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## Screening of plant morphological characteristics of safflower against Safflower aphid

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### Abstract

The investigation entitled “Screening of plant morphological characteristics of safflower against safflower aphid” was carried out at the Department of Agricultural Entomology, VNMKV, Parbhani, during Rabi 2021-22. In screening studies, 15 safflower genotypes were screened against the safflower aphid under field conditions. Based on foliage drying grade, aphid population, plant morphological characters and yield contributing characters it is observed that the safflower genotype entries having more spines, green, thin and waxy leaves, thin capitula, small sized seeds sheltered less aphid population than genotype entries of non-spiny, erect plant type, leathery leaves with succulent stems. Considering the all plant morphological characters more spiny genotypes viz., SSF-682, SSF-695, SSF-714, SSF-704, SSF-734 were observed resistance against safflower aphid compared to national check A-1. Mostly the plant morphology plays crucial role in the aphid resistance mechanism.

**Keywords:** *Uroleucon compositae*, safflower aphid, capitula, genotypes

### Introduction

Safflower *Carthamus tinctorium* L., Compositae is the most important rabi oilseed crop. There are numbers of safflower varieties under cultivation in different agroclimatic region in India. Still the area under cultivation decreases day by day. Number of factors is responsible for decreasing area. Crop damage due to insect pest is one of the major constraints. Safflower crop is damaged by a number of insect pests of which Aphid *Uroleucon compositae* Theobald (Aphidae: Homoptera) is the key pest causing 20-60% loss in seed yield of safflower. Safflower flowers contain all necessary amino acids except tryptophan [1]. India, United States, Mexico, and China are the world's top safflower producers in the ascending order. In India, safflower production is primarily limited to rainfed conditions throughout the winter season, particularly in the Rabi track. In the year 2021-22, India is the largest producer of safflower (2.0 lakh tones) in the world with highest acreage (4.3 lakh hectares) but with average productivity of only 465 kg/ha. [1]. Besides loss in seed yield, aphids incidence also results in reduction in oil content of damaged seeds up to 32% and seed weight by 50.6%. Many broad spectrum insecticides are being use intensively and indiscriminately by farmers for the management this pest, which lead to several problems like pest resurgence, insecticidal resistance in key pest species. Secondary pest outbreak, pesticides residues in food chain, degradation in the quality of ecosystem and human health. To overcome this problem, present study was carried out to find out germplasm accession for resistant to safflower aphids and to develop a component integrated pest management as aphid resistant variety. Among the several factors responsible for low production of safflower, insect pests have been considered as one of the important biotic factors. Among them, aphid (*Uroleucon compositae* Theobald) is the key pest of the crop which causes yield losses to the extent of 20 to 60% with an average of 37% throughout India [10]. Use of resistant varieties/genotypes is a way of lowering the cost of pest protection as part of integrated pest management in safflower.

## Materials and Methods

The experiment was conducted during 2021-22 at College of Agriculture, Parbhani, Department of Agril. Entomology Farm, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra by growing a total of 14 safflower germplasm accessions on 23<sup>rd</sup> November, 2022 in an Randomized Block Design. The plots were two rows 4 m long and spaced 45 cm apart with 20 cm between plants within rows. The susceptible infester check and A-1 as a resistant check was used. The

observation of safflower aphid in untreated regimes were recorded at weekly interval on 15 randomly selected plants in each plot size. Aphid count was taken by observing 5 cm twig of the selected and tagged plot from experiment plot. The aphid count recorded on resistant plot compared with checks.

After survival of aphids the genotype and checks are categorized into 1 to 5 scales on the basis of foliage drying due to aphid feeding. The A.I.I was calculated with the help of following formula.

