Colegio de Postgraduados

HVC JAIRA: Grain Sorghum Hybrid For Sinaloa, Mexico

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ABSTRACT

Objective: To describe the morphological and agronomic characteristics of HVC JAIRA, a red grain sorghum hybrid.
Design/methodology/approach: HVC JAIRA was developed at the INIFAP Culiacán Valley Experimental Station in 2011, as the result of a breeding program based on hybridization. Between 2012 and 2015, performance trials of experimental hybrids were conducted, leading to the selection of the HVC 4AX37R hybrid (HVC JAIRA) due to its tolerance to pests and diseases.
Results: According to the evaluation data, the HVC JAIRA hybrid achieved the highest average yield.
Study limitations/implications: Promotion of this hybrid in agroecological environments of the state of Sinaloa is recommended.
Findings/conclusions: HVC JAIRA demonstrated adaptability to adverse climatic conditions by consistently producing superior yields across all test locations.

Keywords: Hybrids, Sorghum, Yield.

INTRODUCTION

Sorghum grain is primarily used in animal feed, although it also has several industrial applications, including the production of starch, dextrose, dextrose syrup, edible oils, and beverages. It is also utilized in brewing, local drinks, natural dyes, cosmetics, paper, and pharmaceutical products (Saucedo, 2008). The state of Sinaloa ranks third nationally in

terms of sorghum grain production and planted area. In 2023, a total of 65,919 hectares were planted, of which approximately 30% consisted of open-pollinated commercial varieties, and the remainder of commercial hybrids. Over 60% of the crop was cultivated under rainfed conditions during the spring-summer growing season, yielding 296,455 tons of grain sorghum and 136,586 tons of forage sorghum (SIAP, 2024). National sorghum production does not meet internal demand; therefore, reducing the supply deficit requires increasing yields through the development of new varieties or hybrids with enhanced agronomic traits (Williams *et al.*, 2022). The development of improved sorghum hybrids is essential to increase productivity and resistance to biotic and abiotic stressors, especially under the ongoing challenges posed by climate change.

MATERIALS AND METHODS

Origin

The sorghum hybrid HVC JAIRA was developed at the Valle de Culiacán Experimental Station of the National Institute for Forestry, Agricultural and Livestock Research (INIFAP) in 2011, as the result of a hybridization-based breeding process and performance evaluations. It was developed through crosses of heterogeneous lines introduced from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The F1 cross (4Ax37R) involved the female parent, male-sterile line "ATX624" (4A) notable for its pest and disease tolerance, and the male parent, fertility-restorer line "VG-342" (37R), notable for its high grain yield; this combination was locally designated as HVC 4Ax37R. From 2012 to 2015, yield trials of three experimental hybrids (7AX47R, 8AX10R, 4AX37R) were conducted, and HVC 4AX37R was selected for its tolerance to pests, diseases and adaptability to adverse climatic conditions.

Trait Evaluation

The varietal description of the hybrid was conducted according to the descriptors of the International Union for the Protection of New Varieties of Plants (UPOV) under irrigated conditions in the municipalities of Mazatlán, Elota and Culiacán, Sinaloa. Based on experimental results, under irrigated conditions the hybrid HVC JAIRA remains entirely green until harvest, thus better utilizing soil nutrients and water. Evaluation of HVC JAIRA was carried out over four fall winter cycles under irrigation and adverse climatic conditions such as temperatures of 35-40 °C. HVC JAIRA presents an intermediate vegetative cycle, 80-85 days to flowering and 105-110 days to harvest. Average plant height is 1.62 m; its leaves are light green, of medium texture and without anthocyanins. It has a stem with seven internodes and panicles averaging 26 cm in length, semi-compact, with good exertion (26 cm); the grain is reddish, elliptic, semi-flattened, with a crystalline testa and endosperm, and medium texture (Figure 1).

