Interdependence Among a Genotype, CMS Source and Some Other Characters of Sunflower (*Helianthus annuus* L)

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Abstract

The subject of the study was interdependence of four inbred lines, two sources of sterility (PET-1 and ANN-5) and certain plant or seed traits. The traits monitored for changes were not only those of the inbred lines under investigation but also of hybrids between them and of three restorers as well. All four inbred lines were shown to have different values of the examined traits, depending upon the cms source that had been introduced into them. The majority of the traits had the highest values in the crosses between maintainers and the three restorers.

Key words: Inbred lines, PET-1, ANN-5, restorer, hybrid

Introduction

The discovery of cytoplasmatic male sterility by LECLERCQ (1969), as well as that of restorer genes by KINMAN (1970), VRANCEANU AND STOENESCU (1971) and others, made possible the development of sunflower hybrids for wide use.

The cms source discovered by LECLERCQ is the basic one and is widely used in the sunflower hybrid production. Yet, the use of one and the same cms source over and over again presents a great risk. What is essential, therefore, is a more detailed research of the cms sources discovered so far and, at the same time, an effort towards the discovery of new ones.

Researches of certain authors have so far been focused on monitoring the changes in quantitative traits of the lines into which particular cms sources have been introduced. Thus, STOJANOVA AND PETROV (1980) report that the cytoplasm of *Helianthus petiolaris* has no effect on the biological and economic characteristics of sunflower and, therefore, can be successfully applied in the hybrid seed production. Several years later, PETROV ET AL.

(1985) suggest that the sterile sunflower analogs based on the *H. petiolaris* cytoplasm appear to be more susceptible to broomrape than the maintainers.

PETROV (1990) reports that the PET-2 cytoplasm has no depressive effect on the biological and economical characters and can, therefore, be successfully used in the hybrid sunflower production. However, the ANN-1 and ANT-1 cytoplasm affects plant height, seed yield per head and head diameter and can be used in sunflower production within certain limits.

The objective behind this paper was to make a step forward in these researches. We are of the opinion that it is of vital importance to learn if the genotype, cms sources and major agronomic traits in hybrid combinations with different restorers really are interdependent, and if they are, of what character this interdependence is.

Materials and methods

The experimental material consisted of four inbred lines (L-1, L-10, L-14, L-19) and three restorers (RHA-1, RHA-2, RHA-3). The PET-1 and ANN-1 sources of sterility (by LECLERCQ (1969) and MARINKOVIĆ and MILLER (1995), respectively) were introduced into all four lines and , in the course of 1993 and 1994, crosses were made between the cms lines and restorers. In addition to this, restorers were crossed with maintainers from all lines. The stamens of the maintainer plants serving as females were removed manually and in the early morning hours.

In 1995, at the Experimental Field of the Rimski Šančevi breeding station within the Institute of Field and Vegetable Crops, Novi Sad, the trial with the full set of experimental material was established in a randomised block design with three replications. The spacing between the rows was 70 cm and that between plants in a row 30 cm. During the vegetation period, crops were cultivated and hoed for the purpose of weed control.

At the end of vegetation period, head diameter (cm), 1000 seed mass (g), oil content (%) and seed yield per plant (g) were established in the laboratory.

Data processing was done by ANOVA-II (MSTATC program) and treatment comparison by means of LSD test with a levels of significance of 5%.

Results and discussion

Both sterile forms of the line L-1 had a significantly better performance than the maintainers only with regard to seed oil content (Table 1.), whereas

with regards to head diameter, the maintainers were significantly outperformed only by the sterile form of the line with the PET-1 source. The sterile forms of lines and maintainers did not differ as to 1000 seed mass and seed yield per plant.

In regard to head diameter, seed oil content and seed yield per plant, the sterile form of the line 10 with the source PET-1 had significantly higher values from both the maintainers and sterile forms with the source ANN-5. The latter significantly outperformed the other two with regards to 1000 seed mass.

With line L-14, the sterile form with the source ANN-5 produced significantly higher values than the maintainers with respect to all investigated traits, whereas the other sterile form was significantly outperformed with regard to head diameter and seed yield per plant. The sterile form with the source PET-1 had significantly higher values than the maintainers with regard to 1000 seed mass and seed oil content.

The sterile forms of the line L-19 had a significantly better performance than the maintainers only as to seed oil content. Regarding all other traits, the values of these forms were either lower or level with those of the maintainers.

It should be noticed that the values of the majority of investigated traits in crosses are the highest in the crosses between the maintainers of all four lines and the restorers (Table 1.).

Regarding all the crosses, those between both of the sterile forms of the line L-1 and the restorer RHA-3 had significantly higher 1000 seed mass, whereas those between the sterile form with the source ANN-5 and the restorer RHA-1 performed significantly better with regard to seed oil content. The values of all the other crosses between both of the sterile forms and the three restorers were either level with or lower than those of the crosses between the maintainers and restorers.

Combinations between both of the sterile forms of the line L-10 and the restorer RHA-1 had the highest values for head diameter and seed oil content. With regard to the latter trait, significantly high values were also observed in the cross between the sterile form with the source PET-1 and the restorer RHA-3.

A similar situation was also present in the crosses between all three sterile forms of the line L-14 and the three restorers. Only the crosses between both of this line's sterile forms and the restorers RHA-1 and RHA-2 exhibited significantly higher values than the rest of the crosses, namely with regard to seed oil content.

In crossing both of the sterile forms of the line L-19 with the restorer RHA-3, highest values were detected solely in regard to 1000 seed mass. All other crosses between the sterile forms and restorers produced values that were either level with or lower than those of the crosses between the maintainers and restorers.

