



Estimation of mean performance and genetic association of yield and yield components traits under rainfed condition in sunflower (*Helianthus annuus* L.)

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ARTICLE INFO	ABSTRACT
<p>Original Research Article Received on May 21, 2020 Revised on May 30, 2020 Accepted on June 03, 2020 Published on June 11, 2020</p> <p>Article Authors Mohan Vamsi D., Sandhyasree, G., Meena, H. P., Payasi, S. K. Corresponding Author Email mohhandasari@gmail.com</p>	<p>The present investigation was carried out at the Research Fields, ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, Telangana, India. The material for present study consisted of twenty newly developed mono and multi headed restorer lines including CMS lines. The data for agronomic and yield traits <i>i.e.</i> days to 50% flowering, days to physiological maturity, plant height, head diameter, volume weight, 100 seed weight, seed yield per plant oil content and oil yield was recorded. The analysis of variance revealed significant differences among the genotypes for almost all characters which favour the selection. Associations among characters especially indicated that among the seven traits studied, seed yield per plant had a highly significant positive association with head diameter and significant negative correlation with days to 50% flowering and days to maturity. The genotypes, COSF-6B, COSF-7B, RGP-11-P₁-S₂, RGP-58-P₄-S₁₋₁ and RGP-46-P₃ were identified as the most important genotypes for different traits and should be utilized in heterosis breeding programme to realize high heterosis for yield and yield contributing traits.</p>
<p>PUBLICATION INFO International Journal of Agricultural Invention (IJAI) RNI: UPENG/2016/70091 ISSN: 2456-1797 (P) Vol.: 5, Issue: 2, Pages: 203-207 Journal Homepage URL http://agriinventionjournal.com/ DOI: 10.46492/IJAI/2020.5.2.10</p>	<p>KEYWORDS Sunflower, Estimation, Mean Performance, Genetic Association, Yield Components, Rainfed Condition</p>

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Sunflower (*Helianthus annuus* L.) is an important oilseed crop in the world and it is arousing the interest of farmers, agriculture professionals and companies, due to the good quality edible oil, short duration, and more adaptability to different agro-climatic conditions. Sunflower was introduced to India in late 1960s (Meena *et al.*, 2013). The government, convinced of the potential of sunflower in contributing to self-sufficiency in edible oil, has strongly promoted cultivation of the crop by farmers on a large scale. This is done with a two pronged approach first by Technology Mission on Oilseeds (TMO) which promotes scientific cultivation of sunflower to

improve productivity levels and secondly by restricting import of edible oils through import tariff interventions to ensure better commodity price for domestic sunflower growers. Karnataka, Andhra Pradesh and Maharashtra are the major sunflower producing states accounting for 92.3% area and 80.8% of production. Of late, it has spread to non-traditional states like as an important oilseeds crop in Punjab, Haryana and Uttar Pradesh (Mangala Rai, 2002). Earlier researchers more focused on development of open pollinated varieties in sunflower but after identification of stable CMS base and highly cross pollinated nature of the crop made it ideally for exploitation of heterosis.

This has resulted in the development and release of twenty nine hybrids (Sujatha *et al.*, 2019) suitable for different agro-climatic situations in India. Present day sunflower breeding is totally dependent upon the development of F₁ hybrids. Improvement in sunflower emphasizes the urgency of generating a heterotic hybrid that is achieved by heterotic vigour available in the genetically diverse parental lines. Involvement of genetically divergent parents in hybridization will result in enhanced vigour or heterosis in the resultant hybrid (Tyagi *et al.*, 2018, Allard, 1999).

With this background, the present investigation was carried out to identify promising inbreeds based on mean performance for each among twenty inbred lines of sunflower under rainfed condition for further utilization in hybrid breeding program.

