

## SUNFLOWER GENETIC IMPROVEMENT IN THE MEXICAN "ALTIPLANO POTOSINO" SEMIARID ZONE

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### SUMMARY

Three sunflower (*Helianthus annuus* L.) open pollinated varieties and one hybrid were tested in two selection cycles during 1986 and 1987. The produced populations were evaluated in 1988 in an experiment planted in the "Altiplano potosino" semiarid north central zone of México.

A 10% from each population was selected on the following aspects basis: head diameter, plant height (1.40-1.60 m), black color of the seed, absence of branches with head, and disease and pest freedom. Selection was made on the basis of the best adjusted weight using the following formula:  $Y = \bar{X}_g + (Pp - \bar{X}_p)$ .

Based on the agronomic characteristics and yield components evaluated, the five best yields were found in the following genetic materials: TECMON 3 original, TECMON 3 1st. cycle, TECMON 3 2nd. cycle, Victoria variety and D0-725 original hybrid, with the yields of about 2.252, 2.577, 2.261, 2.302 and 2.583 t/ha, respectively. At the same time, they were the genetic materials with the best oil content ranging from 35.75% to 44.13%.

**Key words:** Sunflower (*Helianthus annuus* L.), breeding, seed yield, semi-arid.

### INTRODUCTION

The main critical aspect that limits the agricultural production in the "Altiplano Potosino" zone is the lack of water. Rainwater is not only insufficient in the dryland areas, but too irregular during the agricultural cycle. The Altiplano is a zone of about 890,000 km<sup>2</sup> in the north central region of México, but only 6.6% of the Altiplano Potosino are irrigated lands. In the dry land portion there is a 300-400 mm average rainfall.

The program developed to obtain satisfactory production under low rainfall conditions has to pursue as an objective to produce as much as it is possible under that limiting factor. In this sense, there are many ways to modify vegetal populations and to change them in the desired way, but it is important to consider the behavior developed by the wild species, which, under an evolution process, acquired properties which helped them to survive.

To avoid the loss of genetic resources it is necessary to make a selection process in each micro climate bearing in mind that the objectives in each location will be different. In this way, an efficient or sustainable use of natural resources and ecology of every region will be made.

There are regions in México with a pattern of rain level from 300 to 400 mm on the annual basis in which it is economically and technically feasible to establish cultivars but accepting only a low yield. Sunflower is an alternative cultivar in these zones. That is why this experiment was initiated using the genetic materials TECMON1, 2 and 3, and D0-725.

## MATERIALS AND METHODS

The experiment was carried out in the Altiplano Potosino zone in Mexico, in the spring-summer cycle in 1986, 1987 and 1988. In the first stage, selection was made using the modern mass stratified method in the following varieties: TECMON1, TECMON 2, TECMON 3 and D0-725 under irrigation conditions during 1986 and 1987. In the second stage, an evaluation was made including the commercial variety Victoria as the control, TECMON 4 and D0-725 which had been harvested as the first dry land selection. The TECMON varieties were developed, produced and provided by the Instituto Tecnológico y de Estudios Superiores de Monterrey, México.

The experiment was established at the Experiment Station of the School of Agriculture of the UASLP located north 22,14'03" Lat. and west 100,53'10" Long. and 1,832 meters above sea level. The climate is dry, cold, with a 17.6 Celsius degrees average, 7.5 minimum and 35.5 maximum. The annual rainfall level average is 371.3 mm, the rain occurring mainly from May to September. Soils are rich in potassium, low in nitrogen content and moderate in phosphorus content and poor in organic matter.

### a) First stage: modern mass stratified selection, 1986 and 1987

Four selection lots were established with TECMON 1 to 3 and D0-725. Trying to standardize the agronomic characteristics of each variety, a negative phenotypic selection was made by discarding plants with one or various non-desirable characteristics. In each lot, 10% of plants were chosen considering agronomic criteria as head diameter, plant height (1.40-1.60 m), black color seed, absence of branching, freedom from diseases and pests, and with a uniform pattern of competence. The selected plants were labeled in order to identify the source. They were threshed, the seed weighed and the weight per plant estimated using the following formula:  $Y = \bar{X}_g + (Pp - \bar{X}_p)$  in which  $Y$  = adjusted weight,  $\bar{X}_g$  = mean,  $Pp$  = weight per plant and  $\bar{X}_p$  = mean per plot. Under this criteria, the selection of heads per plot relative to 10% of total was made, selecting by seed color and on the best adjusted weight basis, obtaining a balanced mixture for each variety. Three seeds of each head selected were used to set up a variety sample that was analyzed in the CIAMEC-INIFAP-SARHA Olegianous Laboratory in Chapingo, México, to determine the oil content. Identical methodology was used in both cycles, 1986 and 1987.

