# Identification of sources of resistance against Aphid, *Uroleucon compositae* (Theobald) in safflower

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ABSTRACT

Safflower (Carthamus tinctorius L.) is one of the most important traditional rabi oilseed crops grown in India. Safflower aphid, Uroleucon compositae(Theobald) is the key pest which causes yield losses to the extent of 30 to 78 per cent if not managed properly. Use of resistant varieties is one of the important components of IPM in safflower as the crop is mainly grown under resources poor conditions. The experiments were conducted during rabi, 2018-2019 at ICRISAT Farm, ICAR- IIOR, Hyderabad to evaluate 50 safflower germplasm accessions and 20 varieties for their reaction to aphids under artificial infestation. Test entries were infested with aphids artificially by transferring infested plants from an infester block raised separately. The reaction was recorded and categorized based on Aphid Infestation Index (AII) on 1.0 to 5.0 scale. Ten germplasm accessions, viz. GMU-671, GMU-599, GMU-3256, GMU-5133, GMU-5848, GMU-7868, GMU-7869, GMU-7870, GMU-7885, GMU-7917 were found moderately resistant to aphids with an average AII ranging from 2.3- 3.0. Out of 21 varieties evaluated, one variety, Girna was found resistant with an average AII of 2.0. Seven varieties viz. SSF-748, Bhima, A-1, SSF-708, PBNS-12, SSF-733 and Manjira were found moderately resistant to aphids with an average AII ranging from 2.3 to 3.0.

**Keywords**: Aphid, Plant resistance, Safflower, Screening, *Uroleucon compositae*

Safflower (Carthamus tinctorius L.: Asteraceae) is an important oilseed crop, grown in India since ages. This is cultivated on residual soil moisture in rabi season. Safflower is cultivated in India in Maharashtra, Northern Karnataka, Telangana, Madhya Pradesh, Gujarat and parts of Andhra Pradesh under different cropping systems. India's total production of safflower is 1.22 MT from an area of 1.56 lakh ha with a productivity of 782 kg per ha (Mukta et al., 2017). Aphid, Uroleucon compositae (Theobald) is considered as a major pest. A yield loss up to 78.5% was recorded on susceptible variety, SSF-658 whereas 48.5% was observed on moderately resistant variety, A-1 when proper control measures were not taken (Anonymous, 2015). Both nymphs and adults suck the sap from shoot and young leaves, due to which the plant growth is stunted. In case of severe attack of the aphid, the plants start showing yellowing and drying, resulting in premature death of plants. In addition, aphids also excrete honeydew, which falls on the upper surface of below leaves on which sooty mold develops hindering the photosynthetic activity (Balikai, 2000). Mostly, safflower crop is grown by small and marginal farmers with low inputs and may not receive any plant protection measures (Hanumantharaya et al., 2007) to minimize production cost. This often results in significant yield loss. Many authors have studied the reaction of safflower to aphids under natural infestation (Vijay Singh, 2008; Dayalu Patil, 2008; Kamal Anand, 2009; Rajput et al., 2013; Guljar and Rajesh, 2016). Few safflower accessions were reported for their reaction under artificial release of aphids (Srinivas and Mukta, 2015; Anonymous, 2015; Anonymous, 2016; Anonymous, 2017; Mukta et al., 2017).

Growing resistant cultivars of safflower offers a better alternative method that reduces the cost of plant protection and also safer to environment. Not many aphid resistant sources are identified from large collection of safflower germplasm available. Therefore, it is very important to identify aphid resistant sources of safflower germplasm, which will be used in breeding programme to develop resistant varieties. Twenty four safflower varieties have been developed and released so far in safflower. But their reaction to aphid under field conditions is not known. Therefore, the present investigation was undertaken to identify resistance sources from safflower germplasm accessions and released cultivars.

The present study was carried out at ICAR- IIOR Farm, ICRISAT (17.5300 N latitude and 78.2700 E Longitude) during rabI season of 2018-2019. The experiment was carried out in randomized block design (RBD) with two replications. Fifty safflower germplasm accessions and 20 safflower varieties were sown each in single row of 2 m with a spacing of 45 X 10 cm with 2 checks, A-1, resistant and CO-1, susceptible repeated after 10 test entries.

