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EFFECTS OF MONO AND POLYCEPHALY IN SUNFLOWER YIELD

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Summary

A possible alternative to increase sunflower yield is to consider plants with two or more heads of the same size and with simultaneous flowering and maturity.

The objetive of this work was to determine yield variation between monocephalic sunflower plants and those polycephalic obtained artificially.If the last ones had a higher yield,a breeding plan to produce this kind of plants genetically would be justified.

Three trials were made during three seasons.Different sunflower hybrids were used in a split plot design.

During the three years it was observed that polycephalic plants had the same or higher number of seeds with the same or lower weight than monocephalic plants and higher oil content.Seed and oil yields were the same or lower than those obtained from monocephalic plants.

Introduction

The increase in oil and grain yield is the principal objective in sunflower plant breeding.Experiences in other crops like corn, show the possibility of increasing yield through the increment in the number of ears by plant.

Sunflower commercial cultivars have one head (monocephalic) but extrapolating what is said above about corn, we could believe that polycephalic sunflower would have more heads and so yield would be increased.Unfortunatelly, polycephalic sunflower produces a diminished head size and non-simultaneous maturation of heads that difficults harvest.

Nevertheless, there is an Y-branched form, that has two heads which mature simultaneously and whose all other morphological characters are very similar.

Making a mechanical elimination of the apical meristem, it is possible to produce a phenocopy of this gene and an evaluation of its behaviour can be done.If Y-branched sunflower produced in this way had more yield than monocephalic sunflower, an effort to introduce Y-branched character in cultivated sunflower material is worthwhile.

The objetive of this work is to study how polycephaly affects yield in one genotype.

Materials and Methods

Three trials were carried out during 1986/87,1987/88 and 1989/90 seasons at the Balcarce Experiment Station (INTA-Faculty of Agricultural Sciences).

A split-plot in a completely randomized design with 4 repetitions was used, where the commercial hybrids were the principal plot and the treatments: mono-polycephalic were the sub-plots.

The sub-parcels had four rows, 5.10m long and 0.70m apart.The distance between plants was 0.30m.

To produce polycephalic plants, the apical meristem was eliminated when the first two true leaves were present.

In the first assay, plants with two, three and four branches were obtained.In the second and third assay,only two branches were left, and the rest were cut off.

On table 1, cultivars used, sowing dates and measurements done are found.

Analysis of variance was performed.

Results and Discussion

When monocephalic and polycephalic treatments were compared in the **first trial** (Table 2), significant differences between means were detected ($p<0.01$) by the analysis of variance for the variables: number of heads by plant, number of seeds by plant and 1000 seed weight.Although the number of seeds in polycephalic plants was higher than in monocephalic, their lower weight was probably the factor that equilibrated both yields.

The number of floral stems by surface unit in polycephalic plants was probably too high and competence did not allow to produce higher yields.To dismiss this hypothesis in the following trials two branched plants (dicephalic) were evaluated.

In the **second assay** (Table 2) no significant differences were detected between monocephalic and dicephalic sunflowers for the variables: 1000 seed weight, seed number by plant, seed yield and oil yield, but dicephalic plants produced 0.6 points more ($p<0.05$) oil content.

Dicephalic plants flowered three days later than monocephalic plants probably as a consecuence of the stress suffered by the elimination of apical meristem and excess of branches.Head surface of monocephalic plants did not differ significantly from the total surface of both heads of dicephalic plants, so it can be infered that monocephalic and dicephalic plants contributed to yield with the same head surface.

Monocephalic plants were in average 15 cm taller ($p<0.01$) than dicephalic plants, this difference was higher in the stages following the elimination of apical meristem than later in full flowering stage.Probably,dicephalic plants recovered from the stress suffered.

Although the upper third part of the leaf area in dicephalic plants was significantly higher ($p<0.01$),total leaf area and the absorbed photosynthetically active radiation by plant were similar in both treatments.

40% less of dicephalic plants were affected by *Sclerotinia sclerotiorum* but this value was subestimated because practically in all the cases each attacked dicephalic plants presented only one diseased head. This is in agreement with Leclercq's (1984) opinion. So, if a strong attack of Sclerotinia occurred, with a determined quantity of inoculum, the damage suffered by the polycephalic cultivar, and provided all the other factors remain constant, would be lower.

In the **third assay** (Table 2), the number of seeds did not differ among treatments, but 1000 seed weight in monocephalic plants was 21% higher, producing in consecuence a higher seed yield ($p<0.01$).

Dicephalic plant seeds produced ($p<0.05$) a higher oil percentage in relation to monocephalic plants, in coincidence with the results of season 1987/88. Oil production per surface unit of monocephalic plants was significantly higher ($p<0.01$), probably as a consecuence of the higher seed yield that has not been compensated by the higher oil content of dicephalic plants.

