COMPETITION EFFECTS AMONG CULTIVARS DIFFERING IN CYCLE IN SUNFLOWER TRIALS

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SUMMARY

The influence of interactions between type of plot and cultivar on the suitability of sunflower trials was evaluated by comparing two hybrids differing in cycle in one and two row plots bordered by both hybrids in all possible combinations.

Competition effects of the genotype bordering the plots were evident both under irrigation and rainfed conditions, but in the latter they were lessened and non significant. Yield of the early hybrid was understimated when plots were bordered by the late one, while in the opposite situation (late bordered by early) yield was overestimated. The degree of missestimation was higher in the case of one row plot. It was concluded that the use of one or two unbordered row plots in sunflower trials could significantly affect the estimation of yield, if neighbouring genotypes differ in cicle and that three or four row plots should be used for suitable evaluation.

INTRODUCTION

Most large scale sunflower testing programs, wheter they support development of commercial cultivars or basic research, depend on yield results obtained from one to four row plots to estimate relative performance. There has been a long-standing concern over the effect of plant cycle competition between adjacent plots on measured yields. If the magnitude of the relative competitive advantage of sunflower cultivars in adjacent plots due to differences in

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length of cycle is large relative to the yield differentials on which decissions are based, a significant bias will favor the advancement of either long or short cycle cultivars, both in breeding and to commercial levels.

The need for guard rows in yield trials to avoid border effects has been established for such crops as soybean (*Glycyne max* (L.) Merr.) (6) but has been found unnecesary in other crops as sorghum (*Sorghum bicolor* (L.) Moench) (9). In corn trials, there is literature to both support (2), (5), (7) and oppose (1), (8) the use of borders.

In sunflower, Enns et al. (3) reported that the yield of an early cultivar was reduced significantly in nonbordered plots as a result of competition from a late cultivar. Fick and Swallers (4), compared one and three row plots, finding yields of individual cultivars ranging from 50 % higher to 25 % lower in single row plots as compared to three row plots. They suggested an association between these differences and differences in height and maturity of neighbouring cultivars

In Spain, the official yield trials carried out by the National Seed Institute (I.N.S.P.V) produce basic data which is used to approve new cultivars which are registered in the National Variety List. These trials, in the case of sunflower, and for practical reasons, are in some instances arranged in two unbordered row plots.

In sunflower breeding programs is quite usual to obtain preliminary yield data from single row plot trials. Single row plots have advantages for preliminary evaluation of experimental sunflower cultivars in that relatively small amounts of seed are required and a large number of entries can be tested on a limited land area.

We conducted this study to obtain additional information on the effects of intercultivar competition and to determine whether unbordered single or two row plots would provide reliable yield and seed oil content data on sunflower cultivar performance as compared with bordered plots.

MATERIAL AND METHODS

One late hybrid, SH-222 (S) and one short cycle hybrid, ARBUNG-E-353 (A), differing approximatedly 10 days in 50 % days to flowering were arranged in 12 treatments. These consisted of one and two row plots of each hybrid bordered by themselves in all possible combinations. Therefore the 12 possible treatments resulted as follows:

AAA SAA SAS Short cycle in single row plot
SSS ASS ASA Long cycle in single row plot
AAAA AAAS SAAS Short cycle in two rows plot
SSSS ASSS ASSA Long cycle in two rows plot

Treatments were assigned to a Randomized Complete Block Design with 4 replications. Rows were 10 meters long, 0.75 meters apart (as usual in trials). Two identical trials were carried out: one in irrigated conditions and the other in a typical rainfed sunflower cropped area of west Andaluisa (southern Spain).

Trials were managed as usually done with other sunflower trials. Data were recorded on days to flowering, seed yield of each individual plot (converted to Kg/Ha) and a seed sample of each plot was analysed for oil content using the N.M.R. technique. For seed yield, depending on type of plot, one or two rows were harvested.

RESULTS AND DISCUSSION

Data corresponding to seed yield (Kg/Ha) and seed oil content (%) of the different treatment combinations are presented in Table 1.

There where no significant differences in days to flowering for each hybrid tested in a different plot treatment, being always 11 days the difference between the long cycle hybrid, SH-222 (S) and the earlier one, ARBUNG-E-353 in whatever combination under irrigated conditions and 9 days in rainfed conditions.

Table 1.- Yield (Kg/Ha) and seed oil content (%) of the different treatment combinations on both environments.

TREATMENTS	YIELD (Kg/Ha)		OIL CONTENT (%)	
	Irrigated	Rainfed	Irrigated	Rainfed
AAA	3015	1333	47	43
SAA	2816	1179	49	43
SAS	2347	1206	48	43
SSS	3059	1021	49	44
ASS	3686	1130	49	44
ASA	4079	1056	49	44
AAAA	3205	1324	50	43
SAAA	2975	1086	48	43
SAAS	2756	1268	47	43
SSSS	3249	1033	48	44
ASSS	3168	883	48	44
ASSA	3676	1110	50	44
Mean	3169	1136	49	43
l.s.d. (5 %)	582	246	n.s.(1)	1
Hybrid A (2)	2852	1232	48	43
Hybrid S (2)	3486	1038	49	44
l.s.d. (5 %)	284	101	n.s.(1)	1

(1) n.s.= non significant (5%)
(2) Averaged over treatments
A = Short cycle hybrid row
S = Long Cycle hybrid row

Late hybrid (S) yielded significantly higher in the irrigated environment than the early hybrid (A). The opposite situation holds in the rainfed environment , where the stress caused by a limited soil water content makes the early hybrid more suitable, although in a quite lower yield level.

According with the results obtained in both experiments there were no significant diffferences between yield of each individual hybrid in one and two row plots when bordered by themselves, which suggest that trial efficiency should not be negatively affected by using three row plots instead the most usual four row plot arrangement.

According with data from the irrigated trial, yield of the early sunflower hybrid grown in single row plots was negatively and significatively affected when it was bordered in both sides by the late cultivar (SAS), as

compared with the same hybrid bordered by itself (AAA). Opposite border effects were evident when the late hybrid grown in one row plot was both-sides bordered by the early one (ASA) as compared with SSS. These results are in agreement with those reported by Fick and Swallers (4).

Similar border effect seems to hold for treatments in two row plots of both early and late hybrids when bordered in both sides by the other one, although in this case differences do not reach the level of significance at 5 %.

However in the rainfed experiment, competition influence did not reach the same magnitude. Although in most of the cases treatments both-sides bordered by a distinct hybrid showed yield differences in treatments with hybrids bordered by themselves, these differences, were always non significant. This fact might be due to the low level of yield (about 1 Tm./Ha), typical of a more stressed environment that precludes the possibility of full potential expression of each hybrid, making the early hybrid (A) to outyield the late hybrid (S) in spite of the higher yield potential of the latter (as shown in the irrigated environment). Early hybrids, in most of the cases, perform better under such a water limited environmental conditions (8).

Competition does not seem to have any effect on the seed oil content of the hybrid in none of the environments (Table 1) which agrees with the results obtained by Fick and Swaller (4)

Based in the results presented in this study it does appear that bordered plots improved efficiency to the point that it is worth the expense of increasing the plot an test size. Because of the apparent association between yield and competitor maturity, an accurate identification of early and even late, high yielding cultivar in one row and possibly in two row plots would be difficult if they are bordered by cultivars of different maturity. This difficulty would be of higher magnitude in those more productive environments.

Unbiased results from sunflower yield trials would appear to be avoided only by bordering a cultivar by itself, or possibly by grouping cultivars to avoid intermixing of extreme types in maturity and/or height.

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