IDENTIFICATION OF HIGH YIELDING AND GENETICALLY POTENTIAL SAFFLOWER GENOTYPES ON THE BASIS OF FIELD PERFORMANCE

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ABSTRACT

Five candidate and one commercial safflower genotypes, namely, P-I 253 566, P-I 405 995, P-I 205 077, P-I 405 990, P-I 195 895 and Thori-78 (Check) were evaluated for yield potential during the year 2012-2013. The experiment was conducted in a three replicated Randomized Complete Block design at Oilseeds Section, A.R.I. Tandojam. The study was aimed to identify safflower genotypes on the basis of yield potential that can well suit the area and perform well, secondly progenies from these could also be obtained so as to reach varietal development in safflower. The results revealed that among safflower genotypes, for primary branches cultivar P1-205 077, for secondary branches cultivars P1-205 077, P1-405 995 and P1-405 990, in capsules.plant^{-1} cultivars P1-405 995, P1-205 077 and P1-405 990, in seeds.capsule^{-1} cultivar P1-405 995, for seed index cultivars P1-405 995, P1-405 990, P1-253 566 and P1-205 077; and in seed yield.plant^{-1} cultivars P1-253 566, P1-405 995; P1-195 895 and P1-405 990; surpassed the commercial check Thori-78.

Keywords: Safflower, Field performance, Yield potential, genetic diversity, Pakistan.

INTROUCTION

Safflower (*Carthamus tinctorius* L.) belongs to family Asteraceae (Compositae) and considered to be the only cultivated species of *Carthamus* genus. It is a multipurpose crop, possessing potential medical, pharmaceutical and cosmetic importance all over the world (Emongor, 2010). Safflower is currently grown mostly for edible oil, considered as one of the best for human consumption due to high quantities (70-75%) of poly-unsaturated (Linoleic acid) or monounsaturated fatty acid (Oleic acid) (Nimbkar and Singh, 2005). The crop was originally grown for the flowers that were used in making red and yellow dyes for clothing and food preparation. Today this crop supplies oil, meal, birdseed, and foods (residue from oil processing) for the food and industrial market products, although this crop is now primarily grown for the oil. This crop is adapted to dryland or irrigated cropping systems (Helm *et al.*, 1991; Oelke *et al.*, 2004). In Pakistan, the commercial varieties of safflower are Gilla, US-10, S-208 (spiny) Thori-78 and Pawari-95 (spineless).

Evolution and utilization of high yielding and early maturing varieties have a pivotal position in the crop production technology package. In most of the countries, efforts are being made to breed earlier maturing and more determinate crop varieties. In some countries, the breeding programs are continued over many years with the objective to develop varieties which can best be grown in a season restricted by temperature (Mehta and Arias, 2001). Selection is one of the most important tools in crop improvement. The importance of selection for a particular trait depends upon the extent of correlation between yield traits and seed yield. Therefore, before initiating selection in a crop improvement program it becomes necessary to know the relative importance of different traits in influencing the trait of economic importance in the desired direction. Moreover, the success of safflower production as an economical crop and its competition with the other oilseed crops is dependent upon the development of high yielding cultivars. Thus, most efforts in safflower breeding programs emphasize on improvement of seed yield and oil content. The effectiveness of a selection program for improving a quantitative trait such as seed yield and oil content is mostly dependent upon the genetic variation of the trait in the germplasm and its heritability (Falconer and Mackay, 1996). The study was aimed to identify safflower genotypes on the basis of yield potential.

MATERIALS AND METHODS

The study was carried out during 2012-13 on the evaluation of yield potential in commercial varieties of safflower by assessing *per se* under field conditions. The seed of safflower varieties were sown in a randomized complete block design with three replications in experimental field of Oilseeds Section, Agriculture Research Institute, Tandojam in a plot size of 4.5m x 2.4m. The safflower varieties were sown in 0.6 m apart rows. Four rows of each of the following safflower genotypes were grown for studies. Thinning in the experimental safflower crop

was carried out after one month of sowing to maintain plant to plant space. Ten plants of each genotype from each replication selected at random were tagged to record the data in the field and laboratory. The genetic materials were consisted of five candidate genotypes and one check varieties viz., P-I 253 566, P-I 405 995, P-I 205 077, P-I 405 990, P-I 195 895 and Thori-78 (Check). The traits investigated were days to 75% flowering, days to 90% maturity, plant height in (cm), number of primary branches.plant^{-1}, number of secondary branches.plant^{-1}, number of capsules.plant^{-1}, number of seeds.capsule^{-1}, seed index (100 seed weight, g) and seed yield.plant^{-1} (g). The data collected was subjected to analysis of variance using the statistical software MSTATC. The difference among the treatment means were compared by the least significant difference (LSD) at least at $p<0.05$ (Steel and Torrie, 1984).