**Table 1:** Methodology for Aphid Scoring and Aphid Infestation Index.

Sr. No.	Percent foliage yellowing and drying	Damaging grade	Resistance category	Aphid infestation grade (A.I.I)
1.	0-20%	1	Highly resistance	1.0
2	21-40%	2	Resistance	1.1-2.0
3	41- 60%	3	Moderately resistance	2.1-3.0
4	61-80%	4	Susceptible	3.1-4.0
5	80% & above	5	Highly susceptible	4.1-5.0

A. I. I.:-  $1 \times a + 2 \times b + 3 \times c + 4 \times d + 5 \times e$

$a + b + c + d + e$

Where a, b, c, d, e are the actual number of plants falling each of the corresponding damage foliage drying grades i.e. 1 to 5.

**Table 2:** The following plant characters were recorded during the crop growth period.

Sr. No.	Characteristics	States	Grade
1.	First leaf:- Length of blade (cm)	Very short(<6) Short (6 -8) Medium (8-10) long(10-12) Very long(>12)	1 3 5 7 9
2	First leaf:- Width of blade (cm)	Very narrow(<1.5) Narrow(1.5-2.0) Medium(2.-2.5) Broad(2.5-3) Very broad(>3)	1 3 5 7 9
3	Plant:- Time of 50% flowering(days)	Very early(<65) Early (65-75) Medium(76-85) Late(86-95) Very late(>95)	1 3 5 7 9
4	Petal:- Colour	White Pale yellow Yellow Orange	1 2 3 4
5.	Leaf:- Length of blade (cm)	very short(<4) Short(4-8) Medium(8-12) Long(12-16) Very long(>16)	1 3 5 7 9
6	Leaf:- Number of spines	Very few Few Medium Many Very many	1 3 5 7 9
7	Capitulum:- Length of outer involucre bract of main capitula (cm)	Short(<2.5) Medium(2.5-5) Long(>5)	3 5 7
8	Capitulum:- Number. of spines on the outer involucre bract of main capitula	Absent Sparse Dense	1 3 5
9	Capitulum:- Diameter of main capitula (cm)	Small(<2) Medium(2-2.5) Long(>2.5)	3 5 7
10	Plant:- Height up to main capitula (cm)	Very short(<51) Short(51-60) Medium(61-70) Tall(71-80) Very tall(>80)	1 3 5 7 9
11	Seed:- Weight of 1000 seeds (g)	Very low (<41)	1

		Low (41-50) Medium(51-60) High (61-70)	3 5 7
		Very high(>70)	9
12	Seed:- Colour	White White yellowish Brown yellowish Brown	1 2 3 4
13	Seed:- Number per main capitula	Low(<15) Medium(15-30) High(>30)	3 5 7

## Results and Discussion

**Table 3:** Screening of safflower germplasm against safflower aphid, *Uroleucon compositae* (Theobald) (2021-22)

Sr. No.	Name of Entry	Aphids/ 5 cm	Foliage Drying Grade	Category of resistance	A.I.I.
1	SSF-682	99 (9.97)	II	R	1.4
2	SSF-684	114.67 (10.73)	II	R	2.0
3	SSF-695	95.67 (9.75)	II	R	1.4
4	SSF-704	92.33 (9.63)	II	R	1.7
5	SSF-714	104.67 (10.22)	II	R	1.4
6	SF-10-4	114 (10.70)	II	R	1.9
7	SSF-734	102 (10.09)	II	R	1.6
8	SSF-807	118.67 (10.86)	III	R	2.0
9	SAF-11-13	117.33 (10.83)	II	R	1.6
10	SAF-12-24	121.33 (11.01)	II	R	1.9
11	SAF-1335	127.33 (11.29)	II	R	2.0
12	SAF-1356	128 (11.34)	II	R	1.4
13	SAF-1340	189.33 (13.77)	II	R	1.7
14	GMU-1628	117 (10.78)	II	R	1.5
15	A-1(C)	168 (12.95)	III	MR	1.9
S.E.±	-	0.487	-	-	-
C.D.5%	-	1.349	-	-	-
C.V.%	-	7.71	-	-	-

**Note:** R= Resistant, MR= Moderately Resistant, S: Susceptible, AII= Aphid Infestation Index

As per the data given in the Table 3. it is seen that the all 14 genotypes were categorized under resistant A.I.I. (1.30-2.00) whereas A-1 was categorized into moderately resistant category. The results revealed that (Table. 4) Comparing the aphid population with national check A-1 it is observed that the

percent aphid population recorded by the genotypes viz., SSF-682, SSF-695, SSF-704, SSF-714 and SSF-734 were to the tune of 58.92, 56.94, 54.95, 62.30, 60.71 percent respectively compared to A-1 (100%).

