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REMEXCA

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Investigation note

Assessment of sunflower hybrid yield in southern Sonora

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Abstract

The sunflower (*Helianthus annuus* L.) is native to North America, originating in the southwestern United States of America and northern Mexico; the seed oil of sunflower varieties is considered of good quality for edible purposes. Likewise, limited water availability is a recurring problem in irrigation districts in southern Sonora, forcing producers to look for low-water crop options for the autumn-winter agricultural cycle; in this sense, sunflower is a crop with a low demand for water. The study aimed to identify sunflower hybrids, which would allow them to be suggested for planting to producers in southern Sonora. The trial was carried out in the 2020-2021 autumn-winter agricultural cycle. Commercial high oleic hybrids were used. The following agronomic characteristics were recorded: start and development of the flower bud, start and end of flowering, physiological maturity, plant height, weight of 100 seeds, hectoliter weight, and grain yield. The sunflower hybrid SYN 3 950 HO had yields of 3 362 and 3 596 kg ha-1, Cobalt II HO of 2 634 and 3 058 kg ha-1, and Daytona CL of 2 281 and 2 545 kg ha-1. The yields obtained from the sunflower hybrids evaluated allow us to suggest them for planting to producers in southern Sonora.

Keywords:

Helianthus annuus L., high oleic, sunflower production.

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Introduction

The sunflower (*Helianthus annuus* L.) is native to North America, originating in the southwestern United States of America and northern Mexico, where it still grows wild (Bye *et al*., 2009). The genus *Helianthus* is highly diversified, consisting of 14 annual and 37 perennial species, which represent considerable variability that can be used for the genetic improvement of several agronomic and industrial characteristics of the cultivated species; and evidence indicates that Mexico is the oldest center of origin (Bye *et al*., 2009).

The seed oil of sunflower varieties is considered of good quality for edible purposes; currently, the development of varieties with high oleic acid content is the main objective of genetic improvement (Martínez *et al*., 2015). In the 2003-2016 period, a significant increase in the sunflower planted area was observed, which went from 1 480 to 9 350 ha in the period, which allowed reaching a production of 8 970 t in 2016; nevertheless, only 7.49% of the national requirement of this oilseed is covered, so Mexico imports this oilseed from other countries, with an estimated production of 9 970 and 10 720 t for the years 2024 and 2030, respectively (SAGARPA, 2023).

This poses a challenge for the current agricultural sector, which involves reducing the import of oilseeds, such as rapeseed, sunflower, soybeans and safflower. In this context, in the northwest region of Mexico, there are two oil companies (Aceites del Mayo in Navojoa, Sonora and Pastas y Aceites y Proteinas in Culiacán, Sinaloa) that depend on the import of oilseeds, so regional production would be extremely useful to reduce imports.

The optimization of the irrigation water resource is also essential due to its scarcity, so it is imperative to consider efficient crops, such as sunflower (Inzunza *et al*., 2022); likewise, limited water availability is a recurring problem in irrigation districts in southern Sonora, which forces producers to look for low-water crop options for the autumn-winter agricultural cycle. In this sense, sunflower is a crop with a low water demand; however, depending on the type of soil, it responds favorably to supplemental irrigation, which must be carried out uniformly and lightly, avoiding waterlogging, with water layers of approximately 10-12 cm; depending on the type of soil, it requires a total irrigation depth of 45 to 55 cm, which considers the application of pre-sowing irrigation and two supplemental irrigations (Castillo *et al*., 2018).

In 2019, in the state of Sonora, an area of 390.99 ha of sunflower was harvested, with a yield of 1 960 kg ha-1, being one of the largest producers along with Jalisco, Durango, Guanajuato, and Tamaulipas, which comprise approximately 90% of the national production, with an average yield of 1 770 kg ha-1 (SIAP, 2023). Likewise, in southern Sonora, around 350 000 ha can be planted during the autumn-winter cycle; this area is covered with a reduced number of crops, among which wheat and corn stand out, which require high volumes of water for irrigation; in this regard, in recent years, the availability of water for irrigation has decreased and for February 2024, 22.9% storage in the dam system of the Yaqui River basin is reported (Rio Yaqui, 2024).

Based on the above, it is a priority to carry out a productive conversion to achieve sustainable agriculture, especially related to the efficient use of water, using crops with low water needs, such as sunflower, in a complementary way. Therefore, this study aimed to identify sunflower hybrids, which will allow them to be suggested for planting to producers in southern Sonora.

Materials and methods

The trial was established in the Norman E. Borlaug-INIFAP experimental field, located at coordinates 27° 22’ 10.96” north latitude and 109° 55’ 51.41” west longitude, Ciudad Obregón, Sonora, Mexico. The commercial high oleic hybrids SYN 3950 HO, Cobalt II HO, and Daytona CL were used as biological material; the sowing was carried out in the 2020-2021 autumn-winter agricultural cycle in a clay soil (> 50% clay) under irrigated conditions. Fertilization was done in pre-sowing with the formula 149-52-00 (N-P-K), applying 300 kg ha-1 of Urea (46% of N) and 100 kg ha-1 of MAP (11-52-00), and the herbicide Gesagard (Prometryn 480 g of ai. L) was applied in full in pre-sowing in a dose of 1.4 L ha-1 for the control of broadleaf and narrow-leaved weeds.

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A pre-sowing irrigation and two supplemental irrigations were carried out, with a total irrigation depth of approximately 45 to 55 cm. A final population of five plants per linear meter (62 500 plants ha-1) was obtained and there were no problems with pests, diseases and weeds. During the development of the crop, the technological package used was that of sunflower under irrigation conditions recommended by CENEB-INIFAP (Castillo *et al*., 2018).

