



Genetic analysis of earliness trait and its components in safflower (*Carthamus tinctorius* L.) by diallel cross

Hossein Hatamzadeh¹, Sayyed Saeed Pourdad¹, Mehdi Jamshid Moghddam¹, Khoshnood Alizadeh¹,

1. Dry land Agricultural Research Institution, Sararood Station, Kermanshah, P.O. BOX: 67145-1164, Iran, hosseinhatamzadeh@yahoo.com

Abstract

To improve hardiness of dry stress at maturity stages in rain fed conditions, varieties are needed which have shorter growing cycle. Therefore the genetic control determining the number of days to the beginning of flowering, days to end flowering, flowering period and days to maturity needs to be determined to allow the efficient breeding of early maturing lines and varieties. In this research, in the first year, genotypes were crossed in one way diallel. The results showed that parents PI-250537 and PI-301055 were better than other parents for earliness traits due to their general combining ability (GCA) for these traits with suitable additive genes in two parents (PI-250537 and PI-301055) for earlier days to beginning flowering, earlier days to end flowering and earlier days to maturity. PI-250537*PI-301055 hybrid was the best hybrids. in terms of heterosis for days to beginning flowering and days to maturity (-1.33 and -3.33 respectively); this hybrid also had the best SCA for traits under in this study with strong dominant genes for earliness traits and it can be used for production of early maturing hybrids .

Key words: Genetic analysis – earliness – heritability - safflower

Introduction

All the time, genetic variation had been basic requirement for breeding. Researchers can execute breeding proper methods when they know genetic variation in plant populations. Shitole et al. (1986) studied genetic variation in safflower populations developed through pedigree and bulk methods. They proclaimed that both of these methods had high heritability for days to flowering 50% and days to maturity. But expected genetic gain was relatively low. In research on general compatibility it has been reported that the variety JLSF19A shows good general compatibility for earliness, plant height and seed yield (Patil et al. 1992). Gupta and Singh (1990) advertised that EC31367 * LOCAL and EC31367 * EC27249 inoculations showed the most mines heterosis (-2.28%) for days to flowering and the most mines heterosis (-2.29%) days to maturity. Also, they reported additive, dominant and epistasis genes effects. Patil et al. (1992) reported high heritability for days to flowering 50%, days to maturity, plant height and seed yield. Kotecha (1979) reported that gene action was non additive for flowering time, maturity time and flowering to maturity time. Musa and Munoz (1990) reported that the variety Quririego88 was three days later than Gila variety for flowering and maturity. Meanwhile, its seed yield and oil% (3020 Kg/ha and 38.1% respectively) was more than Gila variety (2504 Kg/ha and 37.2% respectively).

Materials and methods

Three early varieties (PI-250537, PI-258417, PI-301055) and two late varieties (Arak Local and Ajabshir Local) were selected as parents for crossing. They were selected based on results from previous year's experiments. In the first year, varieties were crossed in a one way diallel according to the method of Griffing (1956). For this purpose, parents were planted in two rows with two meters length and distance row to row 30 centimeters in first November. The crosses were irrigated for increasing success rate and prevention of dry stress. Field activities included plough and disc at the end of September. Fertilizer rate was N60, P₂O₅60 (Maleki and Feri, 2006). In second year, parents and F1 seeds were compared in a RCBD with three replications at the Agricultural Research Station of Sararood-Iran. During the growing season and after harvesting traits recorded included day to beginning of flowering, day to end of flowering, flowering period and day to maturity. Weeds were deleted by hand (before rosette and



beginning stem). Method three of Gardener–Eberhart was used in order to conduct the diallel analysis for earliness. In this way, sum of square were separated to three parts (parents, parents Vs F1, F1). F1 were separated two parts (GCA and SCA). Using this method, parents yield does not influence the estimate of combining ability (Parodi and et al. 1983).

Results:

Variance analysis results (Table1) showed that there were significant differences among genotypes at 1% probability level for days to beginning flowering, ending flowering, flowering period and days to maturity. Parents mean of squares (Table1) indicated significant differences at 1% probability level for all traits. Parents Vs hybrids mean of squares (Table1) showed significant differences at 1% probability level for days to beginning flowering, ending flowering, flowering period and days to maturity. Hybrids mean of squares (Table1) showed significant differences at 1% probability level for days to beginning flowering, ending flowering and days to maturity.

Table1: Mean squares for diallel data utilizing method III according to Gardener–Eberhart.

S.O.V	df	DBF	DEF	FP	DM
Replication.	2	0.422 ^{ns}	0.089 ^{ns}	0.267 ^{ns}	1.267 ^{ns}
Genotype.	14	80.232 ^{**}	54.07 ^{**}	10.37 ^{**}	76.39 ^{**}
Parents	4	91.882 ^{**}	90.9755 ^{**}	4.7413 ^{**}	88.0853 ^{**}
P vs F1	1	217.687 ^{**}	110.276 ^{**}	11.9348 ^{**}	60.4288 ^{**}
F1	9	59.781 ^{**}	31.422 ^{**}	12.70 ^{ns}	72.967 ^{**}
Error	28	0.851	0.737	0.767	1.671
CV%		0.40	0.35	7.38	0.49

df=degree of freedom, GCA= general compatibility, SCA= special compatibility, DBF= days to beginning flowering, DEF= days to end flowering, FP= flowering period, DM=days to maturity. **, *, ns significant at 1%, 5% probability level and non significant respectively.