**Table 4:** Aphids/5cm twig/plant (2021-22)

Sr. No.	Genotype Entry	Aphid/5cm twig/plant	% Aphids compared to A- 1(TC)
1	SSF-682	99	58.92
2	SSF-684	114.67	67.85
3	SSF-695	95.67	56.94
4	SSF-704	92.33	54.95
5	SSF-714	104.67	62.30
6	SF-10-4	114	67.85
7	SSF-734	102	60.71

8	SSF-807	118.67	70.63
9	SAF-11-13	117.33	69.83
10	SAF-12-24	121.33	72.22
11	SAF-1335	127.33	75.79
12	SAF-1356	128	76.19
13	SAF-1340	189.33	112.6
14	GMU-1628	117	69.64
15	A-1(C)	168	100

**Table 5:** Screening of morphological characteristics of safflower

Sr. No.	Genotype Entry	Character No.1 First leaf: Length of blade (cm)	States	Character No. 2. First leaf: Width of blade (cm)	States	Character No. 3 Plant:- Time of 50% flowering (days)	States
1	SSF-682	14.40	Very long	4.5	Very Broad	63.667	Very Early
2	SSF-684	15.20	Very long	5.483	Very Broad	70	Early
3	SSF-695	16.15	Very long	6.333	Very Broad	66	Early
4	SSF-704	17.90	Very long	5.5	Very Broad	62.66	Early
5	SSF-714	17.16	Very long	5.417	Very Broad	66	Early
6	SF-10-4	16.38	Very long	6.333	Very Broad	73	Medium
7	SSF-734	14.75	Very long	5.25	Very Broad	76	Medium
8	SSF-807	15.40	Very long	5.317	Very Broad	73.33	Medium
9	SAF-11-13	16.25	Very long	5.5	Very Broad	69.33	Early
10	SAF-12-24	16.50	Very long	5.483	Very Broad	69.333	Early
11	SAF-1335	14.5	Very long	5.1	Very Broad	70.66	Medium
12	SAF-1356	16.41	Very long	6.083	Very Broad	73.33	Medium
13	SAF-1340	16.08	Very long	6.25	Very Broad	69.66	Early
14	GMU-1628	14.41	Very long	4.083	Very Broad	69.00	Early
15	A-1(C)	14.91	Very long	6.167	Very Broad	81.33	Late
C.D.	-	1.97	-	0.954	-	9.444	-
SE±	-	0.67	-	0.328	-	3.243	-
C.V.	-	7.43	-	10.278	-	8.000	-

**Characteristic No.1:- First leaf blade length (cm)**

As per the data given in the Table 5, first leaf blade length was very long in all given genotypes.

**Characteristic No.2:- First leaf blade width (cm)**

As per the data given in the Table 5, first leaf blade width was very broad in all given genotypes

**Characteristic No.3:- 50% flowering (days)**

Days required to attain the 50% flowering were recorded in the respective genotypes. It was observed that the nine genotypes viz., SSF-682, SSF-684, SSF-695, SSF-704, SSF-714, SAF- 11-13, SAF-12-24, SAF-1340, GMU-1628 attained earlier than check A-1. (Table 5.).

