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INVESTIGATION ON THE INHERITANCE OF THE TRAITS NUMBER OF SEEDS PER PLANT AND 1000 KERNEL WEIGHT IN SUNFLOWER HYBRIDS

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Abstract
The investigation was carried out during 2013 – 2016 at Dobrudzha Agricultural Institute – General Toshevo, Bulgaria. The traits number of seeds per plant and 1000 kernel weight are of primary importance; they influence the increase of yield. This investigation included 8 hybrid combinations and the parental forms involved in the crosses. The additive-dominant relations of the traits were analyzed through the ratio between the parameters d/a. In crosses 217A x 88R, 813A x 97R, 813A x 100R, and 2003A x 98R, super dominance according to the parental forms was observed. Higher number of seeds per plant and 1000 kernel weight were obtained in these hybrid combinations in comparison to the parental forms. Incomplete dominance of these traits was found in combinations 217 x RW666 and 217 x 138R.

Keywords: sunflower breeding, inheritance, quantitative traits.

Introduction

Sunflower, together with soybean and oil seed rape, amounts to 87 % of the production of oleaginous plants worldwide. It is a main agricultural crop grown on 23 million ha worldwide (FAO, 2012). Cultural sunflower (*Helianthus annuus* L.) ranks second after soybean by production of vegetable oils in the world. During the last 30 years, the world production has increased several times (Quresh *et al*., 1992). The developing of genetic diversity is directly related to the higher efficiency of the breeding process (Mihova and Dimova, 2012). The use of the wild species for developing of new fertility restorer lines is related to enhancement of the quantitative and qualitative indices of the hybrid combinations and their resistance to biotic and abiotic stress (Valkova, D., 2013, 2015). The thorough investigation of the main characters determining the yield of the parental sunflower lines is a good basis for more efficient breeding work. These statements have been confirmed in the investigations on other crops by a number of authors (Chamurliyski et al., 2012; Nenova et al., 2005). The number of seeds per plant is a character ensuring high yields. Kovacik and Skalound (1977) reported a high correlation between yield and number of seeds per plant. Thousand kernel weight is a variable value dependant on the effects of genetic factors and environmental conditions. This character, being an important qualitative index, gives an idea about the size, plumpness and fullness of the seeds. The character 1000 kernel weight is strongly influenced by the climatic factors, the used agronomy practices, and most of all – by the genotype. It is a main element of yield. The breeding for higher 1000 kernel weight leads to higher seed yield, so this character is used as a criterion for selection in the developing of sunflower hybrids (Miller and Fick, 1997; Kaya et. al., 2003; Goksoy and Turan, 2007; Hladni et al. 2008; Yasin and Singh 2010; Kholghi et al.2011). The aim of this investigation was to follow the type of inheritance of the main indices of F_1 in sunflower: number of seeds per plant and 1000 kernel weight. A direct effect was found depending on the type of inheritance of these characters.

Material and methods

The field experiment was carried out in the trial field of Dobrudzha Agricultural Institute – General Toshevo (DAI) during 2013 – 2016 according to a conventional technology for growing of sunflower

(Georgiev et al., 1997). Eight hybrid combinations were tested, which were obtained from the crossing of three lines with cytoplasmic male sterility to three fertility restorers. The hybrid combinations were tested in a field trial designed in three replications according to the Latin square method. The size of the plot was 7.35 м^2. The Bulgarian hybrids San Luka and Veleka were used as standards, as well as one of the most productive and popular foreign hybrid PR64F50. The indices number of seeds per plant and 1000 kernel weight were investigated in all hybrid combinations, and the heritability rate in F_1 was determined. The heritability rate of these two indices in the hybrid combinations was determined by the methodology of (Romero, G. & Gray, F., 1973). Correlation analysis was applied for statistical processing of the results using software XLSTAT Pro. ver 7.0.1.

Results and discussion

Figure 1 presents the results for the heritability rate of the index 1000 kernel weigh in the F_1 hybrid progenies. Super dominance of this index was found in all tested hybrid combinations. The highest values of heritability rate were obtained for crosses 813A x 98R (10.90), 2003A x 98R (11.30), 1017A x 98R (13.10). It is worth mentioning that the same fertility restorer line 98R was included in all of the above three hybrid combinations. The super dominance is a result from the accumulation and recombination of genes in the hybrid crosses. The high values of the index 1000 kernel weight in these three hybrid combinations were due to the fact that the mother and the father lines have similar values. Super dominance of this index was also found in the other hybrid combinations involved in the investigation (217A x 88R, 813A x 100R, 217A x RW666, 217A x 100R, 2003A x 84R); the difference was that their values were lower. This was a result from the values of the mother component significantly exceeding the values of the male parent. Similar results have been obtained also by Laureti, Gatto (2001) and Farroki et. al. **(**2008a).

