Combining Ability for Yield and Agronomic Characters in Sunflower

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Introduction

In the breeding program, it is very important to know the combining abilities of inbred lines that are used as parents in hybrids. The diallel method of genetic analysis has been widely used to assess the combining ability of parents in hybrids (Miller et al., 1980; Kadkol et al., 1984; Sherrif et al., 1985). The analysis of diallel cross by the method proposed by Griffing (1956) which partition the total variation into general combining ability (GCA) of the parents and specific combining ability (SCA) of the crosses have been widely used. Putt (1966) has reported for his materials that SCA was more important than GCA for seed yield, head diameter and 1,000-seed weight. Marinkovic (1993) reported that GCA effect was more important than SCA for oil content and he found that lines with high GCA gave higher yielding hybrids than lines with low GCA. Mijic et al. (2008) reported that both GCA and SCA were significant for yield, oil content and oil yield, and estimates of GCA were greater than SCA in magnitude. This experiment was conducted to estimate general and specific combining ability for seed yield, head diameter, 1,000-seed weight, plant height and oil content to select the best combiner for sunflower hybridization.

Materials and Methods

Seven inbred lines of sunflower were developed by Suranaree University of Technology (SUT), Thailand. They were as 2A, 5A, 7A, 8A, 10A, 11A and 12A. All the inbred lines are of medium to high oil content. A half diallel cross of 7x7 without reciprocals proposed by Griffing (1956) was used to produce F1 hybrids, in 2008. The 21 hybrids were evaluated in a randomized complete block design with three replications at Nakhon Ratchasima, Thailand during 2008-2009. Each plot consisted of 4 rows of 5 m long and spacing of 0.75 m between rows and 0.30 m between plants within row. Fertilizer was applied at the rate of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}. Recommended herbicides were used to suppress weeds. Diseases and insects were controlled by regular application of fungicides and insecticides. Data were recorded for seed yield, head diameter, 1,000-seed weight, plant height and oil content. Analyses of variance were computed for all characters over 2 locations. Griffing Method IV was to estimate combining ability (Griffing, 1956).

Results and Discussion

The mean square for GCA was highly significant for head diameter and significant for seed yield and oil content, whereas mean squares for SCA were highly significant for plant height and 1,000-seed weight (data not shown). The GCA effects for yield and other characters of inbred lines are presented in Table 1. The results revealed that inbred lines 5A, 2A and 7A gave high GCA effects for yield (8.54, 5.26 and 3.44, respectively). The highest GCA effects for head diameter was observed for line 10A (0.60), followed by lines 5A (0.56) and 11A (0.50). The lines 5A and 2A appeared to be good combiners for oil content (1.11 and 1.08, respectively).

The SCA effects for yield and other characters of crosses are presented in Table 2. The cross of 5Ax2A showed the highest SCA effect for 1,000-seed weight (2.67), followed by the crosses of 12Ax5A (1.94) and 7Ax2A (1.31). The highest negative SCA effect for plant height was observed for the cross 12Ax2A (-8.80). However, the highest specific combination for seed yield was 12Ax2A (12.32), followed by 10Ax5A (8.96). Among the crosses, 8Ax7A showed the greatest positive SCA effect for head diameter (1.22), followed by 5Ax2A (0.98). The best specific combinations for oil content were 10Ax8A (1.94), followed by 5Ax2A (1.45) and 8Ax7A (1.22).

Table 1. General combining ability for yield and agronomic characters of 7 inbred lines.

Lines	Yield	Head diameter	1,000-seed weight	Plant height	Oil content
2A	5.26**	-0.66**	0.06	1.35*	1.08**
5A	8.54**	0.56**	1.01**	-0.65	1.11**
7A	3.44*	-0.56**	-0.13	-1.62**	-0.76**
8A	-7.97**	-0.75**	-0.10	-0.29	-0.69**
10A	-4.96**	0.60**	0.29*	2.07**	0.34
11A	-3.71*	0.50**	-0.60**	-1.62**	-0.61**
12A	-0.59	0.30*	-0.62**	0.77	-0.47*

*, ** Significant at 0.05 and 0.01 probability levels, respectively

Table 2. Specifie combining ability for yield and agronomic characters of 21 hybrids.

SCA	Yield	Head diameter	1,000-seed weight	Plant height	Oil content
5Ax2A	6.91	0.98**	2.67**	-6.60**	1.45**
7Ax2A	5.64	-0.28	1.31**	0.57	1.08*
8Ax2A	-7.69	0.38	-0.37	9.80**	-1.74**
10Ax2A	-16.67**	0.09	-0.98**	-0.53	-0.77
11Ax2A	-0.51	-0.91	0.56	5.57**	0.43
12Ax2A	12.32**	-0.25	-3.19**	-8.80**	-0.44
7Ax5A	-4.05	-0.02	-2.56**	-2.20	-0.06
8Ax5A	6.87	-0.73**	-0.33	3.20*	-1.06*
10Ax5A	8.96	0.34	-0.39	-1.47	-0.11
11Ax5A	-6.32	0.62**	-1.34**	-0.87	-0.62
12Ax5A	-12.36**	-1.18**	1.94**	7.93**	0.40
8Ax7A	-13.37**	1.22**	0.17	-0.13	1.22*
10Ax7A	3.83	-0.89**	0.79*	9.70**	-0.63
11Ax7A	1.77	0.01	0.84*	-4.20**	-1.17*
12Ax7A	6.17	-0.04	-0.57	-3.73**	-0.45
10Ax8A	6.31	-0.41	-0.09	-8.40**	1.94**
11Ax8A	1.29	-0.51*	-0.35	-2.97*	-0.96
12Ax8A	6.59	0.05	0.97**	-1.50	0.59
11Ax10A	5.53	0.13	0.05	-1.47	0.99
12Ax10A	-10.95*	0.76**	0.62	2.17	-1.43**
12Ax11A	-3.26	0.66**	0.23	3.93**	1.32*

*, ** Significant at 0.05 and 0.01 probability levels, respectively

Conclusion

Seed yield, head diameter and oil content are important traits in sunflower. Among the lines, 2A and 5A were found to be good general combiners for yield, 1,000-seed weight and oil content and also involved in promising cross combinations. The lines 5A and 10A exhibited maximum GCA effect for head diameter. Among the crosses, 2Ax5A gave high seed yield, high oil content, high 1,000-seed weight, medium head diameter and plant height, which are the desired traits for better population. Therefore, the lines 2A and 5A were of good potential to be used as parents for hybrid due to their high performance and their hybrid having one of the highest SCA effect in yield, 1,000-seed weight and oil content.

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