**Table 6:** Screening of morphological characteristics of safflower

Sr. No.	Character No. 4. Genotype Entry	Petal color	States	Character No. 5. 6 <sup>th</sup> leaf length (cm)	States	Character No. 6. No. of spines	States	Seed Yield (Kg/ha)
1	SSF-682	3	Yellow	13.08	Long	49.66	Very Many	806.66
2	SSF-684	3	Yellow	16.58	Very Long	40.33	Many	578.00
3	SSF-695	3	Yellow	15.33	Long	46.66	Very Many	679.66
4	SSF-704	3	Yellow	14.75	Long	43.33	Many	660.00
5	SSF-714	2	Pale yellow	16.25	Very Long	44.66	Many	710.00
6	SF-10-4	3	Yellow	16.41	Very Long	42.33	Many	649.66
7	SSF-734	3	Yellow	15.83	Long	51.33	Very Many	693.00
8	SSF-807	3	Yellow	16.25	Very Long	40.00	Many	664.66
9	SAF-11-13	3	Yellow	17.25	Very Long	39.00	Medium	709.66
10	SAF-12-24	3	Yellow	17.25	Very Long	42.00	Many	692.33
11	SAF-1335	3	Yellow	18.50	Very Long	39.66	Medium	569.00

12	SAF-1356	3	Yellow	15.41	Long	44.33	Many	636.66
13	SAF-1340	3	Yellow	15.50	Long	41.33	Many	603.33
14	GMU-1628	1	White	17.41	Very Long	38.33	Medium	621.66
15	A-1(C)	3	Yellow	16.66	Very Long	38.66	Medium	605.33
C.D.	-			2.452		5.754		92.421
SE±	-			0.842		1.976		31.740
C.V.	-			9.023		8.000		8.347

#### Characteristic No.4: Petal color

In safflower crop petal colors observed are generally white (1), pale yellow (2), yellow (3) except that petal color of GMU-1628 varies with the crop advancement.(Table 6).

#### Characteristic No.5:- 6<sup>th</sup> leaf length (cm)

Among all genotypes SSF-682, SSF-695, SSF-704, SSF-734, SSF-1356 and SSF-1340 the 6<sup>th</sup> leaf blade length was measured between 13.08-18.50 whereas SSF-684, SSF-714, SF-10-4, SSF-807, SAF-11-13, SAF-1224, SAF-1335, GMU-1628, A-1 was measured greater than 16.0 cm (Very Long) given in (Table 6).

#### Characteristic No.6:- Leaf - Number of spines

The number of spines observed on leaf are more in all given safflower genotypes than that of check A-1. Number of spines on leaf are directly correlated with the resistance to the safflower aphids. More spiny plants showed higher resistant to aphid infestation. (Table 6). Earlier workers also found some germplasm accessions resistant to safflower aphids [2]. Based on aphid population, foliage drying grades, bio-physical, biochemical and yield attributing characters, out of 14 pre-identified aphid tolerant safflower genotypes only five more spiny genotypes viz., SSF-682, SSF-695, SSF-704, SSF-714 and SSF-734 were found most promising and confirmed resistance against safflower aphid [3, 4] and [10]. In general, spiny genotypes with thin stems, pale green leaves were observed as tolerant / resistant to aphid infestation while non-spiny, late maturing and tall appearance with succulent stem and green leathery leaves of plants contributed for aphid susceptibility. These results are in accordance to the observations of [5, 6, 7, 8, 9, 10].

#### Summary and Conclusion

In screening studies, 15 safflower genotypes were screened against the safflower aphid under field conditions. Based on foliage drying grade, aphid population, plant morphological characters and yield contributing characters it is observed that the safflower genotype entries having more spines, green, thin and waxy leaves, thin capitula, small sized seeds sheltered less aphid population than genotype entries of non-spiny, erect plant type, leathery leaves with succulent stems. Considering the all plant morphological characters more spiny genotypes viz., SSF-682, SSF-695, SSF-714, SSF-704, SSF-734 were observed resistance against safflower aphid compared to national check A-1. Mostly the plant morphology plays crucial role in the aphid resistance mechanism.

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**Declaration:** The author declare that they have no conflict of interest

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