

## Evaluation and characterisation of sunflower (*Helianthus annuus* L.) germplasm

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### ABSTRACT

One hundred and ten accession of sunflower germplasm were characterized on the basis of qualitative trait and were evaluated for yield and yield components to study the variability for different quantitative traits. Highest genotypic and phenotypic coefficients of variation were recorded for seed yield plant<sup>-1</sup> (56.5% and 57.0%) and 100-seed weight (25.6% and 27.7%) respectively. High heritability coupled with high genetic advance over mean were recorded for seed yield plant<sup>-1</sup> (98.1% and 115.3%) and number of leaves plant<sup>-1</sup> (93.9%, 38.2%) followed by leaf lamina length, leaf lamina width, plant height, 100-seed weight, petiole length, and head diameter. Qualitative traits also showed wide variation among the accessions.

**Keywords:** Characterisation, genetic variability, *Helianthus annuus*

Sunflower as one of the important edible oilseed crops in the world is spreading to diverse agro-production situations and thus necessitates development of more productive hybrids with diverse duration. There is a great scope to increase the production and productivity of sunflower. Das et al (2009) Categorised the sunflower growers into three groups namely resource rich, resource moderate and resource poor depending upon the problems faced by themselves. The nature and magnitude of variability present in a crop has significant impact on the success of plant breeding. Furthermore, the assessment of heritable and non-heritable components of variability and characterisation of germplasm bears immense value in the choice of suitable breeding lines. Hence, the present study was conducted to estimate the amount of genetic variability, heritability and genetic advance over mean for yield and its components and to characterize the different germplasm accessions based on qualitative characters.

### MATERIALS AND METHODS

The present study comprised 107 germplasm of sunflower and three checks viz., LS-11, LSF-8 and Modern. The experiment was conducted at Oilseed Research Station, Latur, Maharashtra State, India, during *kharif*, 2011. The farm is located at an Altitude of 633.8 m, Latitude 18° 24' N and Longitude 76° 36' E, under moderate to assured rainfall zone (652.4 mm). where the soil was medium to black with pH 7.0 – 7.9 and temperature range between 11°C and 38.3°C with 15% - 91% relative humidity. Each accession was sown in one row of 3 m length spacing of 60 cm between rows and 30 cm between plants following Augmented Design (Federer and Ragavarao, 1975) with one replication in three blocks with three checks namely LSF-8, CS-11 and Modern. At maturity five plants from each accession were selected randomly for

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collect data on yield and yield related characters viz., length and width of leaf lamina, petiole length, days to 50 per cent flowering, days to maturity, plant height, number of leaves plant<sup>-1</sup>, head diameter, oil content, hull content, seed filling per cent, 100-seed weight and seed yield plant<sup>-1</sup>. The genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) were computed following Burton and Devane (1953), heritability ( $h^2$ ) following Hanson *et al.* (1956) and expected genetic advance over mean (GAM) as suggested by Johnson *et al.* (1955).

The accessions were characterised into on the basis of recommended qualitative characters as per DUS guidelines (Dillon *et al.* 2010) viz., early plant vigour, leaf margin, leaf colour, stem and leaf pubescence, leaf shape, disc and ray floret colour, type of branching, head shape, head position and seed colour. A basal dose of 20 kg N ha<sup>-1</sup>, 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> and 40 kg K<sub>2</sub>O ha<sup>-1</sup> was applied at the time of sowing. One month after sowing 20 kg N ha<sup>-1</sup> was given at the top dressing. All recommended agronomic practice and prophylactic measures were adopted for raising a good and healthy.

### RESULTS AND DISCUSSION

Significant variation in most of the 13 characters is evident from the mean squares (Table 1). Range, genotypic and phenotypic variance, genotypic and phenotypic coefficients of variation, heritability estimates and predicted genetic advance over mean for the respective characters are presented in Table 2. The highest GCV and PCV and their close correspondence found for seed yield plant<sup>-1</sup> (56.5% and 57.0%), and 100-seed weight (25.6% and 27.7%) indicated selection. High estimates of PCV and GCV for these characters have earlier been reported by Virupakshappa and Sindagi (1987); Gangappa (1991); Suma and Virupakshappa (1994); Reddy and Reddy (2006) and Kalukhe *et al.* (2010).

**Table 1: Analysis of variance (mean squares) for seed yield and yield component**

Source	d.f	Leaf lamina length	Leaf lamina width	Petiole length	Days to 50% flowering	Days to maturity	Plant height	Head diameter	No. of leaves plant <sup>-1</sup>	Seed filling (%)	Oil (%)	Hull (%)	100-seed weight	Seed yield plant <sup>-1</sup>
Block	2	0.08	2.19	0.75	0.08	6.08	4.75	0.75	0.75	2.36	2.47	0.27	0.06	1.58
Treatments	109	13.2**	14.5*	9.5	22.0*	16.7**	413.5*	5.7	20.9**	50.2*	13.2	9.1	1.7*	435.5**
Error	4	0.95	1.69	1.87	1.70	0.83	56.37	1.37	1.37	6.01	3.07	1.77	0.31	8.33

