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Evaluation of Agronomic Variables of Six Genotypes of Sunflower (*Helianthus annuus L.*) in the Early Cycle June 2019, Marín, N. L.

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Abstract: Sunflower (*Helianthus annuus* L.) is an oleaginous crop of great economic importance worldwide due to the beauty of its flowers and the nutritional quality of seeds. The influence of the environment on grain yield and the agronomic behavior of other variables in the studied genotypes in the cycle February-June 2019 of the crop in the Municipality of Marín, N.L. The experimental design was a completely randomized blocks designes with 6 treatments and 4 repetitions. Based on the variables analyzed, the genotypes obtained satisfactory results, the highest grain yield was of the Jaguar variety with 3.72 t ha^{-1}, as well as the larger diameter, weight of the flower with 12.95 cm and 188.20 g, greater length, width and seed weight with 1.48, 0.48 cm and 11.33 g, the lowest percentage of seed moisture was Hornet with 6.85%.

Key words: oleaginous, nutritional quality, genotypes, environment

1. Introduction

The sunflower (*Helianthus annuus* L.) for its high oil content in seed that is framed between 35 and 45% and its nutritional quality is composed of having a high content of unsaturated acids (85-90%), giving great importance to its uses as grain for human consumption, animal feed, natural colorants, protein sources, pectin and as a raw material for biodiesel, making it one of the three main oilseed crops produced in the world, surpassed only by soybeans and canola [1]. It is a crop with low requirements for cultivation work, easy mechanization and with a relative tolerance to water stress [2].

In Mexico, 49 species have been refuelled, of which 12 are annual and 37 perennial, these species have the characteristic of easily adapting to different environments, currently being cultivated throughout the world [3]. At the national level, the gross domestic product of this seed is 0.007%, although its highest production in Mexico is as an ornamental, it is one of the oilseeds with the highest international demand as seed [4].

It is a crop with low labor requirements, easy mechanization, with a relative tolerance to water stress, these results are exposed from the SIAP (2018) [2] where in 2017 the highest national production was 8,862.01 t and the main producer States of Mexico were: Jalisco with 17%, followed by San Luis Potosí with 16%, Tamaulipas with 15%, Guanajuato with 14% and Sonora with 12% [2].

The specialists of the National Institute of Agricultural and Livestock Research [5], point out that the sowing of the sunflower crop represents a viable alternative for the northwest of the country because it is

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tolerant to low temperatures, the use of less water and the high demand in the national industry.

As alternatives to be developed at the regional level, because no previous research has been reported in the Municipality of Marín, belonging to the State of Nuevo León, with sunflower genotypes of high yield potential, resistant to drought and the variable climate that exists in this area, to obtain new viable alternatives, responding to the concerns of producers in the area, setting as an objective of our research the evaluation of six sunflower genotypes of which: three genotypes are highly efficient hybrids in seed production for oil extraction (oleaginous) and three genotypes are high quality varieties for the production of seed for human consumption (confectionery), in the early cycle (February-June 2019).

General hypothesis: The environment, the genotype and their interaction have a direct effect on the production of the sunflower crop, mainly on the yield and other agronomic variables.

Objective: To determine the influence of the environment on the grain yield and the agronomic behavior of other variables in the genotypes under study in the early February-June 2019 cycle.

2. Materials and Methods

Location of the experimental plots. The study was carried out in the experimental Campus of the Faculty of Agronomy, UANL, located in the Municipality of Marín, Nuevo León, which is located in the Northeast of the State at a North latitude of 25°52' and a West longitude of 100°02', at a height of 393 meters above sea level.

Analysis of Agronomic variables obtained in the crop (Early cycle February, June 2019). The evaluation of the agronomic variables of the 6 sunflower genotypes under study was carried out according to the methodology carried out by Robles-Sanchez (1980) [6], as explained later.

Plant height. The height of 10 plants was measured at random per experimental unit during the maturation of the flower, the measurement was taken from the base of the stem to the tip of the inflorescence. The data was expressed in meters.

Number of leaves per plant. 10 plants were selected at random per experimental unit, for each of the genotypes and repetitions, the leaves were counted, starting from the lowest part of the stem to the base of the flower, it was carried out before the senescence of the plant leaves, before harvest.

Days to flowering. This stage occurs from sowing until the appearance of the flower bud or primordium. The days to flowering were identified when 50%+1 of the plants found in that stage, counting the number of days it took to start flowering in each of the genotypes per experimental unit.

Days to maturity. This stage is determined by the filling of the grain from the flowers of the periphery to the central region of the flower, when it has exceeded 50%+1. It occurred when the achenes did not accumulate more dry weight, the color of their bracts changed and they took a brown coloration.

Frame diameter. A ruler was used, measuring each of the chapters selected in the field.

Frame weight. The weight of 10 flower per experimental unit was determined with a Tor-Rey model L-EQ analytical balance.

Number of seeds per flower. The seeds of 10 flowers per experimental unit were shelled and the number of seeds for each of the flowers selected in the field was counted.

