EVALUATION OF RELATION BETWEEN THE YIELD OF ACHENES AND YIELD COMPONENTS IN HYBRID SUNFLOWER BREEDING

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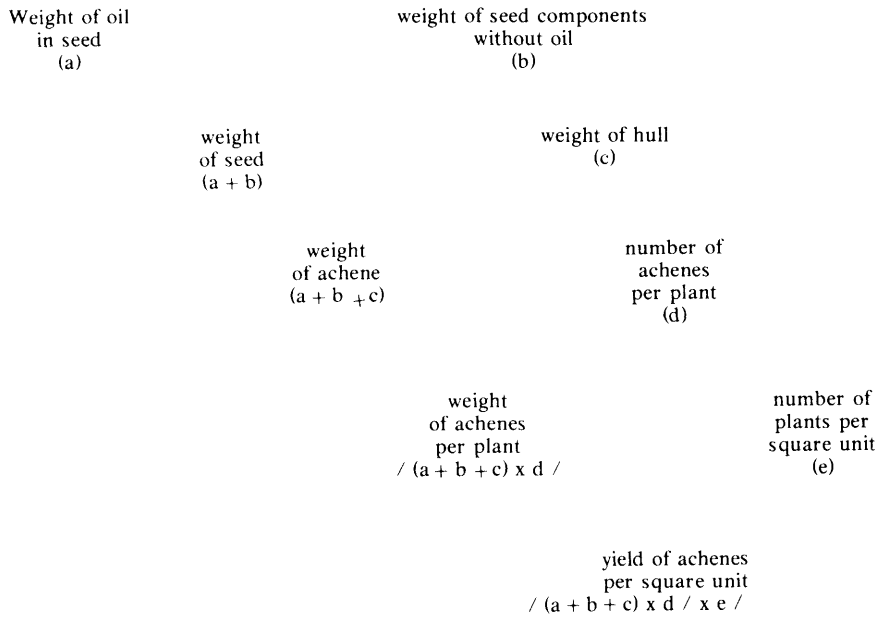
At the present level of sunflower breding the increase of yield of achenes per square unit by breeding with simultaneous conservation of the high level of oil content and low level of hulls of achenes seems to be the decisive factor for the increase of sunflower oil production.

Yield of achenes like yield of oil per square unit is a complex genetic trait. Following scheme presents its components:



If we express the yield of achenes per square unit by means of the given formula // (a+b+c) x d / xe / then the yield of oil per square unit can be expressed either directly (a x d x e) or indirectly //(a+b+c) x y x d / x e /, where y represents the proportion of oil in relation to the weight of achene.

If we consider the single binomials from the point of view of breeding in the scheme we can state that the ratio of components a, b as well as of components (a+b), c has already achieved optimum by breeding. The decisive factor in sunflower breeding still remains to be the improvement of value of the component d and its optimum relation to the component (a+b+c) namely to the number of achenes per plant and weight of achene. Component e, number of plants per square unit can be affected by breeding to a certain degree, however, it depends largely on the organization of the stand, i.e. management practices.

We investigated several aspects of hybrid sunflower breeding affecting the value of the trait and relations between the traits in the case of yields of achenes per plant, number of achenes per plant and weight of achene. We studied following relations:

1. Effect of various duration of inbreeding on the yield of achenes and its components in lines.
2. Effect of duration of inbreeding of parents on the yield of achenes and its components in F_1 hybrids.
3. Effect of the origin of lines from one or more populations on the yield of achenes and its components in F_1 hybrids.
4. Strength of the relation between parental lines and F_1 hybrids in the yield of achenes and its components.

RESULTS

Value levels of traits achieved in single inbred generations in percentage of I_1 generation are given in table 1.

TABLE 1

Inbred generation	yield of achenes	number of achenes	weight of achene	diameter of head
L_3	54,17	66,71	81,25	95,90
I_4	32,53	44,72	72,73	87,89
I_5	12,21	20,76	55,68	84,38

Data in the table indicate that inbreeding leads to a significant decrease of the yield of achenes as well as of both its components. Whereas the most distinct decrease was found in the yield of achenes, the components are less affected by the inbred depression. Decrease of the number of achenes per head contributes more to the decrease of yield of achenes than reduction of weight of single achenes.

Comparison of both yield components with the diameter of head shows that after inbreeding the number of achenes decreased considerably and to a certain degree also the size of achenes even when the size of head was not remarkably reduced. This anomaly is obviously caused by a larger distance between achenes in the head in the lines than in the hybrids.

Table 2 shows hybrid vigour in percentage of hybrids differing in the duration of inbreeding of parents. Group of lines 19-25 represents I_2 generation, group of lines 27-33 represents I_3 generation.

TABLE 2

Combination of lines	yield of achenes	number of achenes	weight of achene
19 x 20	128,65	106,00	121,34
19 x 22	126,22	90,82	106,12
20 x 21	162,07	142,15	114,04
23 x 25	121,65	94,16	107,28
27 x 28	126,12	111,15	95,74
27 x 30	93,17	79,74	93,54
28 x 29	109,77	106,07	94,73
31 x 33	109,24	100,30	97,14

Data show that the hybrid vigour in the weight of achenes is lower when parents after long-lasting inbreeding are used. Similar trend for the differentiation of hybrids into two discrete groups correlated with the duration of inbreeding of parental lines was not observed in the number of achenes. Values of the hybrid vigour in this trait were heterogeneous in the hybrids of lines in I_2 and I_3. The dependence upon the combining ability of parents without influence of the duration of their inbreeding has the decisive role. In the yield of achenes the effect of both components is important. Consequently, there is a trend to a partial differentiation of hybrids into two groups. However, this trend is substantially weaker than in the weight of achenes.

achenes although to a smaller extent. Coefficient of correlation achieves an intermediate value in this case, therefore for the realization of the phenotype of the hybrid a larger contribution of the effect of combining ability of parental lines than of the level of their trait value can be presumed.

Both components are characterized to a certain degreee by the trend for the realization of relation between the parental phenotype and the manifestation of the trait in hybrid progeny. Mutual complementarity of these components does not enable to differentiate the effect of the parental phenotype in the yield of achenes as a complex trait. In the yield of achenes the productivity of the parental lines does not decide the level of the trait in the hybrid; their combining ability has the decisive role.

To a certain level of yield of achenes the productive value of the hybrid is not determined either by the difference in the productivity or by the difference in the origin of parental lines, but by their concrete hybridization prerequisites expressed by the combining ability. We can presume that in the breeding of highly productive hybrids in the future the distinct genotypic difference of lines connected with their distant origin will decide the possibility to overcome the present yield level.