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CHARACTERIZATION AND EVALUATION OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) GERMPLASM

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ABSTRACT

One hundred and ninety six germplasm accessions of sunflower were evaluated for yield and yield components to study the extent of variation in different quantitative traits. The germplasm accessions were also characterized on the basis of qualitative traits. Highest phenotypic and genotypic coefficients of variation were recorded for 100-seed weight, followed by seed yield, oil yield, number of filled seeds per plant, plant height and head diameter. Heritability was highest for 100-seed weight (72.0%), followed by seed (68.6%), number of filled seeds per plant (64.9%), oil yield (64.1%), and oil content (56.0%). Genetic advance as per cent of mean was highest for oil yield (50.7%), followed by seed yield (50.6%) and number of filled seeds per plant (33.9%). Qualitative traits also showed wide variability among the genotypes.

Key words: Sunflower, germplasm, characterization, variability.

Cultivation of sunflower in diverse agro-ecological regions has necessiated the development of more productive hybrids of diverse duration. Concerted breeding efforts are needed to meet this demand. Success in plant breeding primarily depends on the nature and magnitude of variation present in the germplasm. The assessment of heritable and nonheritable components in the total variability observed will be of immense value in the choice of suitable breeding procedures. Characterization based on the qualitative characters is useful in their identification, because of the reliability of qualitative attributes over environments. Hence the current study aims to estimate the amount of genetic variability, heritability, and expected genetic advance for yield and yield components and characterization of the germplasm accessions based on the qualitative characters.

MATERIALS AND METHODS

One hundred ninety six germplasm accessions of sunflower were grown during kharif 1991 in 14 x 14 simple lattice design with two replications. Each entry was sown in a single

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3 m long row with the spacing of 60 cm between row and 30 cm between plants. The data on yield, yield components and oil content were recorded on five randomly selected plants in each replication.

The phenotypic and genotypic coefficients of variation (PCV, GCV) were computed as suggested by Burton and Dewane [1], heritability as per Hanson et al. [2], and expected genetic advance (GA) as per cent mean following [3].

The germplasm collections were characterized based on leaf shape, leaf margin, leaf colour, petiole length, anthocyanin pigmentation, internode length, leaf size, seedling vigour, branching pattern, disc colour, head inclination, bending per cent, and angle of lateral veins. Characterization was done as per Knowles [4] and IBPGR descriptor.

RESULTS AND DISCUSSION

Mean squares were highly significant for all the characters (Table 1). The range, phenotypic and genotypic variance, PCV, GCV, heritability estimates and predicted GA for these characters are presented in Table 2. The PCV and GCV were high for 100-seed weight (41.7% and 40.1%, respectively), followed by oil yield, (38.4% and 30.7), seed yield (35.8% and 26.4%), number of filled seeds per plant, plant height and head diameter, indicating greater variability for these traits among the entries, suggesting ample scope for improvement in these traits through selection. Moderate PCV and GCV were recorded for stem diameter, leaves per plant, and were low for seed filling, days to 50% flowering and oil content. The low variability for these traits emphasises the need for generating more variability. Low variability for these characters was also reported by other workers earlier [5–7].

Table 1. Mean sum of squares for quantitative characters in sunflower

Source	d.f.	Plant height	Stem diameter	Head diameter	Days to flowering	Leaves per plant	100-seed weight	Yield per plant	Filled seeds per plant	Seed filling %	Oil content	Oil yield
Genotypes	195	1931.8**	0.203**	10.5**	39.0**	44.6**	1.5**	131.9**	4023.1**	83.0**	38.4**	13.5**
Replications	1	252.3	0.211	26.9	3.8	0.4	1.5	711.1	2176.3	33.5	40.7	78.0
Intrablock error	169	381.9	0.066	4.8	10.5	10.6	0.2	24.6	8593.3	45.8	10.8	3.0
Effective error	169	366.3	0.061	4.6	10.1	10.1	0.2	23.8	8600.0	45.7	10.7	2.9
CV (%)		12.7	12.900	16.3	5.6	11.1	11.3	20.1	15.0	8.4	10.8	23.0

**Significant at 1% level.

Table 2. Range, mean, phenotypic and genotypic variance, PCV, GCV, heritability and genetic advance for economic traits in sunflower germplasm