RESULTS

It is apparent from the results in Tables 1 and 2 that among safflower genotypes, the growth and yield components such as days to 75% flowering, plant height, number of secondary branches.plant^{-1}, number of capsules.plant^{-1}, number of seeds.capsule^{-1}, seed index and seed yield.plant^{-1} were significantly ($P<0.05$) different; while the differences among genotypes for the number of days to 90% maturity and number of primary branches.plant^{-1} were statistically non-significant ($P>0.05$). The non-significant differences among varieties for days to 90 percent maturity might be associated with the climatic conditions, because in case the sudden change in the weather conditions, particularly sudden rise in the temperature; early maturity of winter plants is expected, regardless the varieties. Moreover, the primary branches generally do not much affect the yield traits, but the secondary branches have the prime role in influencing the safflower yield.

Table 1. Mean squares from analysis of variances for days to 75% flowering, days to 90% maturity, plant height, number of primary branches.plant^{-1} and number of secondary branches.plant^{-1}

Source of variation	Degrees of Freedom	Characters				
		Days to 75% flowering	Days to 90% maturity	Plant height	Number of primary branches plant^{-1}	Number of secondary branches plant^{-1}
Replications	2	28667.00	0.01556	0.867	0.93556	2.2400
Genotypes	5	57467.00**	0.33289^{NS}	206.478**	1.17689^{NS}	18.8893**
Error	10	44133.00	0.42622	21.681	0.45822	0.9333

** = Significant at 1% probability level; NS= Non-Significant

Table 2. Mean squares from analysis of variances for number of capsules.plant^{-1}, number of seeds.capsule^{-1}, seed index and seed yield.plant^{-1}

Source of variation	Degrees of Freedom	Character			
		Number of capsules spike^{-1}	Number of seeds capsule^{-1}	Seed index	Seed yield plant^{-1}
Replications	2	4.1489	236.00	0.03357	1.02504
Genotypes	5	10.4729**	136950.00**	0.44093**	9.57518**
Error	10	1.2156	2131.00	0.04429	1.76422

** = Significant at 1% probability level.

The data regarding the mean performance of different yield traits of safflower genotypes presented in Tables 3 and 4 revealed that among candidate safflower genotypes tested in this experiment, P1-253-566 took relatively more days to 75% flowering (29.467) against 31.933 days to 75% flowering by commercial genotype Thori-78 (check) which took significantly ($P<0.05$) maximum number of days to 75% flowering, further followed by genotypes P1-195 895, P1-205 077 and P1-405 990 with taking 29.200, 28.867 and 28.333 mean number of days to 75% flowering, respectively; while the minimum days to 75% flowering (27.60) was noted in case of genotype P1-405 995. Relatively more days to 90% maturity (34.067) by genotype P-195 895 against 34.333 days to 90% maturity by commercial check Thori-78 and there were non-significant differences in days to 90% maturity when compared with

rest of the candidate safflower genotypes with commercial check. Significantly maximum plant height (175.53 cm) was found in candidate variety P1-253 566, followed by P1-205 077, P1-405 990 and P1-405 995 with 170.70, 159.67 and 159.40 cm average plant height, respectively; against 160.00 cm plant height of Thori-78 (check); while the lowest plant height (153.27 cm) was resulted by candidate variety P1-195 895. Hence, P1-253 566 and P1-205 077 surpassed check variety and P1-405 990 and P1-405 995 were at par when compared with Thori-78 for plant height. Comparatively greater number of primary branches.plant^{-1} (10.067) was produced in candidate variety P1-205 077, followed by P1-253 566 and P1-405 995 with 9.267 and 9.067 primary branches plant^{-1}, respectively; against 9.400 primary branches.plant^{-1} in Thori-78 (check); while the lesser number of primary branches.plant^{-1} (8.533 and 8.333) were produced by candidate varieties P1-195 895 and P1-405 990. This shows that candidate cultivar P1-205 077 surpassed commercial check Thori-78 in primary branches. The secondary branches.plant^{-1} were significantly ($P<0.05$) maximum (24.333) under P1-205 077, followed by P1-405 995 and P1-405 990 with 23.133 and 22.133 secondary branches.plant^{-1}, respectively against 18.867 secondary branches.plant^{-1} in Thori-78 (check); while the lowest number (18.200) of secondary branches. plant^{-1} were observed under candidate variety P1-253 566. Hence, in secondary branches, candidate genotypes P1-205 077, P1-405 995 and P1-405 990 surpassed the commercial check Thori-78. The number of capsules plant^{-1} were significantly maximum (23.133) under P1-405 995, followed by P1-205 077 and P1-405 990 with 21.667 and 20.667 capsules.plant^{-1}, respectively against 20.133 capsules.plant^{-1} in Thori-78 (check); while the lowest number (19.733) of capsules.plant^{-1} were observed under candidate variety P1-195 895. Hence, in capsules plant^{-1}, candidate varieties P1-405 995, P1-205 077 and P1-405 990 surpassed the commercial check Thori-78. The number of seeds.capsule^{-1} was significantly ($P<0.05$) maximum (618.67) under P1-405 995, followed by P1-195 895 and P1-253 566 with 564.33 and 506.80 seeds.capsule^{-1}, respectively against 599.00 seeds.capsule^{-1} in Thori-78 (check); while the lowest number (159.60) of seeds.capsule^{-1} was observed under candidate variety P1-405 990. Hence, in seeds.capsule^{-1}, candidate variety P1-405 995 surpassed the commercial check Thori-78.The seed index was significantly ($P<0.05$) highest (5.6633 g) in P1-405 995, followed by P1-405 990, P1-253 566 and P1-205 077 with 5.3527, 5.2720 and 5.1727 g, respectively; while lowest seed index value of 4.67 g was found in Thori-78 (check). Hence, in seed index, candidate varieties P1-405 995, P1-405 990, P1-253 566 and P1-205 077 surpassed the commercial check Thori-78.The seed yield.plant^{-1} was significantly ($P<0.05$) highest (20.969 g) in P1-253 566, followed by P1-405 995 and P1-195 895 with 20.816 g and 20.345 g seed yield.plant^{-1}, respectively against 17.196 g seed yield.plant^{-1} in Thori-78 (check); while the lowest number (17.012 g) of seed yield.plant^{-1} was observed under candidate variety P1-205 077. Hence, in seed yield, candidate genotypes P1-253 566, P1-405 995, P1-195 895 and P1-405 990 surpassed the commercial check Thori-78.

