The Bioscan 14(3): 207-209, 2019
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

STUDIES ON GENETIC VARIABILITY IN SAFFLOWER (*Carthamus tinctorius* L.)

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KEYWORDS
Safflower
Genetic variability
Seed yield

Received on :
22.05.2019

Accepted on :
25.07.2019

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ABSTRACT
An evaluation was carried out to study the variability estimates among the yield component traits. A considerable amount of variation shown by all genotypes in their mean performances with respect to evaluated characters indicates the presence of ample variability. It scopes for selection of superior and desirable genotypes for breeding. The ANOVA revealed that the component of variance for genotypes were positively highly significant for all the characters studied *viz*. rosette period (34.98), days to 50% flowering (103.69), days to maturity (67.97), plant height (263.03), capitulum/plant (77.55), seeds per capitulum (45.87), volume weight (gms /100 ml water volume) (60.01) and harvest index %(12.72) . High genotypic and phenotypic coefficient of variation played a major role for the expression of the traits with seed yield (20.58 %, GCV) (21.21%, PCV), while moderate GCV & PCV recorded for characters *viz*. number of capitulum per plant (19.08 % , 19.90 %), number of branches per plant (17.90%,19.24 %), 100 seed weight (gms) (14.43 %,14.65 %), number of seeds per capitulum (12.52 %,13.90 %), biological yield per plot (kg) (13.78 %,13.90 %) and harvest index % (10.62 %,12.08 %). The high GCV and PCV value indicates the importance of these characters and which can be strategically used to improve the yield of safflower.

INTRODUCTION

Safflower is an important oilseed crop grown in India. It is mainly grown in Maharashtra, Karnataka and parts of Andhra Pradesh, Madhya Pradesh, Orissa, Bihar, *etc*. In Chhattisgarh it is cultivated in an area of 600 hectares with a production of 200 tonnes and a productivity of 333 kg/ hectare. Whereas in India the Safflower is grown in an area of 1, 78,000 hectares with a production of 1, 14,000 tonnes and productivity of 641 kg/hectare in the year 2013-14. (Anonymous, 2015)

Variability for yield and ancillary traits (days to flowering, plant height, number of capitulum, seed number, test weight and seed yield), morphological (seed size, shape, hull types, hull content) and biochemical traits (oil content) has been well documented in safflower (Johnson *et al*., 1955) . A few studies have explored the relationships among seed yield components and oil content in safflower. Capitulum numbers were observed to be the most important components in breeding for higher yield and oil content (Rao *et al*., 1977). Seed yield is also affected by number of capitulum, test weight, plant height and capitulum diameter in safflower (Roopa and Ravikumar, 2008).An improvement of a crop variety lies in the degree of potential variability for the desired character in the breeding material. It is important to decipher the effect of selection for yield traits on genetic gain for the primary trait under consideration. Therefore the present investigation was carried out to study the genetic variability among quantitative traits in safflower genotypes lines for yield and ancillary characters.

MATERIALS AND METHODS

Twenty six genotypes included two checks A-1(Annigeri-1) Spiny(National check), PBNS-12 (Check) and 24 genotypes *viz*. GMU-7368, GMU-3635, AKS-94 -2 x GMU- 3821, NARI-118, SSF-995 X GMU-3806, GMS-NARI-57 (Cross-13), AKS-91-1-1 x GMU- 3802, AKS-91-1-1 x GMU- 3809, MS-06 X PBNS-72(CROSS-15), RVS-12-13 X PBNS-12, Manjeera X GMU-7403, AKS-91-1-1 X GMU-3806, PBNS-12 X GMU-4055, RSS-11-17 X GMU-4037, GMU-6106 X Manjeera, GMU-7403 X JSF-1, RVS-12-13 X Manjeera, GMU 7403 X Manjeera were sown in month of November 2017 in RBD with three replications. Each entries were sown in the plot size of 4 rows of 4 meter length spaced 50 cm apart make a plot size of 8 m2. Observations were recorded on five randomly selected competitive plants from each plot in each replication. The characters selected for the observations were, rosette period (Days), days to 50% flowering, days to maturity, plant height (cm), no. of capitulum per plant, no. of seeds per capitulum, no. of branches per plant, 100 seed weight (gms.), volume weight (gms./100 ml of water volume), biological yield per plot (kg), harvest index (%), seed yield / plot (kg).The data was analyzed statistically for genotype and phenotype coefficients of variation (Burton and Devane (1953), GCV and PCV values were categorized as low, moderate and high values as suggested by Shivasubramanian and Menon (1973) which are as follows.