Weight of 100 seeds of each flower. Of the grains obtained from the most representative flower, 100 seeds were weighed on a digital scale, using three samples per experimental unit.

Greater width of the seed. The width greater than 15 representative seeds of each experimental unit was measured with a vernier.

Lesser width of the seed. The smallest width of 15 representative seeds of each experimental unit was measured with a vernier.

Seed yield. When carrying out the harvest, the

performance of the seeds for each of the genotypes was evaluated, to determine which is the most productive and efficient, sampling two linear meters from the two central furrows, harvesting ten plant flowers with complete competition.

Percent moisture of the seed. was calculated using the methodology of Justice (1972) [7], using the following formula.

Moisture content (%) = (Original weight-Weight after oven drying)/(Original weight) × 100

Experimental design and statistical analysis. The experimental design used was completely randomized blocks with six treatments and four repetitions.

Analysis was performed to determine the effect of the environment on the six sunflower genotypes. When finding statistical differences, the comparison of means was carried out by means of the Tukey test ($\alpha \leq 0.05$).

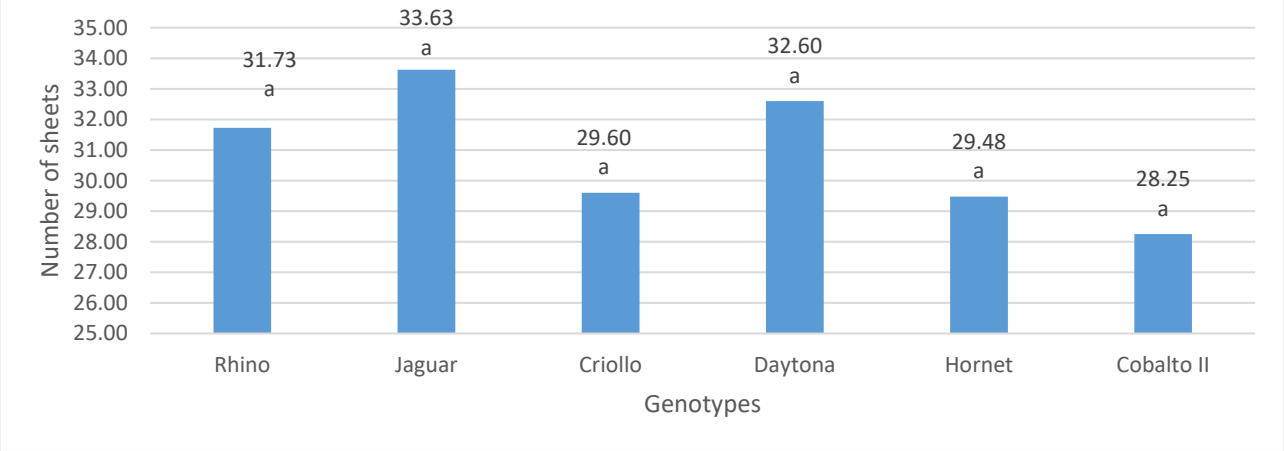
3. Results and Discussion

Regarding the variables number, length and width of leaves, there was no significant difference between the genotypes studied.

Number of leaves per plant. There was no significant difference between the genotypes, Jaguar and Daytona obtained the highest values: 33.63 and 32.60, the lowest value was of the Cobalt II hybrid with 28.25 (Fig. 1).

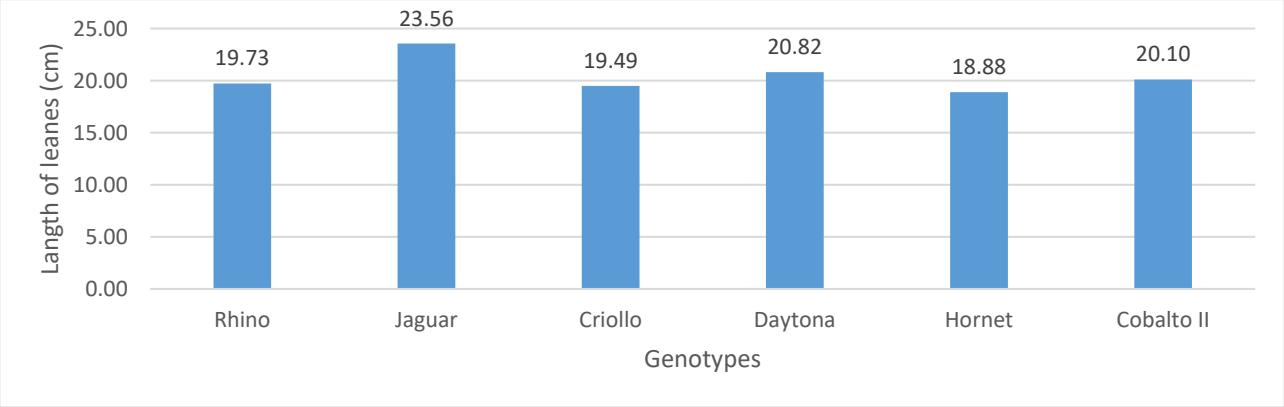
The results obtained agree with Escalante (1999) [8], where two treatments of 0 and 300 kg ha^{-1} did not show significant differences in the number of leaves.

