Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 1198-1203

Received: 06-09-2020
Accepted: 12-10-2020

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Screening of sunflower germplasm lines against major lepidopteran insect-pests

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Abstract
Present inspection was carried out for screening of germplasm lines against sunflower head borer and defoliators at the research farm of Oilseeds Research Station, Latur (Maharashtra) under Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, India during *Kharif*, 2019. Twenty four sunflower germplasm lines were sown for screening against sunflower head borer and defoliators during *Kharif*, 2019 including 'Modern' as susceptible check and 'LSFH-171' as resistant check in randomized block design. Among the different entries screened, the entries IHT-1070, 1073, 1074, 1075, 1077, 1080, 1081, 1083, AHT-4, 5, 6, 8, 9 and LSFH-171 (Ch) showed resistant reaction against head borer. Whereas, the entries IHT-1073, 1080, 1081, AHT-5, 9 and LSFH-171 (Ch) showed resistant reaction against defoliators.

Keywords: Screening, sunflower, germplasm lines, head borer, defoliators

Introduction
Sunflower (*Helianthus annuus* L.) (Family: Asteraceae) is one of the important oilseed crops in the world and ranks third in area after soybean and groundnut. India has 19 percent of the world's total area under oilseeds so, considered as a heaven of oilseed crops, but accounts for only 10 percent of world's total oilseeds production. After cereals, oilseeds form the second largest agricultural commodity and shares 14 percent of the total gross cropped area of the country. (Shankergoud *et al*., 2006) [17]. In India, during 2017-18 sunflower was grown on an area of 0.33 million hectares with 0.23 million metric tonnes of production and 0.70 metric tonnes per hectare of productivity (Anonymous, 2019) [9]. The total production of sunflower in *kharif*, 2018-19 was estimated at 0.93 lakh tonnes (4th advanced estimate, DACFW, GoI) and the production in *Kharif*, 2019-20 was estimated at 0.67 lakh tonnes (1st advanced estimate, DACFW, GoI). In spite of the rapid spread of other crops, the productivity of sunflower is going down in recent years. Susceptibility to insect pests and diseases is one of the major limitations among the several biotic factors that come in way for successful sunflower production. Wide range of insect species prefers sunflower as a host crop. About 251 insects and acarine (mites and ticks) species are using sunflower crop as a food across the world. According to the geographical region, sunflower has its own distinctive insect-pests fauna which is composed mainly of indigenous species (Rajamohan, 1976 [15] and Rogers, 1992 [16]). In India more than 50 insect species have been found to damage the crop at different stages of the crop growth.

Crop losses due to insect pests in sunflower vary from region to region. As a result of severity of seedling pests, the plant stand of sunflower crop could be reduced by more than 30% (Basappa and Bhat, 1998) [10]. Among defoliators, tobacco caterpillar, Bihar hairy caterpillar, green semilooper and cabbage green semilooper are of major importance. Armyworm, safflower caterpillar, tea caterpillar are defoliators of minor importance. Insect resistance in crop plants is a non-monetary input at farmer's end which forms an important component of integrated pest management (IPM). Need of insecticides can be drastically reduced even by a low level of tolerance in crop plants? So, resistant and tolerant cultivars forms the basic component of IPM over which other components can be built. For keeping insect population below economic threshold level (ETL), use of resistant or tolerant cultivars is one of the most important method. Screening techniques generally vary with crop and pest (Kavitha and Reddy 2012) [13].

It is necessary to evaluate the varietal resistance against different insect-pests of sunflower. Considering this the present inspection was carried out to screen some sunflower germplasm lines.

Materials and Methods

A field screening experiment with 24 germplasm lines (IHT-1069-1083 and AHT-1-9) along with infester rows of susceptible check 'Morden' and resistant check 'LSFH-171' was carried out. Germplasm lines were screened for their resistance against head borer (*Helicoverpa armigera* Hubner) and defoliators (*Spodoptera litura* Fabricius and *Trichoplusia ni* Hubner) during *Kharif*, 2019-20 at Oilseeds Research Station, Latur, Maharashtra. Sunflower seeds were sown at a spacing of 60 x 30 cm, fifteen plants were maintained per row. A known susceptible check 'Morden' and resistant check 'LSFH-171' were maintained as infester rows. Recommended agronomic practices were followed except plant protection measures. Observations on the number of head borer and defoliators and damage caused by them were made at weekly interval as follows:

Head borer

For *Helicoverpa armigera* observations on larval population and percent (%) head damage were recorded from 5 randomly selected plants, % seed damage per head and the larval number per flower bud and per flower head were recorded.

Defoliators

Defoliation by *Spodoptera litura* larvae and *Trichoplusia ni* larvae were recorded on 5 randomly selected plants, total leaves and damaged leaves were counted and their damage was expressed in percentage. The mean larval population per plant and percent damage was worked out and categorization of germplasm entries were made for resistance or tolerance. Scales were used to evaluate the level of resistance of the screened entries, after some modifications as reported by Kavitha and Reddy (2012) [13] to obtain the results.