### b) Second stage: evaluation of genetic materials in 1988

An evaluation lot was established in June, 1988. Four original populations, four samples obtained from the first cycle (1986), four samples obtained from the second cycle (1987) and the first selection cycle under dry land conditions of D0-725 variety, with the commercial "Victoria" variety as the control and a new variety TECMON 4 were sown.

The design used was RCBD in four replicates, with 0.75 m distance between rows and 0.25 m distance between plants. The following agronomic characteristics were measured: leaves per plant, leaf area, plant weight and stem diameter. The following yield aspects

Table 1. Agronomic and yield characteristics from 14 sunflower cultivars, evaluated in Summer 1988. Experimental Station. School of Agriculture. UASLP. San Luis Potosi. México.

Material	Leaves per plant	Leaf area (cm <sup>2</sup> )	Height (cm)	Stem diameter (cm)	Moisture (%)	Head diameter (cm)	Seeds per head	Achene weight (g/l)	Yield (t/ha)	Oil content (%)
TECMON 1 Original	20.00	468.14	137.5	2.55	12.55	17.40	858	370.75	1.778	36.97
TECMON 1 1st cycle	22.25	399.52	167.3	2.25	9.05	18.40	968	375.75	1.760	38.42
TECMON 1 2nd cycle	18.75	351.01	150.2	2.03	12.42	16.93	927	382.75	1.766	37.35
TECMON 2 Original	18.25	400.26	149.1	2.26	7.70	15.68	786	409.00	1.559	33.54
TECMON 2 1st cycle	18.00	350.64	161.1	2.13	10.00	15.95	889	408.00	1.866	32.63
TECMON 2 2nd cycle	17.50	421.39	162.0	2.08	13.35	15.20	805	399.25	2.227	36.44
TECMON 3 Original	21.75	397.38	146.3	2.11	9.53	16.28	1294	396.75	2.252	39.25
TECMON 3 1st cycle	23.25	502.98	161.0	2.44	12.90	18.90	1179	394.75	2.577	35.75
TECMON 3 2nd cycle	20.50	443.30	167.3	2.35	9.69	17.17	1154	394.50	2.261	42.71
Victoria (control)	18.75	453.53	155.8	2.38	10.57	18.50	1218	383.75	2.302	41.29
DO-725 Original	23.00	420.05	149.0	2.33	10.36	15.53	1296	360.75	2.583	44.13
DO-725 1st cycle irrigated	19.00	337.94	145.5	2.09	12.46	15.33	1299	377.50	1.868	41.13
DO-725 1st cycle dry land	18.25	395.51	137.0	2.16	10.28	14.68	1029	373.75	1.795	39.20
TECMON 4	21.75	350.88	148.0	2.52	15.65	20.93	833	360.25	1.427	38.74

Note: The oil content analysis was made under the Magnetic Resonance Nuclear Method in dry basis, in the Oleaginous Laboratory. SARH-INIFAP, Chapingo. México.

were measured in each variety: moisture percentage (as a measure of earliness), head diameter, achenes per head, achene liter weight, tons/ha yield and oil content.

## RESULTS AND DISCUSSION

### a) Evaluation of agronomic characteristics

In accordance with the hypothesis test and variation studies, the number of leaves per plant had a range from 17 to 23 with no significant differences. Leaf area had a range from 350 to 503 cm<sup>2</sup>/plant without significant differences (Table 1). Plant height (1.37 to 1.67 m) and stem diameter (2.0 to 2.55 cm) were the characteristics with no significant variation between the varieties evaluated.

### b) Yield components evaluation

Table 1 shows the average results of four replicates for the yield components evaluated.

The variation analysis and hypothesis test (Table 2) indicated significant differences between all the genetic materials in all the yield components evaluated.