Blade length. There was no significant difference between the genotypes, however the Jaguar variety obtained the highest value with 23.56 cm and the Creole variety the lowest with 19.49 cm (Fig. 2).



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 1 Relationship number of leaves per plants for each genotype.

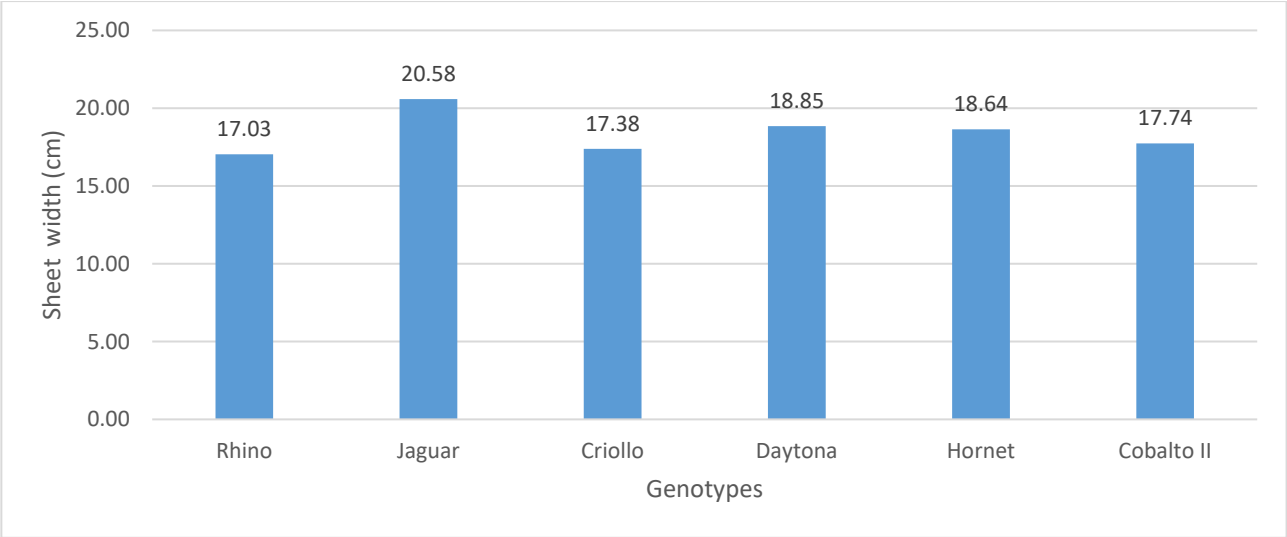


* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 2 Relationship length of leaves by plants for each genotype.

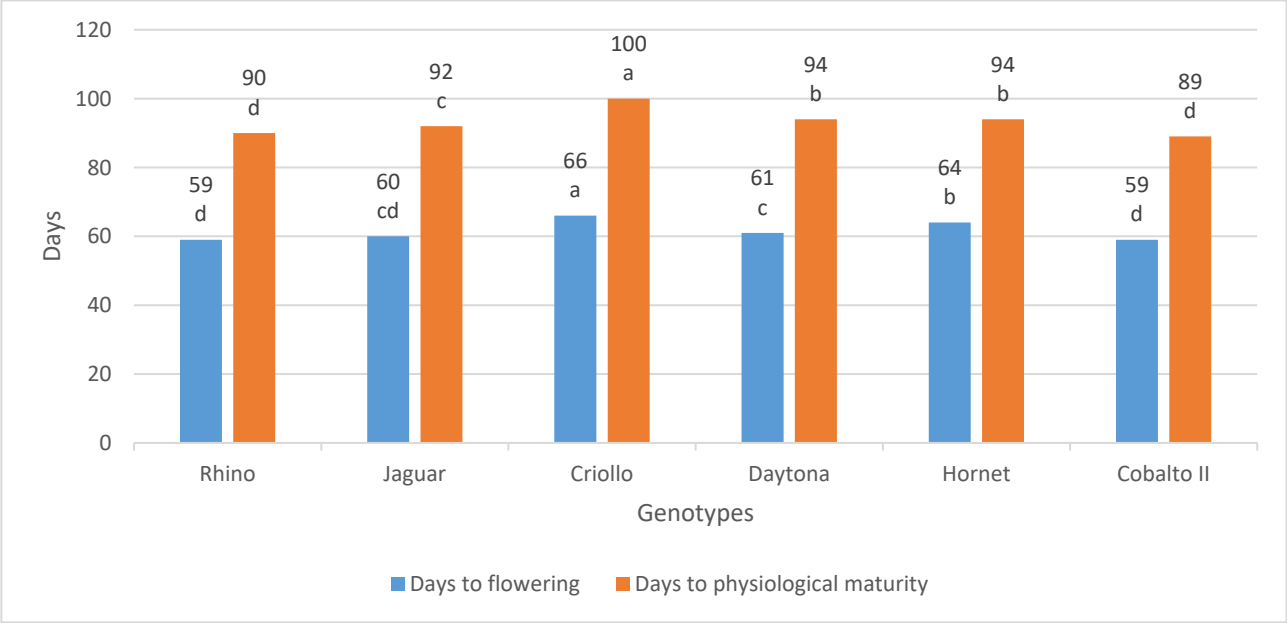
Sheet width. There was no significant difference between the genotypes, however the Jaguar variety obtained the highest value with 20.58 cm and the Rhino variety the lowest value with 17.03 cm (Fig. 3).