\*,\*\* significance at 5% & 1% level respectively

High heritability coupled with high genetic advance as per cent of means observed for seed yield plant<sup>-1</sup> (98.1%, 115.3%) and number of leaves plant<sup>-1</sup> (93.9%, 38.2%) length and width leaf lamina, plant height, 100-seed weight, petiole length and head diameter revealed scope for their improvement through direct selection. Similar results were reported by Gangappa (1991), Jayaramaiah *et al.* (1994) and Makane *et al.* (2011). Germplasm, characterization indicated wide variation for all the qualitative characters among the accessions. Greater variation was observed early plant vigour, leaf margin, leaf

colour, stem and leaf pubescence, leaf shape, colour of disc and ray florets, type of branching, head shape, head position and seed colour. The present findings are in conformity to earlier reports of Virupakshappa and Sindagi (1987).

The accession GMU-312 recorded the highest length (32.50 cm) and width (35.00 cm) of leaf lamina and EC-552038 (30.00 cm) exhibited the highest petiole length. The accessions GMU-437, GMU-438 and GMU-443 revealed to be early flowering (50 days) but considering maturity GA-2 (83.3 days) was the earliest; similarly accessions GMU-1131 (71 days)

**Table 2: Range, mean, coefficients of variation, heritability and genetic advance for quantitative traits**

Character	Range	Mean	Genotypic variance	Phenotypic variance	GCV (%)	PCV (%)	h <sup>2</sup> (%)	GAM
Leaf lamina length (cm)	14.5-32.5	23.5	13.3	14.3	15.5	16.1	93.3	30.9
Leaf lamina width (cm)	14.0-35.0	23.2	14.6	16.3	16.4	17.4	89.6	32.1
Petiole length (cm)	13.0-30.0	19.3	9.5	11.4	15.9	17.5	83.5	30.0
Days to 50% flowering	50.0-72.0	60.0	22.1	23.8	7.8	8.2	92.8	15.6
Days to maturity	83.1-103.0	93.4	16.6	17.5	4.3	4.4	95.2	8.8
Plant height (cm)	105.1-196.1	150.3	413.5	469.9	13.5	14.4	88.0	26.1
Head diameter (cm)	8.0-21.0	13.97	5.7	7.1	17.1	19.0	80.6	31.7
No. of leaves plant <sup>-1</sup>	11.0-35.0	23.9	20.9	22.3	19.1	19.7	93.9	38.2
Seed feeling (%)	58.4-91.4	79.4	50.2	56.2	8.9	9.4	89.3	17.3
Oil (%)	27.0-43.8	34.5	13.2	16.3	10.5	11.6	81.2	19.5
Hull (%)	24.9-39.4	32.2	9.1	10.8	9.3	10.2	83.7	17.6
100-seed weight (g)	2.7-9.0	5.2	1.8	2.1	25.6	27.7	85.1	48.6
Seed yield plant <sup>-1</sup> (g)	8.0-124.0	36.9	435.5	443.8	56.5	57.0	98.1	115.3

PV=Phenotypic variance;GV=Genotypic variance;h<sup>2</sup>=Heritability;GAM=Genetic advance over mean

and EC-601807 (72 days) were late in flowering but GP-115 (103 days) and EC-601807 (103.17 days) took highest number of days to mature. Thus no relation between earliness or lateness in flowering and maturity could be discerned. Considering plant height GMU-476 was the tallest (196.17 cm) and EC-6019514 (105.17 cm) and GP-113 (108 cm) was dwarf. Head diameter was largest in GMU-476 (20.50 cm) and TBS-2 (21.00 cm) but was the smallest in EC-601958 (8.00 cm). Highest number of leaves could be recorded from GMU-558 (35) and DGP-21 (35) but, the least from GMU-443 (11) and GMU-327 (11). Seed filling was the highest in GMU-376 (91.40) and the least in GMU-589 (59.40 %). Considering oil per cent GMU-483 (43.85 %) produced the highest mean and ID-4005 (27.05 %) produced the lowest mean. Considering hundred seed weight GMU-308 had the

highest mean of 9.00 g and revealed to be a promising accession for confectionary purpose. The lowest hull (25.20 %) could be recorded from GMU-342 but it was highest in GMU-475 (39.40 %). Maximum seed yield plant<sup>-1</sup> was observed in accession GMU-571 (124 g) followed by EC-552038 (121.50 g), which can be used for breeding for high yielding lines.

Thus, it can be concluded that no accession was found to be promising for all the quantitative characters. However, some accessions could be identified as promising for different traits with compared to the best check (Table 4). Thus, a gene pool can be generated by constituting the germplasm lines of interest or by creating a broad based cross. Such material could be useful as a base population to develop promising populations and lines.