To summarise, it can be said that the introduction of a cms source into an inbred line brings about either an increase or a decrease in the values of quantitative traits of the sterile analogs. The same is achieved by some crosses between these sterile analogs and certain restorers. All of this points to the conclusion that researches such as this should continue and ideally come to include a greater number of inbred lines as well as sources of sterility and cover a greater stretch of time. For nothing should prevent the replacement of one cms source with another, if it turns out to be economically justified.

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Table 1. Mean values and range of studied genotypes

			Trait							
			Head diameter (cm)		1000 seed weight (g)		Oil content (%)		Seed yield per plant (g)	
1	L-1	M*	18.97	B	49.00	A	48.60	B	47.93	A
	L-1	P	20.47	A	46.70	A	53.32	A	49.93	A
	L-1	A	18.40	B	50.47	A	54.52	A	56.33	A
2	L-10	M	16.33	B	39.10	C	33.42	C	29.00	B
	L-10	P	26.90	A	50.57	B	51.64	A	57.77	A
	L-10	A	15.63	B	62.97	A	42.83	B	30.30	B
3	L-14	M	19.93	C	42.83	B	39.99	B	49.57	B
	L-14	P	21.23	B	50.63	A	41.75	A	49.20	B
	L-14	A	22.27	A	55.80	A	42.43	A	86.10	A
4	L-19	M	25.47	A	53.93	A	49.84	C	58.73	A
	L-19	P	18.00	B	50.83	AB	44.74	B	42.73	C
	L-19	A	25.17	A	45.10	B	52.86	A	51.40	B
5	RHA-1		13.63	B	25.90	B	35.79	C	16.33	B
	RHA-2		15.43	A	37.67	A	46.80	B	26.57	A
	RHA-3		12.23	C	26.27	B	49.20	A	16.43	B
6	L-1 M x RHA-1		27.53	A	56.57	A	46.35	B	95.07	A
	L-1 P x RHA-1		23.77	B	48.80	B	47.22	AB	64.80	C
	L-1 A x RHA-1		22.97	B	50.83	B	49.37	A	82.33	B
7	L-1 M x RHA-2		25.70	A	48.77	A	49.88	A	78.10	A
	L-1 P x RHA-2		25.97	A	46.10	A	50.26	A	78.53	A
	L-1 A x RHA-2		24.63	A	49.00	A	52.50	A	81.50	A
8	L-1 M x RHA-3		24.50	A	45.77	B	51.47	A	70.83	A
	L-1 P x RHA-3		23.17	A	53.27	A	50.23	A	60.43	A
	L-1 A x RHA-3		23.77	A	51.87	A	53.58	A	79.87	A
9	L-10 M x RHA-1		21.40	B	70.33	A	38.18	B	87.57	A
	L-10 P x RHA-1		25.07	A	54.93	B	43.81	A	76.90	A
	L-10 A x RHA-1		21.80	AB	63.43	AB	43.36	A	87.70	A
10	L-10 M x RHA-2		29.63	A	60.37	A	46.65	A	112.3	A
	L-10 P x RHA-2		25.27	B	54.23	A	50.86	A	77.33	B
	L-10 A x RHA-2		23.23	B	59.00	A	48.40	A	89.17	B
11	L-10 M x RHA-3		25.50	A	58.73	A	42.88	C	65.83	A
	L-10 P x RHA-3		23.53	A	47.90	A	52.13	A	69.47	A
	L-10 A x RHA-3		23.17	A	55.23	A	50.45	B	87.63	A
12	L-14 M x RHA-1		22.20	A	64.30	A	37.83	B	90.80	A
	L-14 P x RHA-1		22.10	AB	54.30	B	43.06	A	76.90	A
	L-14 A x RHA-1		20.80	B	56.63	B	42.71	A	86.73	A

Table 1. Mean values and range of studied genotypes (continued).

		Trait							
		Head diameter (cm)		1000 seed weight (g)		Oil content (%)		Seed yield per plant (g)	
13	L-14 M x RHA-2	23.93	AB	53.50	A	45.67	B	81.67	A
	L-14 P x RHA-2	28.17	A	55.37	A	46.43	AB	61.13	B
	L-14 A x RHA-2	22.10	B	53.87	A	47.67	A	79.33	A
14	L-14 M x RHA-3	23.60	A	49.23	A	49.93	A	77.83	A
	L-14 P x RHA-3	23.30	A	52.23	A	48.33	A	72.20	A
	L-14 A x RHA-3	21.07	B	53.90	A	49.50	A	70.50	A
15	L-19 M x RHA-1	27.07	A	55.93	A	46.48	A	71.03	AB
	L-19 P x RHA-1	28.90	A	56.53	A	46.00	A	66.53	B
	L-19 A x RHA-1	22.67	B	55.83	A	49.49	A	86.97	A
16	L-19 M x RHA-2	27.10	A	54.27	A	51.20	A	89.87	A
	L-19 P x RHA-2	25.37	AB	55.53	A	47.86	B	90.70	A
	L-19 A x RHA-2	24.73	B	53.83	A	52.11	A	88.70	A
17	L-19 M x RHA-3	26.80	A	51.37	B	51.82	A	79.00	A
	L-19 P x RHA-3	24.63	A	59.17	A	52.49	A	53.33	B
	L-19 A x RHA-3	23.90	A	55.47	AB	50.99	A	79.50	A

* M = Martainer; P = PET-1 source; A = ANN-5 source