Days to flowering and physiological maturity. Among the genotypes under study, the days to flowering were analyzed, with significant differences where Criollo and Hornet began their late flowering days at 66 and 64 days, however, the genotypes that began the early flowering stage were Jaguar, Rhino, Cobalt II and Jaguar, with a value of 60, 59 and 59 days, however in terms of physiological maturity we can say that the genotypes that presented the earliest were Cobalt II, Rhino and Jaguar with 89.90 and 92 days respectively and those that more The took were Daytona, Hornet and Criollo with values of 94, 94 and 100, as shown in Fig. 4.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 3 Leaf width ratio per plant for each genotype.



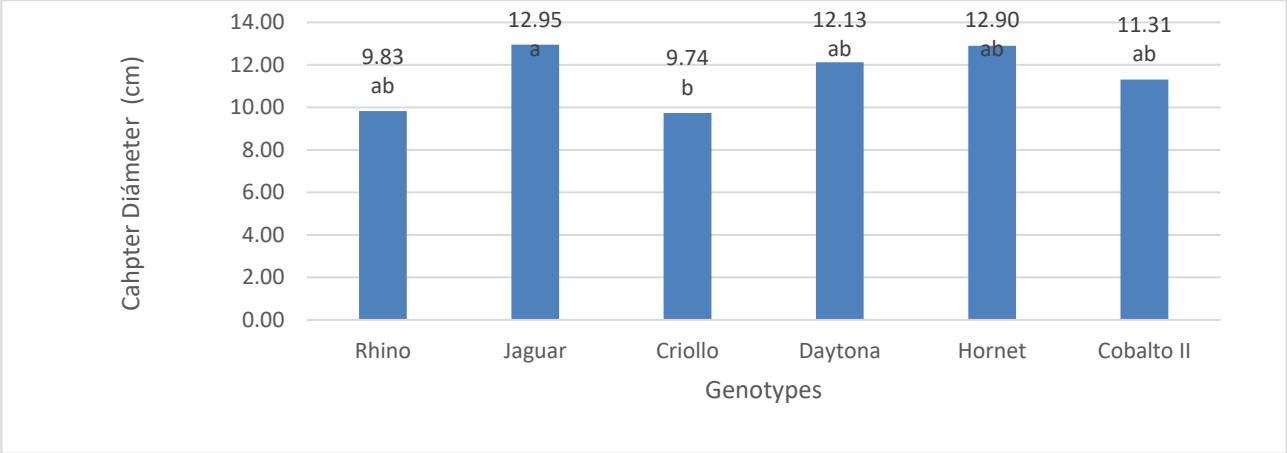
* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 4 Relationship days to flowering and physiological maturity by genotypes.

The results agree with those obtained by Villar et al., in 2004, where they evaluated 45 sunflower cultivars obtaining a flowering period with an average of 62 to 81 days, all of them similar to the results obtained in the previous cycle, agree with Chimeneti et al. (2001) [9], where it states that the Duration of the flower initiation phase depends on the cultivar, the temperature and the photoperiod. Regarding the results obtained on physiological maturity, they do not agree with those obtained by Escalante (1999) [8], where it occurred at 110 and 108 days by applying nitrogen and the control at 120 and 125 days.

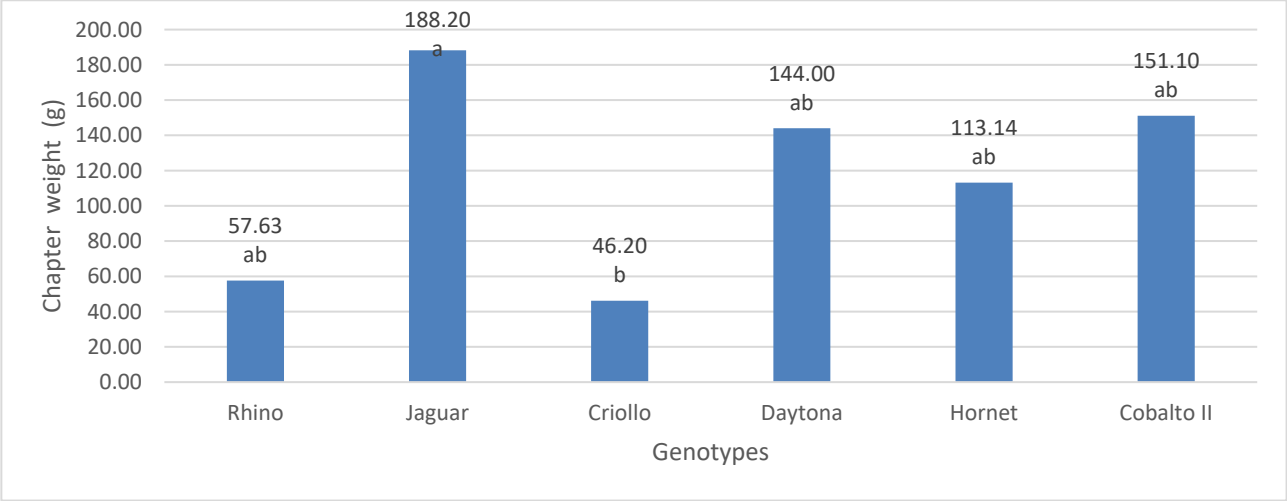
Diameter of the flower: If we analyze the diameter of the flower when comparing them, there was significant difference between the genotypes where Jaguar, Hornet, Daytona and Cobalt II, were those that obtained a greater diameter of the flower with values of 12.95 cm, 12.90 cm, 12.13 cm and 11.31 cm respectively, when comparing with Criollo the diameter was smaller with 9.74 cm, as shown in Fig. 5.