Yield

In yield trials conducted under irrigation in the southern and central zones of Sinaloa, HVC JAIRA showed performance comparable to commercial checks. These evaluations were conducted over four years (2012 to 2015) during the fall-winter

Figure 1. a) Grain sorghum hybrid "HVC JAIRA" plant under irrigated conditions during the fall-winter cycle in Sinaloa (left), and (right) panicle of the grain sorghum hybrid "HVC JAIRA" in Sinaloa, Mexico.

cycle, using a randomized complete block design with four replications per year. Each experimental unit consisted of four rows, 5 m in length. Crop management was conducted according to the recommendations for sorghum cultivation in central Sinaloa (Hernández *et al.*, 2011).

Statistical analysis

A combined analysis of variance (ANOVA) was performed for the main effects of genotype (G) and environment (A) using the following model:

$$Y_{ijk} = \mu + G_i + A_j + (GA)_{ij} + B_k\left(A_j\right) + E_{ijk}$$

where Y_{ijk}=mean yield of the i-th genotype in the j-th environment and k-th replication; μ=overall mean effect; G_i=effect of the i-th genotype; A_j=effect of the j-th environment; $(GA)_{ij}$ =interaction effect between the i-th genotype and the j-th environment; $B_k\left(j\right)$ =effect of the k-th replication within the j-th environment; and E_{ijk}=random error associated with the i-th genotype, j-th environment, and k-th replication, based on the additive linear model. Data were analyzed using SAS statistical software (SAS, 2006). Mean comparisons for agronomic traits were performed using the LSD test ($p \leq 0.05$).

RESULTS AND DISCUSSION

The HVC JAIRA hybrid averaged 7.55 t ha^{-1} of grain yield, which exceeds the mean of three commercial checks by 18.14%. Mean comparisons by fall-winter cycles showed that the lowest yield was 6.21 t ha^{-1} (Table 1). The highest yield was observed in the 2013 fall-winter cycle, with an average of 6.99 t ha^{-1}.

In the physical analysis of the grain of HVC JAIRA, the physical dimensions of the grain (length, width and thickness) were 4.47, 4.59 and 2.62 mm, respectively; similar to those reported by Moreno-Gallegos *et al.* (2018a). Meanwhile, the 1000-grain weight

Table 1. Evaluation of grain yield in sorghum hybrids (t ha^{-1}) under irrigated conditions during the fall-winter cycle in Sinaloa, Mexico.

Autumn/Winter Agricultural Cycle					
Genotype	**2012**	**2013**	**2014**	**2015**	**Average**
HVC JAIRA	7.52a	8.22a	7.63a	6.85a	7.55
RB NORTEÑO*	5.45b	6.27c	6.22ab	5.89a	5.95
G STAR 7304*	6.95a	7.23b	6.42ab	6.64a	6.81
SYNGENTA 5265*	5.48b	6.23c	5.90b	5.45a	5.76
MEDIA	6.35	6.99	6.54	6.21	
CV %	3.36	3.58	8.43	8.19	
DMS P≤0.05	0.60	0.70	1.56	1.43	

*=commercial checks; FW=fall-winter, CV=coefficient of variation, HSD=honest significant difference. Means followed by the same letter are not significantly different.

was 36.53±0.32 g, which is similar to the values reported in other commercial varieties (Moreno-Gallegos *et al.*, 2018b). Additionally, it presented a hectoliter weight of 887.2±4.22 g hL^{-1}, similar to that reported by Moreno-Gallegos *et al.* (2014) for regular sorghum grains. The hybrid HVC JAIRA has demonstrated tolerance to ergot caused by *Claviceps africana* a disease that can reach incidences of up to 100% and severity levels of 1-10% in susceptible hybrids (Montes-Belmont *et al.*, 2002).

CONCLUSIONS

The hybrid HVC JAIRA is a viable option for increasing grain production in the state of Sinaloa. It was registered in 2024 in the National Catalogue of Plant Varieties (Catálogo Nacional de Variedades Vegetales, CNVV) of the National Seed Inspection and Certification Service (Servicio Nacional de Inspección y Certificación de Semilla, SINCS) under number SOG-321-041223 and breeder's title number 3347.

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