Materials and Methods

The present investigation on sunflower was carried out at ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, India. The field experiment was conducted during kharif, 2019. The material for present study consisted of twenty inbred lines including existing maintainer (B) lines (COSF-6B, COSF-7B, CMS-38B, ARM-248B, FMS-852B) and newly developed restorer lines (RGP-21-P₂, RGP-21-P₈, RGP-32-P₁, RGP-46-P₃, RGP-50-P₂, RGP-60-P₁ (NBr), RGP-60-P₂ (Br), RGP-60-P₂ (NBr), RGP-61-P₁ (Br), 298R, RGP-58-P₄-S₁, RGP-58-P₄-S₂, RGP-61-P₅-S₁, RGP-18-P₃-S₂ and RGP-11-P₁-S₁) with two checks (ARM-243B and RHA-6D-1).

Each genotype was sown in 2 rows of 3.0 m length by adopting a spacing of 60 cm x 30 cm in Randomized Block Design with three replications. In each genotype, five plants were randomly selected and used for collection of data on yield and yield related characters like days to 50% flowering, days to physiological maturity, plant height (cm), head diameter (cm), 100 seed weight (g), seed yield per plant (g), volume weight (g/100 ml) and oil content (%). A sample of filled seeds of 10 grams was drawn from each entry and the oil content was measured as percent using Nuclear Magnetic Resonance (NMR) at ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad.

Mean value for each character was worked out by dividing the total with corresponding number of observations, while lowest and highest values of each character were taken as range (Meena and Kumar, 2015). Phenotypic correlation coefficients were calculated using the formula as suggested and described (Johnson *et al.*, 1955).

Results and Discussion

Mean Performances of Genotypes under Rainfed Conditions

The *per se* performance of sunflower genotype revealed that there was a substantial variability among genotypes for all the characters under rainfed condition (table 1). Based on the mean performance, RGP-46-P₃ was the best for seed yield/plant and under rainfed conditions genotypes RGP-11-P₁-S₁, COSF-7B and COSF-6B were the best for seed oil content. Among the test inbreds, RGP-46-P₃ found to be significantly superior and recorded higher seed yield of 24.8 g/plant followed by RGP-60-P₁ (NBr) (18.9 g/plant), COSF-7B (16.9 g/plant), COSF-6B (16.2 g/plant) and FMS-852B (15.5 g/plant) over the best check ARM-243B (14.6 g/plant) (table 2).

Days to 50% flowering ranged from 45-72 days. The test inbred RGP-58-P₄-S₁ was the earliest to flower (45 days) followed by RGP-58-P₄-S₂ (46 days), RGP-60-P₂ (48 days), RGP-61-P₁ (50 days), RGP-32-P₁ (51 days) and RGP-21-P₂ and RGP-RGP-60-P₂ (Br) and 298R (all 52 days) compared to early check RHA-6D-1 (58 days). Whereas, the test inbred RGP-11-P₁-S₁ was found to be late flowering (67 days) followed by RGP-18-P₃-S₂ (66 days). Plant height ranged from 75.3 cm to 162 cm. The inbred RGP-11-P₁-S₁ scored a lowest plant height of 75.2 cm followed by RGP-50-P₂ (78.9 cm) and RGP-60-P₂ (Br) (85.2 cm). The highest plant height was recorded in the RGP-60-P₁ (162 cm). The inbreds FMS-852B, CMS-38B, COSF-7B and COSF-6B have recorded the highest head diameter of 15.6, 15.5, 15.4 and 14.4 cm, respectively. The lowest head diameter (7.0 cm) was recorded by RGP-11-P₁-S₁. Days to maturity ranged from 75 to 100.

Table 1. Analysis of variance (ANOVA) for eight characters under rainfed condition

Source of Variation	D. F.	Characters							
		PH	HD	DF	DM	SW	SY	VW	OC
Replication	2	0.72	0.62	0.59	0.61	0.53	0.25	0.78	0.68
Treatment	20	52.83**	47.32*	48.23*	52.13**	14.82**	15.99**	26.52**	44.65**
Error	40	4.16	5.12	7.02	4.62	5.26	2.32	6.23	7.12

Note: PH: Plant height (cm), HD: Head diameter (cm), DF: Days to 50% flowering, DM: Days to maturity, SW: 100 Seed weight (g), SY: Seed yield/plant (g), VW: Volume weight (g/100 ml), OC: Oil content (%)

Table 2. Mean performances of twenty genotypes for seed yield and related traits under rainfed condition