Frame weight. Regarding the weight of the flower, there were significant differences between the genotypes where the highest weight of the flower was obtained by the Jaguar variety with 188.20 g compared to the other genotypes under study and a lower weight by the Criollo variety with 46.20 g as shown in the Fig. 6.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 5 Strand diameter relationship by genotypes.

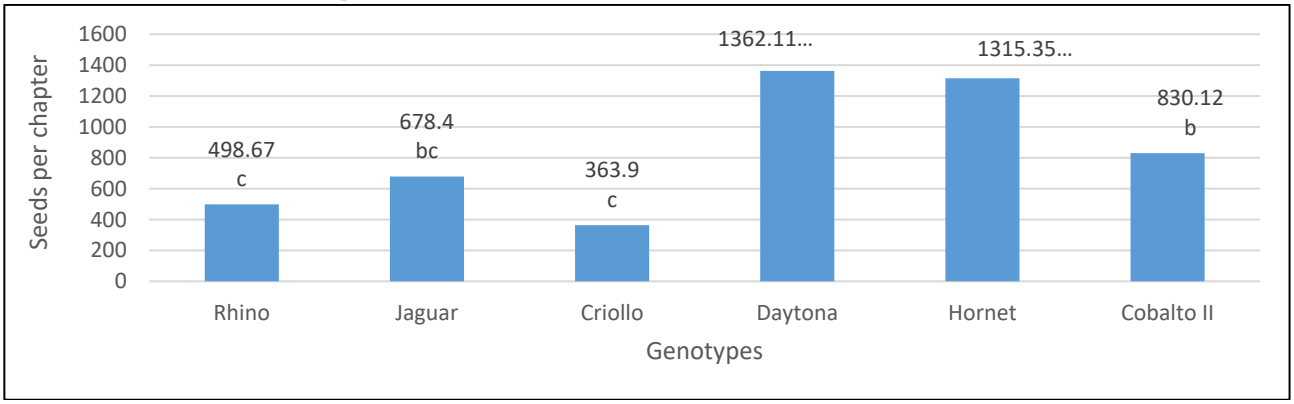


* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 6 Weight ratio of head by genotypes.

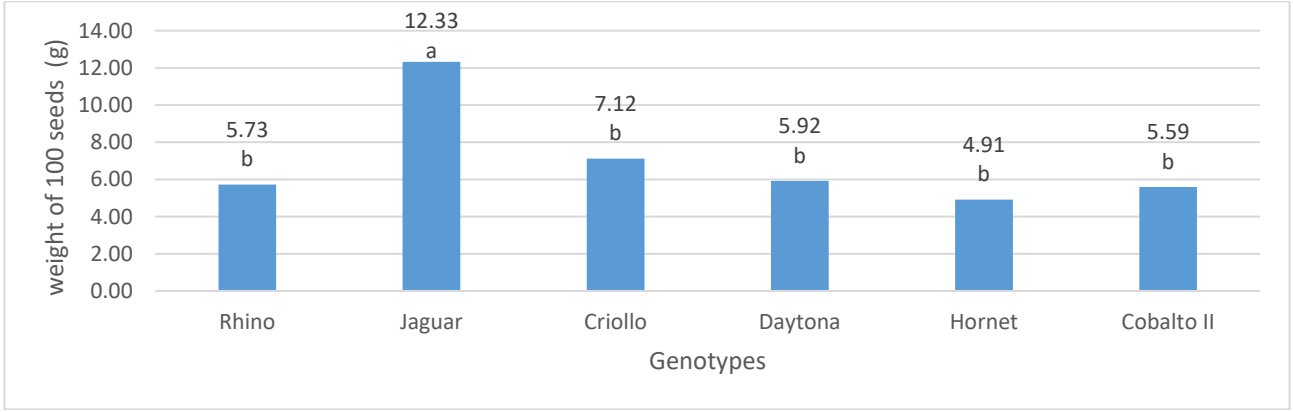
Number of seeds per flower. The numbers of seeds per flower compared in Fig. 7, showed significant differences between all the genotypes where the hybrids, Daytona and Hornet obtained higher numbers of seeds with values of 1362.15 and 1315, 35 the average values were obtained by the hybrid Cobalt II with 830.125 and the Jaguar variety with 678.4 compared to Rhino and Criollo that obtained lower numbers of seeds with a value of 498.67 and 363.9. Coinciding with what was stated by Cantagallo et al. (1997) [10], where he expresses that the main determinant of sunflower yield is the number of grains per unit area.

