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Phenotypic Characterization of Restorer Lines as per UPOV Guidelines in Sunflower (*Helianthus annuus* L.)

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Abstract

Six restorer parents and their thirty crosses were phenotypically characterized as per UPOV (International Union of Protection of Plant varieties) guidelines for leaf shape, leaf color, fineness of leaf serration,petiole pigmentation, type of branching, stem hairiness at top, stem pigmentation, seed shape and seed color. Most of the parents and crosses of restorer lines exhibited cordate leaf shape (three parents out of six and 24 out of 30 crosses), dark green colored leaves (three out of six patents and 27 out of 30 crosses), medium leaf serration (three out of six parents and 14 out of 30 crosses), pigmented petiole (five out of six parents and 30 crosses), pigmented stem (three parents out of six parents and 20 crosses out of 30 crosses), strong stem hairiness (three out of six parents and 16 out of 30 crosses), top half branching (three out of six parents and 20 out of 30 crosses), ovoid elongated seed shape (five out of six parents and 25 out of 30 crosses) and black seed color (four out of six parents and 18 out of 30 crosses). Out of nine crosses studied cordate leaf shape, dark green colored leaves and pigmented petioled showed the dominance effect for these characters in both direct and reciprocal crosses.

Key words : Phenotypic characterization, Restorer lines, UPOV, Sunflower.

Sunflower is one of the important edible oil seed crops in the world. The crop is spreading to diverse agro production situations, crossing climatic and geographic boundaries, which necissated the development of more productive hybrids of diverse duration. Concentrated breeding efforts are needed to meet this demand. Characterization based on the qualitative characters is useful in their identification because of the reliability of qualitative attributes over environment. Sunflower is highly cross pollinated crop. It exhibits lot of variability for phenotypic traits. The phenotypic characterization is important for selection, identification and classification of various inbred lines or germplasm or parents etc. Phenotypic characterization helps to screen lines/parents resistance to insect pests based on the morphological traits such as leaf characters like presence of hairiness on leaves and stem which inhibits oviposition on leaves and stem and also gives tolerance to insect pests (1), leatheriness of leaves, seed color and seed size. Besides this morphological traits also helpful for screening of disease (2) and attraction of insects for pollination. Morphological characterization can also used as a marker gene to identify parents or lines in hybrid seed production and cultivar purity testing. Hence the current study was conducted to study the phenotypic characterization of parents and their crosses of restorer lines.

Methods

The parent materials for the present study comprised of six restorer lines viz., RHA-274, R-393, R-127, RHA-275, R-8297 and R-5. These parents were crossed in Diallel fashion to obtain 30 hybrids which includes direct and reciprocal crosses and these crosses and parents were evaluated during late *rabi* season of 2006-2007. The experiment was conducted at regional agricultural research station, Raichur. Each entry was sown in two rows of 3m length each with a spacing 60 cm between rows and 30 cm between plants. The experiment was laid out in Randomized Block Design with two replications. The parents and their crosses of restorer lines were phenotypically characterized based on UPOV (Intional Union of Protection of Plant Varieties) guidelines such as leaf shape (cordate, oblong, lanceolate, triangular, rounded), leaf color (dark green, medium green, light green), fineness of serration (fine, medium, coarse), type of branching (top half branched, fully branched, top

Table 1. Phenotypic characterization of parents and crosses of sunflower restorer lines.