The highest yields were obtained with the following materials: TECMON 3 original, TECMON 3 1st. cycle, TECMON 3 2nd. cycle, commercial "Victoria" variety and commercial hybrid D0-725 original with the yields about 2.252, 2.577, 2.261, 2.362 and 2.583 t/ha, respectively. They were also the materials with the best oil content, with a range from 35.77 to 44.13%.

Table 2. Variation study for yield components in 14 genetic materials of sunflower evaluated in the summer 1988, UASLP, México. Square mean and significance.

Variation source	Freedom degrees	Humidity %	Chapter diameter (cm)	Seeds per head	Achene weight (g/l)	Yield (t/ha)	Oil content %
Varieties	13	17.454*	12.412*	139990.0*	1018.361*	0.486*	21.491*
Error	39	6.86	5.010	25599.0	14.051	0.144	3.773
C. V.	%	23.49	13.35	15.02	1.0	19.05	5.29

(\*) Significant

## CONCLUSIONS

There is genetic variation in the original materials TECMON 1, 2 and 3 for selection purposes of both, the agronomic and yield characteristics. These materials could be utilized to obtain new, improved open-pollinated varieties for the region.

The highest yield and oil content were obtained from the TECMON 3 materials.

Sunflower hybrids are potentially an important source of germplasm to produce open-pollinated varieties adapted to the micro climates of these areas of México.

Sunflower is an alternative cultivar for semiarid zones in México based on the yields and oil contents indicated in this study.

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**MEJORA DE GIRASOL EN LA ZONA SEMIARIDA MEXICANA DEL "ALTIPLANO POTOSINO"**

## RESUMEN

Tres variedades de polinización libre y un híbrido se sometieron a dos ciclos de selección en los años de 1986 y 1987, siendo evaluadas las poblaciones resultantes en 1988 en un diseño de bloques al azar con cuatro repeticiones en el Altiplano Potosino, México.

La presión de selección aplicada a cada población fue del 10% dirigida a: diámetro del capítulo, altura de planta (1.40-1.60 m), color negro de semilla, ausencia de ramificaciones con capítulo, libre de plagas y enfermedades y competencia completa, realizando la selección en base al mejor peso ajustado por la siguiente fórmula:  $Y = \bar{X}_g + (Pp - \bar{X}_p)$ .

En base a las características agronómicas y componentes del rendimiento evaluados, los cinco mejores rendimientos corresponden a los materiales genéticos: TECMON 3 original, TECMON 3 1er. ciclo, TECMON 3 2nd. ciclo, Variedad Victoria y al híbrido D0-725 original, con rendimientos de 2.252, 2.577, 2.261, 2.302 y 2.583 t/ha respectivamente, así como también son las poblaciones que reportaron mayor porcentaje de aceite, variando desde 35.75 a 44.13%.

**AMELIORATION GENETIQUE DU TOURNESOL DANS LA ZONE SEMIARIDE DE L'ALTIPLANO POTOSINO, AU MEXIQUE**

## RÉSUMÉ

Trois variétés de tournesol (*Helianthus annuus* L.) en pollinisation libre et un hybride ont été testés durant deux cycles de sélection en 1986 et 1987. Les populations produites furent évaluées en 1988 dans un essai implanté au RCBD, en quatre répétitions, dans la zone semi-aride de l'Altiplano potosino, de la région centrale du Nord du Mexique.

Une fraction de 10% de chaque population a été sélectionnée sur les bases suivantes: diamètre du capitule, hauteur de la plante (1.40-1.60 m), coloration brune de la graine, absence de ramification avec capitule dépourvu de maladies ou d'attaques parasitaires. La sélection a été réalisée sur la base d'une meilleure pondération selon la formule suivante:  $Y = \bar{X}_g + (Pp - \bar{X}_p)$ .

Sur la base de l'évaluation des caractéristiques agronomiques et des composantes du rendement, les cinq meilleurs rendements ont été mesurés dans les matériels génétiques suivants: TECMON 3 de départ, TECMON 3 1r cycle, TECMON 3 2 cycle, la variété Victoria et l'hybride DO-725 de départ, avec un rendement de l'ordre de 2.252, 2.577, 2.261, 2.302 et 2.583 t/ha respectivement. Parallèlement, ces matériels génétiques présentaient les meilleurs teneurs en huile (valeurs comprises entre 35.75% et 44.13%).