**Table 3: Grouping of germplasm on the basis of qualitative characters**

Sr. No.	Character	No. of accessions	Sr. No.	Character	No. of accessions
1.	Early plant vigour		7.	Disc floret colour	
	Poor	33		Yellow	101
	Good	58		Purple	0
	Very good	19	Orange	9	
2.	Leaf margin/serration		8.	Ray floret colour	
	Low	33		Yellow	106
	Medium	60		Pale yellow	0
	High	17	Orange	4	
3.	Leaf colour		9.	Type of branching	
	Light green	56		Basal branching	1
	Green	24		Top branching	8
	Dark green	30	Overall branching	7	
4.	Stem pubescence		10.	Absent	94
	Glabrous	0		Head shape	
	Sparsely pubescent	52		Flat	13
	Moderately pubescent	6		Concave	25
	Densely pubescent	52	Convex	56	
5.	Leaf pubescence		11.	Misshape	16
	Glabrous	0		Head position	
	Sparsely pubescent	77		Erect	11
	Moderately pubescent	9		Intermediate	32
	Densely pubescent	24	Drooping	67	
6.	Leaf shape		12.	Seed colour	
	Lanceolate	0		Black	50
	Triangular	21		Black with white strips	10
	Cordate	78		Black with light strips	33
	Round	11	Brown	2	
			Grey	1	
			Grey with white strips	4	
			Grey with black strips	10	

**Table 4: Grouping of germplasm on the basis of quantitative characters**

Sr. No.	Character	No. of accessions	Sr. No.	Character	No. of accessions
1.	Days to 50% flowering		8.	Oil per cent	
	Early	43		Low	69
	Medium	67		Medium	30
	Late	0	High	11	
2.	Days to maturity		9.	Very high	00
	Low	33		Hull per cent	
	Medium	60		Low	00
	High	17	Medium	26	
3.	Plant height		10.	High	84
	Short	04		100- seed weight	
	Medium	30		Low	26
	Tall	54		Medium	54
	Very tall	22	High	30	
4.	Head diameter		11.	Seed yield plant-1	
	Small	62		Low	45
	Medium	37		Medium	53
	Large	1	High	12	
5.	No. of leaves				
	Low	25			
	Medium	72			
	High	13			

**Table 4: Promising accessions of sunflower for different characters (over best check viz., LS-11, LSF-8 and modern)**

Character	Germplasm accessions
Days to 50% flowering (<55 days)	GMU-437, GMU-443, GMU-1027, GMU-1019, GMU-463, GMU-1039, GP-113, EC-601957, EC-623021, ID-5004-3, LOC-6443, NW-22, NW-31
Days to maturity (<90 days)	GMU-1039, GMU-1147-4-2, GMU-389, GMU-531, GA-2, GP-115, EC-623031, EC-623019, EC-601957, ID-5004-3, NW-31, R-274
Plant height (<140 cm)	GMU-438, GMU-531, GMU-447, GMU-437, GMU-475, GMU-488, GMU-579, GMU-443, GP-113, EC-601951, EC-623013, EC-601951, EC-512673, EC-601807, EC-512681, EC-623011, 623018, EC-623016, EC-601764, ID-2033, ID-4036, LOC-6443, LR-6-12, NDLR-06, NDLR-273
No. of leaves plant (>30)	GMU-558, GMU-389, GMU-517, GMU-463, GMU-409, EC-552058, DGP-21
100-seed weight (>6 g)	GMU-484, GMU-392, GMU-1016-2, GMU-487, GMU-1147-4-2, GMU-531, GMU-1027, GMU-519, GMU-1039, GMU-376, GMU-342, GMU-540, GMU-476, GMU-571, GMU-308, GMU-443, GMU-1060-1, GMU-1019, GMU-463, GMU-389, GMU-558, EC-601944, EC-552038, CSFI-5294, IB-2098, ID-2098, ID-5004-3, NDLR-06, TBS-2
Oil per cent (>34 %)	GMU-484, GMU-481, GMU-1131, GMU-1147-4-2, GMU-519, GMU-1039, GMU-420, GMU-376, GMU-342, GMU-476, GMU-1012, GMU-1058, GMU-494, GMU-587, GMU-1019, GMU-545, GMU-589, GMU-463, GMU-554, GMU-558, GMU-447, GMU-488, EC-623026, EC-623031, EC-601751, EC-601764, EC-623016, EC-512673, EC-601958, EC-623029, EC-623013, AK-345, CSFI-5021, DGP-21, IB-03, IB-2087, IB-2098, ID-4036, ID-4093, ID-5004-3, LOC-6443, NW-31
Oil per cent (>40 %)	GMU-327, GMU-438, EC-601957, EC-623021, EC-601944, EC-623018, EC-601963, EC-623019, EC-601871, IR-1-1
Hull per cent (>30 %)	GMU-342, GMU-376, GMU-1147-4-2, GMU-587, GMU-443, GMU-433, GMU-545, GMU-420, GMU-1019, GMU-484, GMU-576, GMU-389, GMU-519, GMU-1060, GMU-463, GA-2, EC-623031
Head diameter (>16 cm)	GMU-476, GMU-409, GMU-448, GMU-376, GMU-519, GMU-389, GMU-1016-2, GMU-571, GMU-1060-1, GMU-463, GMU-312, GMU-484, EC-552038, 601871, ID-5004-3, NDLR-06, TBS-2

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