A yield trial and demonstration plots were conducted. The yield trial used an experimental design of randomized blocks with five replications. The experimental plot was four rows, each 0.8 m wide by 6 m long (19.2 m2) and the useful plot was the two central rows of 5 m long (8 m2). The demonstration plots were eight rows, each 0.8 m wide by 100 m long (640 m2); to evaluate the grain yield, six samples were obtained from two 5 m long furrows (8 m2).

The variables to be evaluated were: flower bud start (R1) and flower bud development (R3), start of flowering (R5) and end of flowering (R6) and physiological maturity (R9), recorded in days after sowing (DAS), plant height (PH), weight of 100 seeds (WHS), hectoliter weight (HW) and yield of grain kg ha-1 adjusted to 11% moisture; the latter data was statistically analyzed by analysis of variance (Anova), Tukey's test at 0.05.

Results and discussion

As can be seen in Tables 1 and 2, according to Schneiter and Miller (1981), in the yield trial and demonstration plots, the reproductive stages of flower bud start (R1), flower bud development (R3), start of flowering (R5), end of flowering (R6) and physiological maturity (R9) occurred consecutively as there were no phytosanitary problems. The plant's height was homogeneous.

Table 1. Average values of the variables indicated for three sunflower hybrids.

Hybrid	R1	R3	R5	R6	R9	PH (cm)	WHS (g)	HW (kg hl-1)	Yield (kg ha-1)
	DAS								
SYN 3950 HO	67	85	97	118	137	170	6.01	39.5	3 362 a
Cobalt II HO	72	88	97	118	135	155	5.13	34	2 634 b
Daytona CL	73	90	99	120	137	170	5.52	33	2 281 b

Different letters in the same column indicate significant differences, according to Tukey= 0.05. DAS= days after sowing.

Table 2. Average values of the variables indicated for 3 sunflower hybrids.

Hybrid	R1	R3	R5	R6	R9	PH (cm)	WHS (g)	HW (kg hl-1)	Yield (kg ha-1)
	DAS								
SYN3950 HO	67	85	97	118	137	165	5.78	39	3 596 a
Cobalt II HO	72	88	97	118	135	140	5.89	33.5	3 058 b
Daytona CL	73	90	99	120	137	165	4.86	34	2 545 c

Different letters in the same column indicate significant differences, according to Tukey= 0.05.

The earliest hybrid was Cobalt II HO, and the latest were SYN 3950 HO and Daytona CL with 135 and 137 DAS, respectively. There were no problems with lodging or diseases that affected the development of the crop. As can be seen in Table 1 of the yield trial, the average values of the variables weight of 100 seeds, hectoliter weight, and grain yield are shown. Among the hybrids, SYN 3950 HO stood out with a yield of 3 362 kg ha-1, which is positively related to the higher hectoliter weight of 39.5 kg hl-1 and a higher weight of 100 seeds with 6.01 g. The hybrids Cobalt II HO and Daytona CL obtained yields of 2 634 and 2 281 kg ha-1, respectively.

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In Table 2 of the demonstration plots, the average values of the variables weight of 100 seeds, hectoliter weight, and grain yield were presented. In terms of yield, the hybrid SYN 3 950 HO stands out with 3 596 kg ha-1, Cobalt II HO obtained 3 058 kg ha-1 and Daytona CL 2 545 kg ha-1. It was observed that the hectoliter weight varied from 33.5 in Cobalt II HO to 39 kg hl-1 in SYN 3950 HO. The weight of 100 seeds ranged from 4.86 in the hybrid Daytona CL to 5.89 gr in the hybrid Cobalt II HO.

In the yield trial, the hybrid SYN 3 950 HO, with a yield of 3 362 kg ha-1, differed significantly from Cobalt II HO and Daytona CL and in the demonstration plots, the hybrids SYN 3 950 HO and Cobalt II HO, with yields of 3 596 and 3 058 kg ha-1 respectively, indicate that it is feasible to obtain yields greater than 3 000 kg ha-1 in southern Sonora; these results agree with Arenas *et al*. (2020), who mention yields greater than 3 570 kg ha-1 of grain, with the application of nitrogen at 100 kg ha-1 and the inoculation of the biofertilizer.

Likewise, Raya *et al*. (2022) report that, in sunflower cv. Victoria aceitero, fertilization with 80 kg of nitrogen (N) and 80 kg of P2O5, using urea (46 N) and diammonium phosphate (18 N-46 P2O5) as a source, and the foliar application of diatomaceous earth in doses of 1% every seven days generated the highest grain yield (2 047 kg ha-1), followed by this same dose every 14 days (1 715 kg ha-1). In this sense, Morales *et al*. (2015) mention that the sunflower cultivars evaluated responded differently to the nitrogen dose applied, where the maximum seed yield was obtained with Periquero when applying the highest dose of nitrogen (120 kg N ha-1) and with the medium dose of slow-release urea; nitrogen is a nutrient that increases growth, the duration of the leaf area, and the photosynthesis of the crop, characteristics that allow the sunflower to increase the seed yield per unit area.

On the other hand, Rodríguez *et al*. (2021) mention that, without fertilizing or applying pesticides in a hybrid experiment where they were evaluated with two controls (DO-704 and Tecmon-2), yields were in a range of 1.4 to 2.5 t ha-1, with the highest yielding group correlated with the hybrid with the highest oil content. Therefore, it is suggested to continue conducting trials on sunflower hybrids in southern Sonora, evaluating different variables such as doses and sources of nitrogen.

Conclusions

The sunflower hybrid SYN 3950 HO presented yields of 3 362 and 3 596 kg ha-1, Cobalt II HO of 2 634 and 3 058 kg ha-1, Daytona CL of 2 281 and 2 545 kg ha-1. The yields obtained from the sunflower hybrids evaluated allowed them to be suggested for planting to producers in southern Sonora.

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