	Entries	Leaf shape	Leaf color	Fineness of serration	Petiole pigmen-tation	Type of branching	Stem hairiness at top	Stem pigmentation	Seed shape	Seed color
Parents										
1	RHA-274	Triangular	Medium green	Coarse	Pigmented	Fully branched	Strong	Pigmented	Ovoid elongate	Black
2	R-393	Cordate	Dark green	Coarse	Pigmented	Fully branched	Strong	Non pigmented	Round	Brown
3	R-127	Cordate	Dark green	Fine	Pigmented	Top half branched	Medium	Non pigmented	Ovoid elongate	Black with white stripes
4	RHA-275	Cordate	Medium green	Coarse	Non pigmented	Top half branched	Strong	Non pigmented	Ovoid elongate	Black
5	R-8297	Triangular	Dark green	Medium	Pigmented	Top half branched	Medium	Pigmented	Ovoid elongate	Black
6	R-5	Triangular	Medium green	Medium	Pigmented	Fully branched	Very strong	Pigmented	Ovoid elongate	Black
Direct Crosses										
7	RHA-274 × R-393	Cordate	Dark green	Coarse	Pigmented	Fully branched	Strong	Pigmented	Elongate	Black
8	RHA-274 × R-127	Cordate	Dark green	Medium	Pigmented	Fully branched	Strong	Pigmented	Elongate	Black with white stripes
9	RHA-274 × RHA-275	Cordate	Dark green	Coarse	Pigmented	Top half branched	Strong	Pigmented	Ovoid elongate	Black
10	RHA-274 × R-8297	Triangular	Dark green	Medium	Pigmented	Top half branched	Very strong	Pigmented	Ovoid elongate	Black
11	RHA-274 × R-5	Triangular	Dark green	Medium	Pigmented	Fully branched	Strong	Pigmented	Elongate	Black
12	R-393 × R-127	Cordate	Dark green	Coarse	Pigmented	Fully branched	Strong	Non pigmented	Ovoid elongate	Black with white stripes
13	R-393 × RHA-275	Cordate	Dark green	Coarse	Pigmented	Top half branched	Strong	Non pigmented	Ovoid elongate	Brown
14	R-393 × R-8297	Cordate	Dark green	Medium	Pigmented	Top half branched	Strong	Non pigmented	Ovoid elongate	Brown
15	R-393 × R-5	Cordate	Dark green	Medium	Pigmented	Fully branched	Very strong	Pigmented	Ovoid elongate	Brown
16	R-127 × RHA-275	Cordate	Dark green	Fine	Pigmented	Top half branched	Medium	Non pigmented	Ovoid elongate	Black with white stripes
17	R-127 × R-8297	Cordate	Dark green	Fine	Pigmented	Top half branched	Medium	Pigmented	Ovoid elongate	Black with white stripes
18	R-127 × R-5	Cordate	Dark green	Fine	Pigmented	Top half branched	Medium	Non pigmented	Ovoid elongate	Black with white stripes
19	RHA-275 × R-8297	Cordate	Dark green	Coarse	Pigmented	Top half branched	Strong	Pigmented	Ovoid elongate	Black

Table 1. Continued.

Entries	Leaf shape	Leaf color	Fineness of serration	Petiole pigmen-tion	Type of branching	Stem hairiness at top	Stem pigmenta-tion	Seed shape	Seed color
20 RHA-275 × R-5	Cordate	Dark green	Coarse	Pigmented	Top half branched	Very strong	Pigmented	Ovoid elongate	Black
21 R-8297 × R-5	Triangular	Dark green	Medium	Pigmented	Top half branched	Medium	Pigmented	Ovoid elongate	Black
Reciprocal crosses									
22 R-393 × RHA-274	Cordate	Dark green	Coarse	Pigmented	Fully branched	Very strong	Non pigmented	Round	Brown
23 R-127 × RHA-274	Cordate	Dark green	Medium	Pigmented	Fully branched	Strong	Pigemented	Ovoid elongate	Black with white stripes
24 RHA-275 × RHA-274	Cordate	Dark green	Coarse	Pigmented	Fully branched	Strong	Pigmented	Ovoid elongate	Black
25 R-8297 × RHA-274	Triangular	Dark green	Coarse	Pigmented	Top half branched	Medium	Pigmented	Ovoid elongate	Black
26 R-5 × RHA-274	Triangular	Medium green	Medium	Pigmented	Fully branched	Very strong	Pigmented	Ovoid elongate	Black
27 R-127 × R-393	Cordate	Dark green	Fine	Pigmented	Top half branched	Medium	Non pigmented	Ovoid elongate	Black with white stripes
28 RHA-275 × R-393	Cordate	Dark green	Coarse	Pigmented	Top half branched	Strong	Non pigmented	Ovoid elongate	Blank
29 R-8297 × R-393	Cordate	Dark green	Coarse	Pigmented	Top half branched	Strong	Pigmented	Ovoid elongate	Black with white stripes
30 R-5 × R-393	Cordate	Medium green	Medium	Pigmented	Fully branched	Strong	Pigmented	Elongate	Black with white stripes
31 RHA-275 × R-127	Cordate	Dark green	Medium	Pigmented	Top half branched	Strong	Non pigmented	Ovoid elongated	Black
32 R-8297 × R-127	Cordate	Dark green	Medium	Pigmented	Top half branched	Medium	Non pigmented	Ovoid elongate	Black with white stripes
33 R-5 × R-127	Cordate	Dark green	Medium	Pigmented	Top half branched	Strong	Pigmented	Ovoid elongate	Black
34 R-8297 × RHA-275	Cordate	Dark green	Coarse	Pigmented	Top half branched	Very strong	Pigmented	Ovoid elongate	Black
35 R-5 × RHA-275	Cordate	Medium green	Medium	Pigmented	Top half branched	Strong	Pigmented	Ovoid elongate	Black
36 R-5 × R-8297	Triangular	Dark green	Medium	Pigmented	Top half branched	Medium	Pigmented	Ovoid elongate	Black

branched), petiole pigmentation (pigmented, non-pigmented), stem pigmentation (pigmented, non-pigmented), hairiness at the top (absent, weak medium, strong, very strong), seed shape (elongate ovoid elongate, ovoid wide, rounded) and seed color (black, black with white stripes, brown, grey).