All the test entries were evaluated for their reaction to aphids through artificial field screening method (Srinivas and Mukta, 2015). The susceptible check, CO-1 was sown in a separate block (Infester block) one month before sowing of test entries. The test entries were sown one month after infester rows sowing with one row of susceptible CO-1 repeated after every 10 rows of test entries. The infester plants with aphids were uprooted and spread across the

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screening block uniformly @ 1 plant per 1m test entry row, when the main crop was at stem elongation stage (35-40 days old). Aphids moved to the test entries, multiplied and caused damage symptoms within 10 days of release. When the susceptible check, CO-1 was killed completely, the damage rating was recorded on a 1-5 scale: 0 to 20 % yellowing & drying of foliage-1;21 to 40 % yellowing & drying of foliage-2; 41 to 60 % yellowing & drying of foliage- 3; 61 to 80 % yellowing & drying of foliage- 4; and 81 to 100 % yellowing & drying of foliage - 5.Injury rating was given to five randomly selected plants from each replication and aphid infestation index (AII) was calculated by using the following formula:

$$AII = \frac{1 \times a + 2 \times b + 3 \times c + 4 \times d + 5 \times e}{a + b + c + d + e}$$

Where, a, b, c, d and e are the actual number of plants falling in each of the 5 corresponding foliage drying grades i.e. 1 to 5. Finally, the mean of AII was calculated and the entries were classified into different grades as - Highly resistant (AII, 1.0), Resistant (AII, >1.0 to 2.0), Moderately resistant (AII, >2.0 to 3.0), Susceptible (AII, >3.0 to 4.0) and Highly susceptible (AII, >4.0 to 5.0).

Table 1 Reaction of safflower germplasm accessions to aphid

| Germplasm accessions | Average AII | Category | Germplasm accessions | Average AII | Category |
|---|---|---|---|---|---|
| GMU-5133 | 2.3 | MR | GMU-5163 | 3.8 | S |
| GMU-5848 | 2.7 | MR | GMU-5908 | 3.8 | S |
| GMU-0599 | 2.8 | MR | GMU-6312 | 3.8 | S |
| GMU-0671 | 2.8 | MR | GMU-7873 | 3.8 | S |
| GMU-7869 | 2.9 | MR | GMU-7881 | 3.8 | S |
| GMU-3256 | 3.0 | MR | GMU-7884 | 3.8 | S |
| GMU-7868 | 3.0 | MR | GMU-0040 | 3.9 | S |
| GMU-7870 | 3.0 | MR | GMU-0593 | 3.9 | S |
| GMU-7885 | 3.0 | MR | GMU-2969 | 3.9 | S |
| GMU-7917 | 3.0 | MR | GMU-7864 | 3.9 | S |
| GMU-7867 | 3.3 | S | GMU-0216 | 4.0 | S |
| GMU-7880 | 3.3 | S | GMU-5935 | 4.0 | S |
| GMU-7863 | 3.4 | S | GMU-7862 | 4.0 | S |
| GMU-7866 | 3.4 | S | GMU-2129 | 4.2 | HS |
| GMU-7871 | 3.4 | S | GMU-7874 | 4.2 | HS |
| GMU-7888 | 3.4 | S | GMU-6556 | 4.3 | HS |
| GMU-7865 | 3.5 | S | GMU-7861 | 4.4 | HS |
| GMU-7879 | 3.5 | S | GMU-2437 | 4.5 | HS |
| GMU-7887 | 3.5 | S | GMU-2616 | 4.5 | HS |
| GMU-7890 | 3.5 | S | GMU-0638 | 4.6 | HS |
| GMU-7872 | 3.6 | S | GMU-7883 | 4.6 | HS |
| GMU-7907 | 3.6 | S | GMU-1047 | 5.0 | HS |
| GMU-2985 | 3.7 | S | GMU-2749 | 5.0 | HS |
| GMU-7877 | 3.7 | S | GMU-3703 | 5.0 | HS |
| GMU-7886 | 3.7 | S | A-1 (RC) | 3.0 | MR |
| GMU-0095 | 3.8 | S | CO-1 (SC) | 5.0 | HS |