Weight of 100 seeds per flower. Regarding the weight of 100 seeds per flower, we can say that there was a significant difference between the genotypes, where the Jaguar, Criollo and Daytona varieties obtained a higher weight with a value of 12.33 g, 7.12 g and 5.92 when compared with Rhino, Cobalto II and Hornet, we obtained a lower weight of 5.73 g, 5.59 g and 4.91 as seen in Fig. 8.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 7 Relationship of the number of seeds per flower in each genotype.



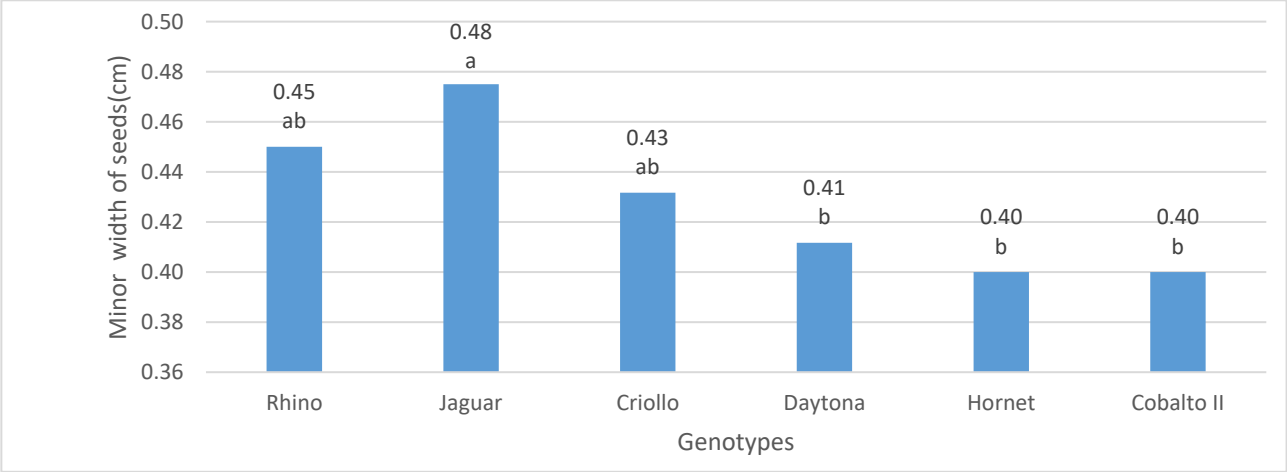
* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 8 Weight ratio of 100 seeds per flower in each genotype.

The average of the six genotypes studied was 6.9 g, which is similar to what Garófalo (2017) [11] obtained, with the application of biostimulants sprays of Basfoliar Algae 2.0 and 1.5 l/ha where they registered the highest weight, in the weight of 100 seeds, the general average was 6.3 g, which does not show an effect of the seeds, which agrees with Tenesaca (2015), who indicates that in the investigations that consider the weight evaluation of 100 seeds or 1000 seeds of a certain grain, will depend directly on the characteristics of the selected sample.

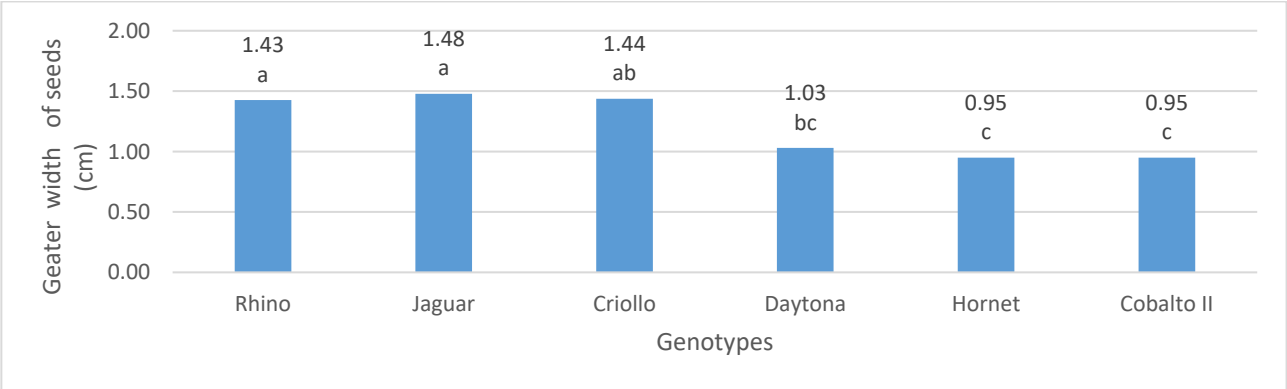
Lesser width of the seed. Regarding the relation of the smaller seed width, there were significant differences between the evaluated genotypes where the Jaguar, Rhino and Criollo varieties obtained a greater value of 0.48 cm, 45 cm and 43 cm, in comparison with the Daytona, Hornet and Cobalt hybrids. II obtained a lower value of 0.41 cm, 0.40 cm and 40 cm as shown in Fig. 9.

