability of seed

Due to the national demand of genotypes tolerant to diseases and drought, the INIFAP makes available to the public the seed 'VCS-Diamante'. Agricultural producers, rural production companies and seed companies interested in this material can go to the Valley of Culiacan Experimental Field and present their request for seed needs.

Conclusions

The VCS-Diamante variety is a good alternative to be cultivated in the state of Sinaloa, because it has desirable forage and grain yield characteristics, making it a good option for state producers.

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Cited literature

Cloud, G. and Rupe, J. 1994. Influence of nitrogen, plant growth stage and environment on charcoal rot of grain sorghum caused by *Macrophomina phaseolina* (Tassi) Goid. Plant Soil 158(2):203-210. https://doi.org/10.1007/BF00009495.

González, R.; Ávila, J. y Pieruzzini, N.2005. Manejo de las principales enfermedades del sorgo en el estado Portuguesa. Aspectos Fitosanitarios. 6(1):29-32. http://sian.inia.gob.ve/inia-divulga/divulga-06/rid6-gonzalez-29-32.pdf.

Hernández, E. L. A.; Moreno, G. T.; Loaiza, M. A. y Reyes, J. J. E. 2010. Gavatero-203, nueva variedad de sorgo forrajero para el estado de Sinaloa. Rev. Mex. Cienc. Agríc. 1(5):727-731. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2007-09342010000500013.

Maya, H. V. y Rodríguez, D. B. L. A. 2014. Pulgón amarillo: una nueva plaga del sorgo en Tamaulipas. http://biblioteca.inifap.gob.mx:8080/jspui/bitstream/handle/123456789/3806/pulgon_amarillo_mayah..pdf?sequence=1.

Montes, G. N.; Williams, A. H.; Moreno, G. T.; Cisneros, L. M. E. y Pecina, Q. V. 2012. Rb-paloma variedad de sorgo blanco para producción de grano y forraje. Rev. Fitotec. Mex. 35(2):185-187. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-73802012000200011.

Moreno, G. T.; Melgoza, V. C. M.; Cuevas, R. V. y Hernández, E. L. A. 2017. Evaluación de la susceptibilidad a *Macrophomina phaseolina* (Tassi) Goid en diferentes variedades e híbridos comerciales de sorgo en Sinaloa, México. Rev. Elec. Nova Sci. 9(18):186-199. http://www.redalyc.org/html/2033/203350918011/.

Pérez, C. E. and Serna, S. O. 2007. Effect of preotease treatment before hydrolisis with -amylasa on the rate of starch and protein hydrolysis of maize, whole sorghum and decorticated sorghum. Cereal Chem. 607-613 pp. http://dx.doi.org/10.1094/CCHEM-84-6-0607.

Reichert, R.; Mwararu, M. and Mukuru, S. 1988. Characterization of colored grain sorghum lines and identification of high tannin lines with good dehulling characteristics. Cereal Chem. 65(3):165-170. https://www.aaccnet.org/publications/cc/backissues/1988/Documents/ 65_165.pdf.

Rooney, L. W. and Serna, S. S. O. 2000. Sorghum. In: Kulp, K. and Ponte, J. G. Jr. (Eds.). Handbook of cereal science and technology. 2nd (Ed.). New York: Marcel D. 149-176 pp.

SIAP. 2018. Servicio de Información y Estadística Agroalimentaria y Pesquera. https://nube.siap.gob.mx/cierreagricola.

Singh, S. K.; Nene, Y. L. and Reddy, M. V. 1990. Influence of cropping systems on *Macrophomina phaseolina* populations in soil. Plant Dis. 74(10):812-814. DOI: 10.1094/PD-74-0812.

Velázquez, V. R.; Narro, S. J. y Torres, M. H. 2001. Diseminación inicial del cornezuelo (*Claviceps africana*) de sorgo en México. Rev. Mex. Fitopatol. 19(1):100-103.

Williams, A. H.; Pecina, Q. V.; Montes, G. N.; Palacios, V. O.; Arcos, C. G. y Vidal, M. V. A. 2009. Reacción de variedades de sorgo [*Sorghum bicolor* (L.) Moench.] para grano a *Macrophomina phaseolina* (Tassi) Goid. Rev. Mex. Fitopatol. 27(2):148-155. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0185-33092009000200007.