Genotypes	PH	HD	DF	DM	SW	SY	VW	OC
COSF-6B	139.5	14.4	52	82	4.2	16.2	39.8	38.8
COSF-7B	140.1	15.4	52	82	5.5	16.9	40.0	37.6
CMS-38B	156.0	15.5	54	84	4.6	3.73	32.2	27.2
ARM-248B	152.9	14.5	54	84	6.1	14.9	33.3	33.8
FMS-852B	137	15.6	55	85	4.2	15.5	36.7	35.9
RGP-21-P ₂	111.7	12.4	52	82	7.3	11.5	28.2	29.9
RGP-21-P ₈	118.8	13.0	51	81	3.4	12.1	31.8	28.3
RGP-32-P ₁	98.0	11.6	51	81	3.5	9.82	22.8	30.7
RGP-46-P ₃	131.8	15.6	52	82	3.9	24.8	32.6	34.6
RGP-50-P ₂	78.9	9.3	45	75	3.6	7.6	32.9	31.6
RGP-60-P ₁ (NBr)	162.0	13.5	56	86	4.1	18.9	33.1	31.0
RGP-60-P ₂ (Br)	85.2	8.2	48	78	4.0	8.1	33.6	30.6
RGP-60-P ₂ (NBr)	98.4	13.8	52	82	3.7	12.6	36.3	31.9
RGP-61-P ₁ (Br)	88.0	11.2	50	80	3.4	7.3	31.9	34.4
298R	127.4	12.8	52	82	3.9	6.9	35.2	32.5
RGP-58-P ₄ -S ₁	104.6	10.8	45	75	3.7	8.3	38.2	39.3
RGP-58-P ₄ -S ₂	114.4	13.0	46	76	5.3	10.1	36.4	30.6
RGP-61-P ₅ -S ₁	87.0	8.4	53	83	4.2	8.9	35.2	29.7
RGP-18-P ₃ -S ₂	92.4	8.0	66	96	2.2	5.6	32.9	30.6
RGP-11-P ₁ -S ₁	75.3	7.0	72	100	1.8	4.6	46.5	39.2
ARM-243B (C)	146.8	14.2	62	92	4.8	14.6	45.2	36.7
RHA-6D-1 (C)	103.2	7.3	58	88	4.2	7.9	46.2	39.7
Mean	115.8	12.0	53.5	83.4	4.1	11.2	35.5	32.9
S.E.	1.5	1.2	2.5	2.3	1.2	1.8	2.7	2.3
CD at 5%	3.0	2.4	5.0	4.6	2.4	3.6	5.4	6.4
Range	75.3-162.0	7.0-15.6	45-72	75-100	1.8-7.3	3.7-24.8	22.8-46.5	27.2-39.7

Note: PH: Plant height (cm), HD: Head diameter (cm), DF: Days to 50% flowering, DM: Days to maturity, SW: 100 Seed weight (g), SY: Seed yield/plant (g), VW: Volume weight (g/100 ml), OC: Oil content (%)

Table 3. Mean, range and identified promising genotypes for different traits

Character	Mean	Range	Promising Genotype
Plant height (cm)	115.8	75.3-162.0	RGP-21-P ₄ -S ₃ (76.8 cm), RGP-61-P ₁ Br (88.0 cm), RGP-60-P ₂ Br (85.2 cm), RGP-60-P ₂ NBr (98.4 cm), RGP-50-P ₂ (78.9 cm)
Head diameter (cm)	12.2	7.0-15.6	RGP-46-P ₃ (15.6 cm), FMS-852B (15.6 cm), CMS-38B (15.5 cm), COSF-7B (15.4 cm)
Days to 50 % flowering	53.5	45-72	RGP-50-P ₂ (45 days), RGP-21-P ₈ (51 days), RGP-32-P ₁ (51 days) COSF-6B (52 days), COSF-7B (52 days)
Days to physiological maturity	83.4	75-100	RGP-50-P ₂ (75 days), RGP-21-P ₈ (81 days), RGP-32-P ₁ (81 days) COSF-6B (82 days), COSF-7B (82 days)
Seed yield (g/plant)	11.2	3.7-24.8	RGP-46-P ₃ (24.8 g), RGP-60-P ₁ NBr (18.9 g), COSF-3B (17.6 g), RCR-72 (18.5 g)
100 seed weight (g)	4.1	1.8-7.3	COSF-6B (4.2 g), COSF-7B (5.5 g), RGP-11-P ₁ -S ₂ (4.2 g), RGP-58-P ₄ -S _{1,1} (3.6 g)
Volume weight (g/100 ml)	35.5	22.8-46.5	COSF-6B (39.9 g), COSF-7B (40.0 g), FMS-852B (36.7 g)
Oil content (%)	32.9	27.2-39.7	COSF-6B (38.8%), COSF-7B (37.6%), RGP-11-P ₁ -S ₁ (39.2%), RGP-58-P ₄ -S ₁ (39.3%)