Table 2. Grouping of parents and crosses of sunflower restorer lines based on phenotypic characterization.

Character			Number of Restorer lines			
			Parents	Crosses Direct	Crosses Reciprocal	Total
1	Leaf shape	a) Cordate	3	12	12	24
		d) Triangular	3	3	3	6
						30
2	Leaf color	a) Dark green	3	15	12	27
		b) Medium green	3	0	3	3
						30
3	Fineness of serration	a) Fine	1	3	1	4
		b) Medium	2	6	8	14
		c) Coarse	3	6	6	12
						30
4	Petiole pigmentation	a) Pigmented	5	15	15	30
		b) Non pigmented	1	0	0	0
						30
5	Type of Branching	a) Top half branched	3	10	10	20
		b) Fully branched	3	5	5	10
						30
6	Stem hairiness at top	c) Medium	2	4	4	8
		d) Strong	3	8	8	16
		e) Very strong	1	3	3	6
						30
7	Stem Pigmentation	a) Pigmented	3	10	10	20
		b) Non pigmented	3	5	5	10
						30
8	Seed shape	a) Elongate	0	3	1	4
		b) Ovoid elongate	5	12	13	25
		d) Rounded	1	0	1	1
						30
9	Seed color	a) Black	4	7	9	16
		b) Black with white stripes	1	5	5	10
		c) Brown	1	3	1	4
						30

Results and Discussion

The results of phenotypic characterization of parents and crosses of restorer lines (Tables 1 and 2) revealed that most of restorer lines (three parents out of six and 24 out of 30 crosses) possessed cordate leaf shape the results are in line with the results obtained by Sujatha (3)and Vishnuvardhan Reddy and Nagaraja Reddy (4). However crossing of cordate leaf shaped parents (R-393, R-127 and RHA-275) with triangular leaf shaped parents (RHA-274, R-8297 and R-5) exhibited cordate leaf shape in both direct (RHA-274 × R-393, R-127 × R-8297 and RHA-275 × R-5) and reciprocal crosses (R-393 × RHA-274, R-8297, R-127and R-5 × RHA-275) indicating the dominance of this trait.

Leaf color was dark green in three out of six parents and 27 out of 30 crosses. Similar results were obtained by Mogali (5). However after crossing the parents (R-393, R-127 and R-8297) having dark green coloured leaves with medium green coloured leaves (RHA-274, RHA-275 and R-5) both direct crosses (RHA-274 × R-393, R-127 × RHA-275 and R-8297 × R-5) and reciprocal crosses (R-393 ×RHA-274, RHA-275 × R-127 and R-5 × R-8297) exhibited dark green leaf color indicating dominance with cumulative effect of dark green genes for this character.

Most of the parents and crosses (three out of six parents and 14 out of 30 crosses) exhibited medium leaf serration. These results obtained are in agreement with Gowda (6). Pigmented stem was observed in most of the restorers (three parents out of six parents and 20 crosses out 30 crosses). Similar results were also reported by Dominguez-Gimenez (7). Most

of the restorers (three out of six parents and 16 out of 30 crosses) showed strong stem hairiness at top. The results were in confirmation with results of Nandini Ramesh (8).

Five out of six parents and all 30 crosses showed petiole pigmentation. The results were in accordance with Satisha (9). However upon crossing of parents (RHA-274, R-393, R-127, R-8297 and R-5) having light purple pigment on the petiole with non pigmented petioled parent (RHA-275) both F_1'-s (RHA-274 × RHA-275, R-393 × RHA-275, R-127 × RHA-275, RHA-275 × R-8297 and RHA-275 × R-5) and reciprocal crosses (RHA-275 × RHA-274, RHA-275 × R-393, RHA-275 × R-127, R-8297 × RHA-275, R-5 ×RHA-275) showed light purple pigmentation indicating that petiole pigmentation was controlled by dominant genes with cumulative effect.

In the present study most of the parents showed pigmented petiole with dominance influence over non pigmented petiole as a result all the 30 F_1's exhibited pigmented petiole revealed from both direct and reciprocal crosses.

Larger portion of restorers (three out od six parents and 20 crosses out of 30 crosses) exhibited top half branching. The results were in line with the findings of Virupakshappa and Sindagi (10). Majority of the restorers (all most all parents and 25 out of 30 crosses) exhibited ovoid elongated seed shape and also black seed color was observed in majority of restorers (four out of six parents and 18 out of 30 crosses showed black seed color) similar results were also reported by Nandini Ramesh (8).

In conclusion, phenotypic characterization of restorer lines revealed that most of the parents and their crosses of restorer lines possessed cordate leaf shape, dark green colored leaves, medium serrated leaves, pigmented stem and petiole, top half branching, strong stem hairiness, ovoid elongated seed shape and black seed color. Also dominance effects of cordate leaf shape, dark green colored leaves and pigmented petiole was observed as revealed from direct and reciprocal crosses.

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