Table 3. Mean performance of safflower genotypes for days to 75% flowering, days to 90% maturity, plant height, number of primary branches.plant^{-1} and number of secondary branches.plant^{-1}

Genotypes	**Characters**				
	Days to 75% flowering	**Days to 90% maturity**	**Plant height (cm)**	**Number of primary branches plant^{-1}**	**Number of secondary branches plant^{-1}**
P-I 253 566	29.467 b	33.667	175.53 a	9.267	18.200 c
P-I 405 995	27.600 b	33.533	159.40 b	9.067	23.133 ab
P-I 205 077	28.867 b	33.600	170.70 a	10.067	24.333 a
P-I 405 990	28.333 b	33.533	159.67 b	8.333	22.133 b
P-I 195 895	29.200 b	34.067	153.27 b	8.533	19.533 c
Thori-78 (Check)	31.933 a	34.333	160.00 b	9.400	18.867 c
S.E.±	0.9802	0.5331	3.8018	0.5527	0.7888
LSD 0.05	2.1841	-	8.4709	-	1.7576

Means followed by similar alphabetic letters are not significantly different from each other according to DMR test.

Table 4. Mean performance of safflower cultivars for number of capsules.plant^{-1}, number of seeds.capsule^{-1}, seed index and seed yield.plant^{-1}

Genotypes	Characters			
	Number of capsules spike^{-1}	**Number of seeds capsule^{-1}**	**Seed index (g)**	**Seed yield plant^{-1} (g)**
P-I 253 566	17.600 c	506.80 b	5.2720 b	20.969 a
P-I 405 995	23.133 a	618.67 a	5.6633 a	20.816 a
P-I 205 077	21.667 ab	170.60 c	5.1727 b	17.012 b
P-I 405 990	20.667 b	159.30 c	5.3527 ab	18.875 ab
P-I 195 895	19.733 b	564.33 ab	4.7200 c	20.345 a
Thori-78 (Check)	20.133 b	599.00 a	4.6700 c	17.196 b
S.E.±	0.9002	37.727	0.1718	1.0845
LSD 0.05	2.0058	84.061	0.3829	2.4164

Means followed by similar alphabetic letters are not significantly different from each other according to DMR test.

DISCUSSION

The genotypic performance of oilseeds in the country is very poor and due non-availability of high yield potential varieties, Pakistan is facing severe shortage of edible oil. The need of the time is to improve the genotypic performance through breeding, so that the yield potential of varieties is improved. The study embodied in this paper was carried out to evaluate the genotypic performance of various candidate cultivars. In this study, five candidate and one check experimental material consisted of genotypes P-I 253 566, P-I 405 995, P-I 205 077, P-I 405 990, P-I 195 895 and Thori-78 (Check). The results revealed that among safflower genotypes, the growth and yield components such as days to 75% flowering, plant height, number of secondary branches.plant^{-1}, number of capsules.plant^{-1}, number of seeds.capsule^{-1}, seed index and seed yield.plant^{-1} were significantly ($P<0.05$) different; while the differences among genotypes for the number of days to 90% maturity and number of primary branches.plant^{-1} were statistically non-significant ($P>0.05$). The genotypic performance indicated that in primary branches cultivar P1-205 077, in secondary branches cultivars P1-205 077, P1-405 995 and P1-405 990, in capsules.plant^{-1} cultivars P1-405 995, P1-205 077 and P1-405 990, in seeds.capsule^{-1} cultivar P1-405 995, for seed index cultivars P1-405 995, P1-405 990, P1-253 566 and P1-205 077 and in seed yield.plant^{-1} cultivars P1-253 566, P1-405 995, P1-195 895 and P1-405 990 surpassed the commercial check Thori-78. These results are further supported by Pandya *et al.* (1996), Makne *et al.* (1979), Khidir (1974), Wuhaib (2007), Singh *et al.* (2000), Singh *et al.* (2008) and Ramesh *et al.* (2002).

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