Class	Range
➢ Low	0-10%
➢ Moderate	10-20%
➢ High	20% and above

RESULTS AND DISCUSSION

Mean sum of squares, error and coefficient of variation (%) for

all the characters studied are presented in Table 1 and 2. Almost all genotypes showed a considerable amount of differences or variation in their mean performances with respect to the characters studied. This indicates that, there is presence of ample variability for the characters evaluated. It indicates scope for selection and breeding of superior and desirable genotypes. The analysis of variance (ANOVA) is presented in Table 1. ANOVA revealed that the component of variance for genotypes were positively highly significant for all the characters studied *viz*. rosette period (34.98), days to 50% flowering (103.69), days to maturity (67.97),plant height (263.03), capitulum /plant (77.55), seeds per capitulum (45.87), branches per plant (4.97), volume weight (gms /100 ml water volume) (60.01) and harvest index % (12.72) at 1% level of significance, Whereas biological yield (2.08) at 5% level of significance. Characters *viz*. 100 seed weight (1.02) and seed yield (0.16) were found positively non-significant.

The estimates of genetic variability, for seed yield per plant and other characters are presented in Table 2. The estimates of PCV were higher than GCV for most of the characters, signifies the high influence of environment for evaluated characters. However the differences between them were not of high magnitude. High estimates of genotypic and phenotypic coefficient of variation were observed for seed yield per plot (kg) GCV (20.58 %) and PCV (21.21 %). Similar results were reported by Lakshyadeep *et al*. (2005), Choulwar (2005), Kumar (2010), Tariq *et al*.(2014), Achhale (2016), Patil (2016) and Manjhi (2017). Moderate GCV were reported for number of capitulum per plant (19.08 %), number of branches per plant (17.90 %), 100 seed weight (gms) (14.43 %), number of seeds per capitulum (12.52 %), biological yield per plot (kg) (13.78 %) and harvest index% (10.62 %) . For the moderate PCV number of capitulum per plant (19.90 %) followed by number of branches per plant (19.24 %), 100 seed weight (gms.) (14.65 %), biological yield per plot (kg) (13.90 %), number of seeds per capitulum (13.90 %) and harvest index% (12.08 %) were recorded. This result is supported by the results of Mukta *et al*. (2008), Mahajan *et al*. (2009), Maryam *et al*. (2011), Kumar *et al*. (2013), Puspavalli (2015) and Manjhi (2017). Under the low GCV range plant height (cm) (9.15 %) followed by volume weight (gms. /100 ml water volume) (9.11 %), rosette period (7.38 %), days to 50% flowering (5.27 %) and days to maturity (3.16 %) were noticed. For the lowest PCV magnitude plant height (cm) (9.75 %) followed by volume weight (gms. /100 ml water volume) (9.11 %), rosette period (8.11 %), days to 50% flowering (5.74 %) and days to maturity (3.43 %) were found. Similar results were also reported by Reddy (2004), Kumar *et al*. (2013), Puspavalli (2015) and Patil (2016).

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Table 1.: Analysis of variance, mean sum of square for yield and its contributing traits of Safflower genotypes.

S.No	Source of variation	d.f	Rosette Period	Days to 50% Flowering	Days to Maturity (cm)	Plant Height	Capitulum /Plant	Seeds / Capitulum	Branches /plant (gm)	100 seed weight	Volume weight (gm)	Biological yield (kg)	Harvest index (kg)	seed yield (kg)
1	Replication	2	32.46	5.65	3.89	65.08	7.39	0.15	0.2	0.01	0.24	0.01	0.15	0
2	Treatment	25	34.98**	103.69**	67.97**	263.03**	77.55**	45.87**	4.97**	1.02	60.01**	2.08*	12.72**	0.16
3	Error	50	2.32	2.36	3.8	11.23	2.18	3.28	0.24	0.01	0.29	0.011	1.14	0

* Significant at 5% level, ** significant at 1% level respectively.

Table 2: Genetic parameters of yield and its contributing traits.

S.No.	Character	General Mean	Range		GCV	PCV
			Minimum	Maximum		
1	Rosette Period	44.76	40.66	52.66	7.3	8.11
2	Days to 50% flowering	105	95	114	5.55	5.74
3	Days to maturity	146	135	154	3.16	3.43
4	Plant height(cm)	100.05	86	117	9.15	9.75
5	Capitulum per plant	26	18	36	19.08	19.9
6	Seeds per capitulum	30	24	39	12.52	13.9
7	Branches / Plant	7	5	10	17.9	19.24
8	100 seed weight (g)	4.02	2.9	5.43	14.43	14.65
9	Volume weight (g)	48.96	42.44	57.91	9.11	9.18
10	Biological yield(kg)	6.04	4.38	8.14	13.78	13.9
11	Harvest index (%)	18.5	14	22.66	10.62	12.08
12	Seed yield (kg)	1.12	0.71	1.57	20.58	21.21

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