In conclusion, the first two years monocephalic and polycephalic plants produced the same seed yield but the behaviour of yield components was different depending upon the year; on the first one, the higher seed number or the higher seed weight was equilibrated by the lower seed weight or the lower seed number depending whether they were monocephalic or polycephalic respectively; while on the second one, weight and number of seed reacted independently from the level of cephaly. On the third year the weight of seeds was the reason of the higher seed yield of monocephalic plants.

But it must be taken into account that to obtain dicephalic plants it was necessary to submit them to stressing conditions and to physiological alterations. This could mask the real situation of the respective gene incorporated in the genetic materials. In agreement with Liu and Leclercq (1988) Y-branched plants yielded in a preliminary trial realized in France 21% more than monocephalic plants, producing a higher number of lighter seeds.

Table 1:Sowing date,hybrids used and measurememt made on the three trials.

ASSAY	SOWING DATE	CULTIVARS	MEASUREMENTS
I(1)	26/11/86	Sungro 382 SPS 891 Asgrow 522 Topflor Contiflor 3	-head number/plant -1000 seed weight -seed number/plant -seed yied
II	22/12/87	Sungro 382 SPS 891 Asgrow 522 Topflor Contiflor 3 Dekalb B 101 Cargill S 430 Florón 328	-days from sowing to complete flowering(2) -head surface/plant -plant height during flowering -upper third part and total foliar area by plant(3) -absorbed photosynthetically active radiation(4) -Percentage of plants with Sclerotinia -1000 seed weight -seed number/plant -oil content -seed and oil yields(5)
III	30/11/89	Topflor Cargill S 430	-days from sowing to complete flowering(2) -1000 seed weight -seed number/plant -oil content -seed and oil yields(5)

(1)Preliminary assay published in the XII International Sunflower Conference.
(2)Full flowering was considered when 50% of the plants of the sub-plot were flowering.
(3)In accord to Pereyra et al.,1982.
(4)In accord to Gallo y Daughtry,1986.
(5)Oil yield=seed yield x oil content

Tabla 2:Average of analyzed variables in monocephalic and polycephalic treatments in the three assays and their meaning.

VARIABLES	ASSAY I			ASSAY II			ASSAY II		
	M(1)	P(2)		M	P		M	P	
days from sowing to flowering	-	-		94	97	**	75	79	**
plant height(m)	-	-		1.38	1.21	**	-	-	**
head surface(cm2)	-	-		226.7	222.3	NS	-	-	
total foliar area/plant(cm2)	-	-		6.750	6.370	NS	-	-	
upper third part area/plant(cm2)	-	-		2.016	2.517	**	-	-	
APAR(3)	-	-		933.4	938.8	NS	-	-	
Plants with Sclerotinia(%)	-	-		10.2	6.7	*	-	-	
1000 seed weight (g)	48.9	40.4	**	46.4	45.4	NS	49.6	41.1	**
seed number/plant	1265	1589	**	904	893	NS	816	882	NS
seed yield(kg/ha)	2554	2470	NS	2002	1958	NS	1984	1667	**
oil content(%)	-	-		46.2	46.8	*	43.8	44.4	*
oil yield(kg/ha)	-	-		922	915	NS	867	741	**

(1):Monocephalic plants
(2):Polycephalic plants
(3):Absorbed photosynthetically active radiation
*:$p<0.05$
**:$p<0.01$
NS:No significant

Conclusions

-The weight of 1000 seeds was the same or higher in monocephalic plants.

-Seed number by plant was the same or higher in polycephalic plants.

-Seed yield was the same or lower in polycephalic plants but never was higher.

-Oil content was higher in polycephalic plants but not high enough to alter significantly the final product: seed yield multiplied by oil content.

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References

GALLO,K.P. and DAUGHTRY,C.D.T. 1986. Techniques for measuring intercepted and absorbed photoshynthetically active radiation in corn canopies. Agronomy Journal 78:752-756.

KESTELOOT,J.A.;CASTAÑO,F. and COLABELLI,M.N. 1988. Comparison between mono and polycephalic sunflower plants. Proc. XII International Sunflower Conference. Novi Sad,Yugoslavia. p.512-517.

LECLERCQ,P. 1984. Etude sur l'heredite du caractere isomature chez le tournesol. Agronomie 4(1):101-104.

LIU,G.S. and LECLERCQ,P. 1988. The expression of the Y-branched character in sunflower. Proc. XII International Sunflower Conference. Novi Sad,Yugoslavia. 2:443-447.

MARCELLAN,O.N. 1988. Comparación de caracteres morfológicos y agronómicos entre híbridos de girasol monocefálicos y dicefálicos. Tesis Ing. Agr. Balcarce,Facultad de Ciencias Agrarias.

PEREYRA,V.;FARIZO,C.L. and CARDINALI,F.J. 1982. Estimation of leaf area on sunflower plants. Proc. X International Sunflower Conference. Surfers Paradise,Australia. P.21-23.