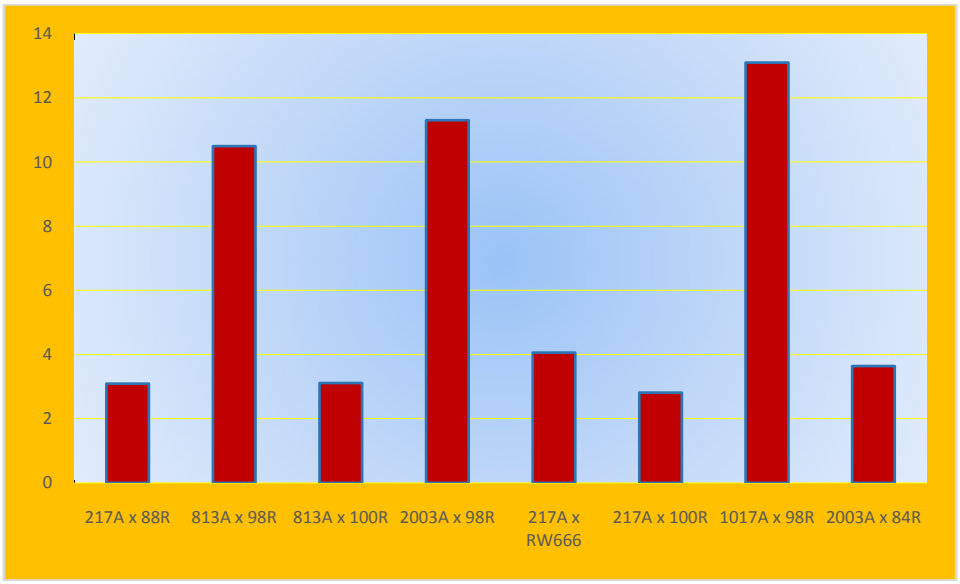

Figure 1. Type of inheritance of the character 1000 kernel weight in hybrid combinations (F_1).

The results presented in Figure 2 characterize the heritability rate of the index number of seeds per plant in the hybrid combinations. With regard to this character, highest values were obtained in crosses 217A x RW666 (3.34), 217A x 88R (2.56), 813A x 100R (2.45) and 813A x 98R (2.38). In all these hybrid combinations, super dominance was found according to the index number of seeds per plant. This super dominance was due to the established difference between the parental lines and the obtained hybrid combination in F_1. Incomplete dominance of this index was found only in one cross: 217A x 100R (0.79). It resulted from the obtained similar values between the mother

parental form and the F_1 hybrid combination. Similar results have been reported by Joksimovic et al. (1992, 1995) and Josic (2004).

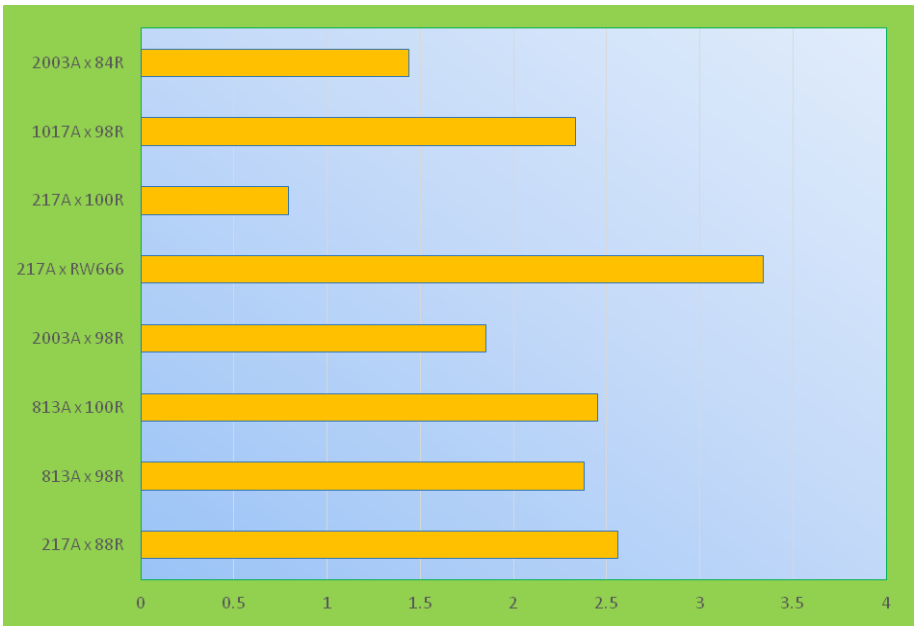

Figure 2. Type of heritability of the character number of seeds per plant in hybrid combinations (F_1)

Table 1 presents the correlation analysis of the characters included in the investigation – number of seeds per plant and 1000 kernel weight. The higher 1000 kernel weight (MC1000 = 0.519**) of the investigated hybrid combinations was in narrow positive correlation with the index number of seeds per plant. Similar results for a positive direct effect between number of seeds per plant and 1000 kernel weight have also been obtained by Marinkovic (1992), Goskoy & Turan (2007), Behradfar et.al. (2009).

Table 1. Correlation analysis

	NSP	*M1000C*
NSP	*1*	
M1000C	*0.519***	*1*

*** - p ≤ 0,01; ** - p ≤ 0,05; * - p ≤ 0,1; n.s. – non significant

Key: NSP – Number of seeds per plant; M1000C - 1000 kernel weight

Conclusions

In three hybrid combinations, 813A x 98R, 2003A x 98R and 1017A x 98R, super dominance of the index 1000 kernel weight was found. It was due to the fact that the mother and the father lines were with similar values. In the hybrid combinations, the genes recombined and accumulated. Lower values of super dominance were determined according to this index also in crosses 217A x 88R, 813A x 100R, 217A x RW666, 217A x 100R and 2003A x 84R; the difference in this case was that the values of the sterile lines significantly exceeded the values of the fertility restorers. According to the index number of seeds per plant, super dominance was found in hybrid combinations 217A x RW666, 217A x 88R, 813A x 100R and 813A x 98R. Incomplete dominance of this character was determined only in one cross: 217A x 100R. It resulted from the similar values of the mother parent and the hybrid combination F_1.

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