GCA mean of squares (Table 2) showed significant differences at 1% probability level for days to ending flowering indicating that additive genetic effects have are significant in explaining days to ending flowering trait. Parents GCA showed that PI-250537 and PI-301055 parents had the most GCA ,significant at 1% probability level for day to beginning of flowering (-3.7996 and -2.3551 respectively) and day to maturity (-2.1333 and -3.6889 respectively). SCA mean of squares (Table2) showed significant differences at 1% probability level for days to beginning flowering, ending flowering, flowering period and days to maturity, indicating that the above traits were influenced by gene dominant effects. Of course, days to ending flowering was influenced by additive and dominant effects. But, Sahu and Tewari (1993) declared that days to flowering 50% was influenced by genetic additive part and days to maturity was influenced by genetic additive and non additive part. PI-301055 parent and PI-250537 * PI-301055 hybrid showed the least day to end of flowering and day to maturity. Mean while, PI-250537 * PI-301055 hybrid average was significantly different from it's parents mean (Table3).

Discussion and conclusion:

The results showed that parents PI-250537 and PI-301055 were better than other parents for earliness traits. There were suitable additive genes in two parents (PI-250537 and PI-301055) for earlier days to beginning flowering, earlier days to end flowering and earlier days to maturity as indicated by these having the highest GCA for above traits (table 4).



Table 2: Mean of square for general and special compatibility in traits under studying

S.O.V	df	DBF	DEF	FP	DM
GCA	4	104.855 ^{ns}	57.644 ^{**}	21.64 ^{ns}	92.52 ^{ns}
SCA	5	23.722 ^{**}	10.444 ^{**}	5.54 ^{**}	57.32 ^{**}
Error	28	0.2837	0.244	0.2557	0.557

df=degree of freedom, GCA= general compatibility, SCA= special compatibility, DBF= days to beginning flowering, DEF= days to end flowering, FP= flowering period, DM=days to maturity. **, *, ns significant at 1%, 5% probability level and non significant respectively.

Table 3: Traits mean for parents and hybrids

DBF= days to beginning flowering, DEF= days to end flowering, FP= flowering period, DM=days to maturity.

	Genotype	DBF	DEF	FP	DM
1	PI-250537	227.67	242.33	14.67	261.33
2	PI-258417	231.67	242.67	11.00	264.00
3	PI-301055	226.33	239.00	12.67	257.00
4	Ajabshir Local	241.33	253.00	11.67	270.00
5	Arak Local	239.33	250.33	11.00	269.00
1*2	(PI-250537*PI-258417)	225.33	239.67	14.33	260.67
1*3	(PI-250537*PI-301055)	225.00	239.00	14.00	253.67
1*4	(PI-250537*Ajabshir Local)	234.00	245.00	11.00	262.00
1*5	(PI-250537*Arak Local)	230.00	244.00	14.00	264.33
2*3	(PI-258417*PI-301055)	231.00	240.67	9.67	261.00
2*4	(PI-258417*Ajabshir Local)	231.67	241.00	9.33	259.67
2*5	(PI-258417*Arak Local)	235.33	245.00	9.67	263.33
3*4	(PI-301055*Ajabshir Local)	234.00	245.00	11.00	265.00
3*5	(PI-301055*Arak Local)	228.67	242.33	13.67	256.33
4*5	(Ajabshir Local*Arak Local)	239.33	249.67	10.33	271.67
	LSD 5%	1.543	1.436	1.465	2.162

Therefore, these two parents in breeding programs as parents with suitable additive genes. PI-250537*PI-301055 hybrid was the best hybrids. This hybrid showed better parent heterosis for days to beginning flowering and days to maturity (-1.33 and -3.33 respectively). PI-250537*PI-301055 hybrid had the best SCA for traits under studying. This hybrid had good dominant genes for earliness traits and it can be used for hybrid productions.

Table 4: general compatibility effects of Parents in traits under studying

		DBF	DEF	FP	DM
Parent	gca effect	gca effect	gca effect	gca effect	gca effect
1	PI-250537	-3.7996 ^{**}	-1.6220 ^{**}	2.1767 ^{**}	-2.1333 ^{**}
2	PI-258417	-0.7996 ^{**}	-2.0653 ^{**}	-1.2667 ^{**}	-0.7989 [*]
3	PI-301055	-2.3551 ^{**}	-1.8453 ^{**}	0.5133 ^{ns}	-3.6889 ^{**}
4	Ajabshir Local	4.4238 ^{**}	2.7113 ^{**}	-1.7133 ^{**}	3.7556 ^{**}
5	Arak Local	2.5327 ^{**}	2.8213 ^{**}	0.2900 ^{ns}	2.8677 ^{**}
	SE(gj)	0.29	0.27	0.29	0.34
	SE(gi-gj)	0.45	0.42	0.45	0.54

DBF= days to beginning flowering, DEF= days to end flowering, FP= flowering period, DM=days to maturity. **, *, ns significant at 1%, 5% probability level and non significant respectively.



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