Greater width of the seed. Regarding the greater width of the seed, there was a significant difference between the genotypes, as shown in Fig. 10, it was obtained in the three varieties Hornet and Daytona with values of 0.59 cm to 0.56 cm for being oilseed, unlike the values obtained in the three varieties Jaguar, Criollo and Rhino that was 1.48 cm 1.44 cm and 1.43 cm, demonstrating their differences for being confectioners, corroborating characteristics of the genotypes under study and the lowest values Daytona, Hornet, Cobalt II with 1.03 cm, 0.95 cm and 0.95 cm.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 9 Minor width ratio of seed by genotype.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 10 Relationship greater width of seed by genotype.

The results obtained from the width less than 0.40 to 0.48 cm and the width greater than 0.95 to 1.48 cm, agree with the data obtained by Knowles (1978) [12], where the relationship varies from 0.7 to 2.5 cm of greater width and 0.4 to 1.3 cm of smaller width.

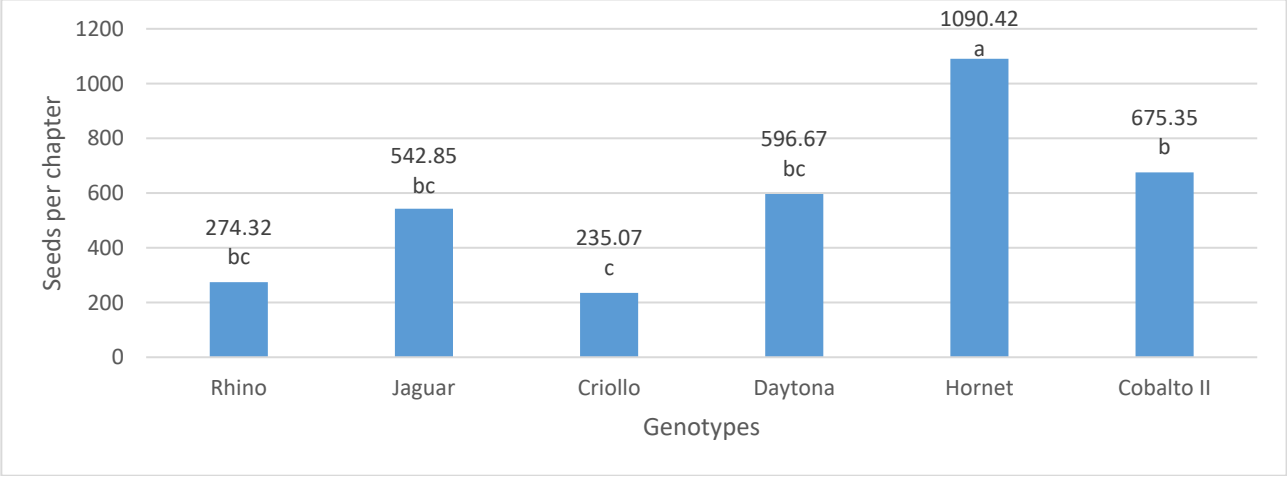
Total seeds per flower. When evaluating the total of seeds per flower, there was a significant difference between the genotypes, the hybrid Hornet, Daytona and Cobalt II is the one that obtained the highest weight with a value of 1090.42, 675.35 and 596.67 compared to the Rhino and Criollo variety that obtained a value less than 274.32 and 235.07 respectively, as shown in Fig. 11.

These results agree with those of Aguirrezábal et al. [13] (2001), where they state that a reduction in the number of flowers per unit area may not cause a reduction in yield due to an increase in the number of fruits per plant and/or the individual weight of the fruits.

Percent moisture of the seed in Fig. 12 the percentage of moisture of the seed was compared where there is a numerical difference between the genotypes studied, the Rhino variety was the one that obtained the highest value with 9.18% and the Hornet hybrid a lower moisture percentage with 6.85%.