AII- Aphid Infestation Index, MR- Moderately Resistant, S- Susceptible, HS- Highly Susceptible, SC- Susceptible Check, RC- Resistant Check

Out of 50 germplasm accessions screened (Table 1), none was found resistant to aphids. Ten accessions viz., GMU-5133, GMU-5848, GMU-599, GMU-671, GMU-7869, GMU-3256, GMU-7868, GMU-7870, GMU-7885, GMU-7917 were moderately resistant with an average AII, ranging from 2.3 to 3.0. Among ten moderately resistant accessions, low AII of 2.3 was recorded on the germplasm accession GMU- 5133 and the accessions, GMU-3256, GMU-7868, GMU- 7870, GMU- 7885 and GMU-7917 recorded maximum AII of 3.0. Among twenty-nine susceptible accessions, GMU- 7867 and GMU- 7880 recorded minimum AII of 3.3 and GMU- 216, GMU- 5935 and GMU- 7862 recorded maximum AII of 4.0. Among eleven highly susceptible accessions, GMU- 2129 and GMU-7874 recorded minimum AII of 4.2 and GMU- 1047, GMU-2749 and GMU- 3703 recorded maximum AII of 5.0. The checks A-1 and CO-1 recorded AII of 3.0 and 5.0 respectively. The susceptible check, CO-1 recorded the highest A I I of 5.0 whereas, A-1, showed moderately resistant reaction to aphid with a AII of 3.0.

Table 2 Reaction of safflower varieties to aphid

| Varieties | A.I.I | Reaction |
|---|---|---|
| Girna | 2.0 | R |
| SSF-748 | 2.4 | MR |
| SSF-733 | 2.6 | MR |
| Bhima | 2.7 | MR |
| A-1 | 2.8 | MR |
| SSF-708 | 3.0 | MR |
| PBNS-12 | 3.0 | MR |
| Manjira | 3.0 | MR |
| JSF-1 | 4.1 | HS |
| A-2 | 4.2 | HS |
| Phule Kusum | 4.2 | HS |
| JSI-97 | 4.2 | HS |
| PKV-Pink | 4.5 | HS |
| AKS-207 | 4.6 | HS |
| SSF-658 | 4.7 | HS |
| JSI-99 | 4.9 | HS |
| Sharda | 5.0 | HS |
| NARI-6 | 5.0 | HS |
| NARI-57 | 5.0 | HS |
| JSI-73 | 5.0 | HS |
| CO-1 (SC) | 5.0 | HS |

A.I.I- Aphid Infestation Index, R- Resistant, MR- Moderately Resistant, HS- Highly Susceptible, SC- Susceptible Check

Out of 20 varieties evaluated (Table 2), one variety, Girna was found resistant with an average AII of 2.0. Seven varieties viz. SSF-748, Bhima, A-1, SSF-708, PBNS-12, SSF-733 and Manjira were moderately resistant to aphids with an average AII ranging from 2.3 to 3.0. Among seven moderately resistant varieties, SSF- 748 recorded minimum AII of 2.3 and SSF- 708, PBNS- 12, Manjira recorded the maximum AII of 3.0. Twelve varieties were highly susceptible to aphid (Table 2). twelve varieties were found highly susceptible (AII 4.1- 5.0). Among twelve highly susceptible varieties, JSF- 1 recorded minimum AII of 4.1 and Sharda, NARI- 6, NARI- 57 and JSI- 73 recorded maximum AII of 5.0.The susceptible check CO-1 recorded the highest AII of 5.0.Gurunath and Balikai (2018) reported A-1 as moderately tolerant variety to safflower aphids.

After confirmation of their reaction to aphids the promising safflower accessions may be useful in incorporating aphid resistance in safflower though breeding programmes. The resistant or moderately resistant safflower varieties may be used and susceptible varieties may be avoided for cultivation in areas where aphid is a regular insect pest.

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