Table 4. Phenotypic correlation coefficients among different characters under rainfed condition

Character	DF	DM	PH	HD	NL	SY	SW	OC
DF	1.000	0.989**	0.091	-0.240	0.132	-0.216**	-0.281	-0.039*
DM		1.000	0.087	-0.272	0.154	-0.243**	-0.276	-0.049
PH			1.000	0.598**	0.489*	0.187	0.089	0.142**
HD				1.000	0.368*	0.198**	0.219	0.008
NL					1.000	0.062	-0.028	-0.062**
SY						1.000	0.149	0.089**
SW							1.000	0.059**
OC								1.000

Note: *, **Significant at 0.05, 0.01 probability levels

PH: Plant height (cm), HD: Head diameter (cm), DF: Days to 50% flowering, DM: Days to maturity, SW: 100 Seed weight (g), SY: Seed yield/plant (g), VW: Volume weight (g/100 ml), OC: Oil content (%)

The inbred RGP-11-P₁-S₁ scored a highest days to maturity of 97 days followed by RGP-18-P₃-S₂ (96 days) compared to late check ARM-243B (92 days). RGP-58-P₄-S₁ was early and matured in 75 days followed by RGP-58-P₄-S₂ (76 days). Highest 100 seed weight (7.3 g) was recorded in inbred RGP-21-P₂ followed by ARM-248B (6.1 g). The lowest test weight of 1.8 g was recorded by the test entry RGP-11-P₁-S₁. RGP-11-P₁-S₁ has recorded the highest volume weight of 46.5 g/100 ml followed by RHA-6D-1 (46.2 g/100 ml). The lowest volume weight of 30.2 g/100 ml was recorded by the test inbred RGP-21-P₂. None of the tested entry surpassed the check RHA-6D-1 (39.7%) in oil content. Range and mean value for eight traits are presented in table 3. Results indicate that genotypes COSF-6B, COSF-7B, RGP-11-P₁-S₂, RGP-58-P₄-S₁ and RGP-46-P₃ were promising for yield and yield contributing traits which can be exploited in hybrid breeding program. Promising entries of this trial will be utilized in heterosis breeding programme for development of heterotic hybrids.

Association between Seed Yield and Yield Components

The association between characters was estimated by correlation analysis (table 4). Character association indicated that among the seven traits studied, seed yield per plant had a highly significant positive association with head diameter (0.198) and significant negative correlation with days to 50% flowering (-0.216) and days to maturity (-0.243) at P = 0.01. Plant height had significant positive correlations with head diameter (0.598), number of leaves per plant (0.489) and oil content (0.31) and however a significant negative association with oil content (0.142).

A significant negative association of days to 50% flowering was observed with head diameter (-0.240), seed yield per plant (-0.216), 100 seed weight (-0.281) and oil content (-0.039). Correlation between seed yield and oil content was not significant in previous study (Alvarez *et al.*, 1992), whereas weak correlation of seed yield with lateness was also reported (Chervet and Vear, 1990). Oil content was negatively associated with all growth and yield components in sunflower (Patil *et al.*, 1996). Many researchers reported a positive association of seed yield with head diameter, 100-seed weight and plant height (Pollikondaperumal and Raja Sekaram, 1993, Punia and Gill, 1994 and Vanisree *et al.*, 1988). Therefore, this study suggested that for success in sunflower improvement programme based on these characters as selection criteria should be given more emphasis.

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