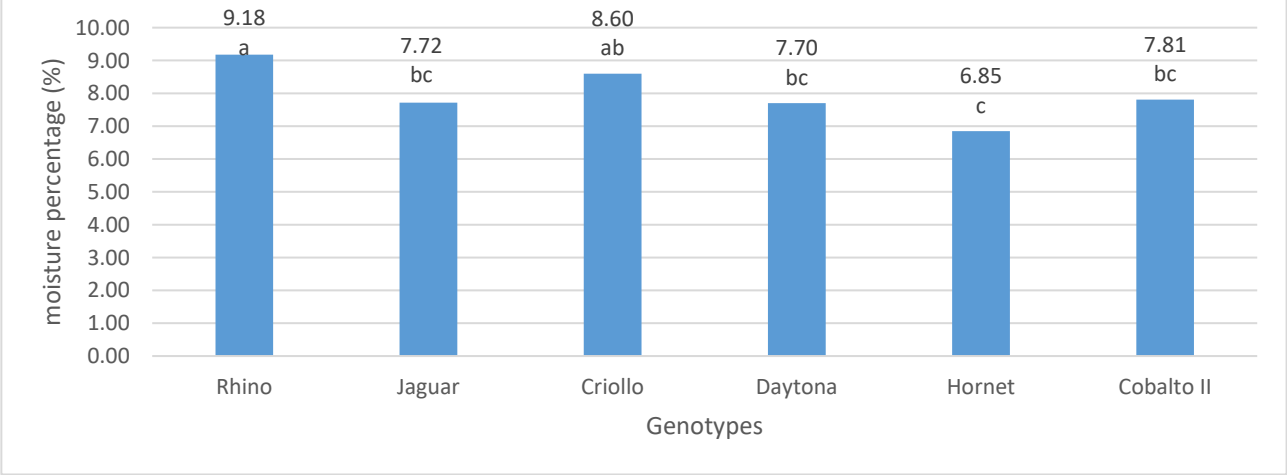
The results obtained in the research are inferior to the results presented by Satorre et al. (2015) [14] since for the commercialization of the grain a minimum of 11% to 14% of grain moisture is needed.

Performance of genotypes. For grain yield, there was a significant difference between the genotypes where the Jaguar variety obtained the highest value with 3.72 t ha-^{1}, followed by Hornet with a value of 3.14 t ha-^{1}, compared to the lowest values obtained by Criollo and Rhino varieties with 1.08 and 1.26 t ha-^{1}, as shown in Fig. 13.



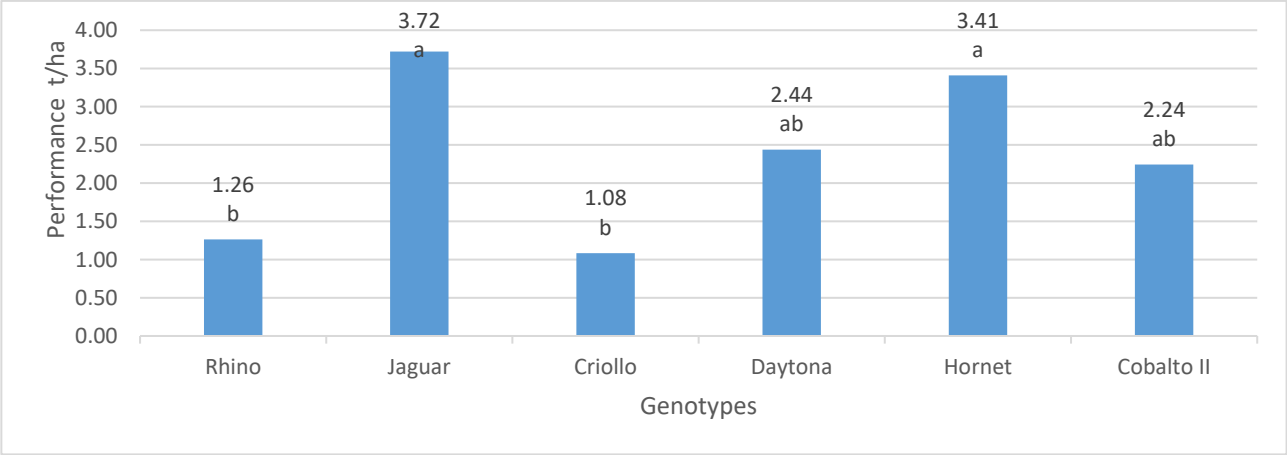
* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 11 Total seed per flower in each genotype.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 12 Percentage of seed moisture by genotypes.



* Tukey significant differences ($\alpha \leq 0.05$).

Fig. 13 Yield of genotypes.

In agreement with the results obtained by Villar et al., In the agricultural cycle of 2004, where they evaluated 45 sunflower cultivars obtaining an average grain yield of 3,413 t ha^{-1}, having detected significant variations between hybrids.

The Jaguar variety obtained 3.72 t ha^{-1} results similar to Garófalo (2017) [11], in the sunflower crop, where the analysis of variance determined significance with that of Basfoliar Aktiv, where the doses of 1.5 and 1.0 l/ha that registered yields of 3.8947 and 3.6094 t ha^{-1}, respectively.

4. Conclusions

The adaptation of the 6 genotypes studied of the sunflower crop to the environment of the Municipality of Marin, Nuevo León in the early February-June 2019 cycle is demonstrated.

The Jaguar and Hornet genotypes obtained the highest value with 3.72 and 3.14 t ha^{-1}. The lowest value obtained by the Criollo and Rhino varieties with 1.08 and 1.26 t ha^{-1}.

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