Character	Range	Mean	Phenotypic variance	Genotypic variance	PCV (%)	GCV (%)	Heritability	GA (% of mean)
Plant height (cm)	54.8–234.5	153.7	1156.8	774.94	22.1	18.1	67.0	30.6
Stem diameter (cm)	1.1–2.8	2.0	0.135	0.068	18.4	13.1	50.9	19.3
Head diameter (cm)	6.7–20.7	13.5	7.687	2.845	20.5	12.5	37.0	15.7
Days to 50% flowering	47.0–67.0	57.7	24.7	14.25	8.6	6.5	57.6	10.2
Leaves/plant	15.5–43.7	29.2	27.6	16.99	17.8	14.2	61.6	22.8
100-seed weight (g)	2.2–7.8	4.4	0.865	0.623	41.7	40.1	72.0	31.6
Seed yield/plant (g)	6.3–48.6	24.7	78.2	53.65	35.8	26.4	68.6	50.5
No. of filled seeds/plant	269.3–972.6	616.6	24508.2	15914.89	25.4	20.4	64.9	33.9
Seed filling (%)	52.1–93.5	81.0	64.4	18.59	9.9	5.3	28.9	5.9
Oil content (%)	19.4–42.0	30.6	24.6	13.78	16.2	12.1	56.0	28.3
Oil yield/plant (g)	1.7–15.5	7.5	8.2	5.29	38.4	30.7	64.1	50.7

High heritability and high genetic advance were recorded for seed yield (68.6% and 50.5%, respectively), oil yield (64.1% and 50.7%), followed by 100-seed weight (72.0% and 31.6%) and seed filling (64.9% and 33.9%). This suggests a definite scope for improvement in these characters through direct selection. Similar results were reported by [8, 9]. Moderate heritability and genetic gain were recorded in respect of stem girth and flowering time. These results are in agreement with those of [10]. Low estimates of heritability and genetic advance were obtained for seed filling, indicating greater influence of environment on the expression of these characters. Therefore, direct selection based on this character alone would be less effective.

While characterizing the germplasm, it was noticed that there was wide variability for all qualitative characters among the genotypes. Most of the accessions showed cordate leaf shape. This was in line with the observations made by Virupakshappa and Sindagi [11]. Out of 196 accessions, 152 had medium petiole length, 115 had strong vigour, 58 showed high branching, 73 genotypes possessed 225° head inclination, and 116 lines had 10% bending (Table 3).

The germplasm entry SG-1459 was tallest (234.50 cm), followed by SG-1464 (233.2 cm), SG 1458 (218.9% and SG 1402 (212.2 cm). Thickest stem was recorded in SG-1465 (2.79 cm), followed by SG 1464 (2.75 cm) and SG-1442 (2.72 cm). SG-1469 had broadest head (20.7 cm) and SG-1541 was the earliest to flower (47.0 days).

Highest number of leaves was recorded in the germplasm entry SG-1464 (43.7), which also had maximum 100-seed weight (7.79 g) and highest yield potential (48.6 g per plant). Although SG-1513 had highest number of filled seeds (972.6 per plant), SG-1364 had maximum seed filling (93.5%). Maximum oil content was recorded in SG-1514 (42.0%) and oil yield in SG-1402 (15.5 g/plant).

It can be concluded that no germplasm accession has high values for all the economic traits. However, different genotypes have been identified as promising for different traits (Table 4). A gene pool can be generated now by combining the traits of the best lines from the collection. Such material could be used as a base population for selection to develop desirable populations and lines.

Table 3. Grouping of germplasm collections of sunflower on the basis of morphological traits

Character	No. of accessions
Leaf shape:	
a) Round	45
b) Ovate	35
c) Cordate	65
d) Deltoid/triangular	47
e) Lanceolate	4
Leaf margin:	
a) Fine	5
b) Medium	117
c) Coarse	74
Leaf colour:	
a) Light green	43
b) Medium green	118
c) Dark green	35
Petiole length:	
a) Short	5
b) Medium	152
c) Extra large	39
Anthocyanin pigmentation on:	
a) Petiole	25
b) Stem	2
c) No pigmentation	166
d) Pigmentation on both stem and petiole	3
Central third internodal length:	
a) Short	20
b) Medium	77
c) Long	99
Leaf size:	
a) Extremely small	5
b) Small	18
c) Medium	103
d) Large	60
e) Extremely large	10
Seedling vigour:	
a) Strong	115
b) Moderate	51
c) Normal	27
d) Weak	3
Branching pattern:	
a) No branching	138
b) Basal branching	9
c) Middle branching	26
d) Top branching	22
e) Full branching	1
Disc colour:	
Pink discs	37
Yellow discs	159
Head inclination:	
a) 225°	73
b) 180°	74
c) 90°	33
d) 45°	16
Per cent bending:	
a) 1%	2
b) 5%	58
c) 10%	116
d) 15%	17
e) 20%	3
Vein angle:	
a) Acute angle	99
b) Right angle	67
c) Obtuse angle	30

Table 4. Promising accessions of sunflower for different economic characters

Character	Germplasm accessions (character means)
Plant height (cm)	SG1459(234.5), SG-1464 (233.2), SG-1458 (218.9), SG-1402 (212.2), SG-1465 (211.9), SG-1391 (211.8), SG-1465 (211.6), SG-1512 (209.5), SG-1552 (208.3), SG-1460 (204.5), SG-1461 (202.8), SG-1529 (193.8)
Stem diameter (cm)	SG-1465 (2.79), SG-1464 (2.75), SG-1442 (2.72), SG-1459 (2.64), SG-1460 (2.60), SG-1425 (2.53), SG-1461 (2.51), SG-1563 (2.52), SG-1417 (2.44), SG-1552 (2.42), SG-1462 (2.33)
Head diameter (cm)	SG-1469 (20.7), SG-1464 (20.0), SG-1459 (18.4), SG-1460 (18.1), SG-1462 (17.8), SG-1384 (17.3), SG-1465 (17.2), SG-1461 (17.1), SG-1425 (16.9), SG-1448 (16.7), SG-1387 (15.6), SG-1458 (14.6) and SG-1563 (14.4)
Days to flowering	SG-1436 (52.5), SG-1449 (52.0), M-174-6-1 (51.5), SG-1433 (50.0), M-789-5-2 (50.0), SG-1397 (0.0), SG-1408 (0.0), M-787-9-2 (49.5), SG-1532 (48.0), SG-1541 (47.0)
No. of leaves/plant	SG-1464 (43.7), SG-1555 (43.0), SG-1460 (42.5), SG-1553 (40.4), SG-1467 (40.2), SG-1527 (39.7), SG-1458 (39.7), SG-1564 (38.9), SG-1462 (36.9), SG-1552 (35.8)
100-seed weight (g)	SG-1464 (7.79), SG-1462 (7.02), SG-1461 (7.01), SG-1552 (6.35), EC-68414 (6.25), SG-1460 (6.10), SG-1543 (5.79), SG-1518 (5.70), SG-1560 (5.68), SG-1385 (5.57), SG-1366 (5.55)
Seed yield/plant (g)	SG-1464 (48.56), SG-1366 (46.42), SG-1460 (43.01), SG-1385 (42.60), SG-1461 (42.58), SG-1557 (40.76), SG-1402 (39.80), SG-1388 (39.75), SG-1394 (38.50) and SG-1408 (37.19)
No. of filled seeds/plant	SG-1513 (972.60), SG-1460 (947.50), SG-1402 (874.80), SG-1559 (865.80), SG-1474, (841.00), SG-1407 (830.90), SG-1428 (823.20), SG-1557 (822.10), SG-1448 (819.80), SG-1464 (815.10), SG-1366 (813.8), SG-1459 (806.80), SG-1378 (806.10) and SG-1461 (799.40)
Seed filling (%)	SG-1364 (93.52), SG-1425 (91.25), SG-1385 (91.08), SG-1549 (90.99), SG-1473 (90.76), SG-1460 (90.48), SG-1366 (90.06), SG-1553 (90.04), SG-1517 (90.01), SG-1565 (89.51), SG-1508 (89.32) and SG-1386 (88.36)
Oil content (%)	SG-1514 (42.03), SG-1482 (42.01), M-733-10-1 (41.67), EC-68415 (41.52), BLC-11-12-6 (40.01), SG-1425 (39.34), SG-1469 (39.23), M-733-10-3 (39.05), SG-1457 (39.94), SG-1474 (39.02) and SG-1406 (38.8)
Oil yield (g)	SG-1402 (15.49), SG-1403 (14.64), SG-1464 (14.45), EC-68414 (14.17), SG-1462, SG-1406 (13.77), SG-1461 (13.19), SG-1406 (13.77), SG-1385 (13.62), SG-1366 (13.60), EC-68414 (13.57), SG-1385 (13.62), SG-1366 (13.60), EC-68414 (13.57), SG-1385 (13.62) and SG-1394 (13.41)
Central head filling	SG-1397, SG-1532, SG-1532, SG-1524, SG-1527, M-233, 10.1, SG-1364, SG-1367, SG-1431, SG-1436, SG-1433, SG-1479, M-733.3-7, SG-1386, SG-1558, SG-1562, SG-1564, SG-1555, SG-1561, SG-11128, SG-1425, SG-1461, SG-1448, SG-1449, SG-1465, SG-1464, SG-1467 and SG-1460

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