Table 1: Scale to categorize germplasm lines for head borer

Sr. No.	% head damage	Score	Grade	Rating (Resistant/Susceptible)
1.	0.00	0-1	I	Highly resistant (HR)
2.	>0.1-2	>1-2	II	Resistant (R)
3.	>2.1-5	>2-3	III	Moderately resistant(MR)
4.	>5.1-8	>3-5	IV	Susceptible (S)
5.	>08	>5-9	V	Highly susceptible (HS)

Table 2: Scale to categorize germplasm lines for defoliators

Sr. No.	% leaf damage	Score	Grade	Rating (Resistant/Susceptible)
1.	0-10	0-1	I	Highly resistant (HR)
2.	>10-20	>1-2	II	Resistant (R)
3.	>20-30	>2-3	III	Moderately resistant (MR)
4.	>30-40	>3-5	IV	Susceptible (S)
5.	>40	>5-9	V	Highly susceptible (HS)

Results and Discussion

Screening of sunflower germplasm lines for resistance/tolerance to head borer and defoliators

The infestation of head borer was noticed after 45 days of emergence and continued till harvest of the crop whereas defoliators infestation was noticed right from the emergence and it was continued till harvest of the crop. The results in concern with the screening of sunflower germplasm lines for resistance/tolerance to head borer and defoliators are presented in Table 3, 4 and 5 and Fig. 1 and 2.

Head borer

The data presented in table no. 3 revealed that larval count of head borer (*Helicoverpa armigera* Hubner) across the different entries ranged between 0.10 to 0.90 larvae/plant. While, the percent head borer damage was observed in the range of 0.5 to 22 percent. The germplasms IHT-1075, 1081, AHT-1, 9 recorded the lowest (0.10 larvae/plant) number of larval population. Whereas, the entry AHT-7 recorded the highest (0.70 larvae/plant) number of larval population.

None of the entries were recorded highly resistant reaction against head borer larvae based on percent head borer damage. The entries IHT-1070 (0.5%), IHT-1073 (0.5%), IHT-1074 (1.0%), IHT-1075 (0.5%), IHT-1077 (0.5%), IHT-1080 (1.0%), IHT-1081 (1.0%), IHT-1083 (0.5%), AHT-4 (1.5%), AHT-5 (0.5%), AHT-6 (0.5%), AHT-8 (0.5%) and AHT-9 (0.5%) showed resistant reaction against the head borer larvae with the damage grade of II. Whereas, moderately resistant reaction was recorded by the entries IHT-1071 (2.5%), IHT-1072 (5.0%), IHT-1078 (3.0%), IHT-1079 (2.5%), IHT-1082 (3.5%), AHT-1 (2.5%), AHT-3 (2.5%) and AHT-7 (3.0%) with the damage grade of III. While, entries IHT-1069 (5.5%) and AHT-2 (6.0%) showed susceptible reaction with the damage grade of IV. Highly susceptible reaction was shown by the entry IHT-1076 (8.5%) against head borer larvae with the damage grade of V.

The check LSFH-171 recorded the larval population of 0.20 larvae/plant, percent head borer damage of 1.0% with the damage grade of II and categorized as resistant check. Whereas, the check Morden recorded the highest (0.90 larvae/plant) number of larval population with 22% head borer damage (Damage grade of V) and categorized as highly susceptible check.

Germplasm lines IHT-1070, 1073, 1074, 1075, 1077, 1080, 1081, 1083, AHT-4, 5, 6, 8, 9 and LSFH-171 (Ch) showed promising reaction towards head borer, therefore can be used further to accelerate resistant improvement and hybrid development programme.

Table 3: Screening of sunflower germplasms against head borer

Sr. No.	Name of Germplasm	No. of head borer larvae/pl	% head borer damage	Damage grade	Reaction
1.	IHT-1069	0.40	5.5	IV	Susceptible (S)
2.	IHT-1070	0.30	0.5	II	Resistant (R)
3.	IHT-1071	0.50	2.5	III	Moderately resistant (MR)
4.	IHT-1072	0.30	5.0	III	Moderately resistant (MR)
5.	IHT-1073	0.20	0.5	II	Resistant (R)
6.	IHT-1074	0.40	1.0	II	Resistant (R)
7.	IHT-1075	0.10	0.5	II	Resistant (R)
8.	IHT-1076	0.50	8.5	V	Highly susceptible (HS)
9.	IHT-1077	0.30	0.5	II	Resistant (R)
10.	IHT-1078	0.20	3.0	III	Moderately resistant (MR)
11.	IHT-1079	0.20	2.5	III	Moderately resistant (MR)
12.	IHT-1080	0.40	1.0	II	Resistant (R)
13.	IHT-1081	0.10	1.0	II	Resistant (R)
14.	IHT-1082	0.40	3.5	III	Moderately resistant (MR)
15.	IHT-1083	0.20	0.5	II	Resistant (R)
16.	AHT-1	0.10	2.5	III	Moderately resistant (MR)
17.	AHT-2	0.30	6.0	IV	Susceptible (S)
18.	AHT-3	0.40	2.5	III	Moderately resistant (MR)
19.	AHT-4	0.20	1.5	II	Resistant (R)
20.	AHT-5	0.30	0.5	II	Resistant (R)
21.	AHT-6	0.20	0.5	II	Resistant (R)
22.	AHT-7	0.70	3.0	III	Moderately resistant (MR)
23.	AHT-8	0.50	0.5	II	Resistant (R)
24.	AHT-9	0.10	0.5	II	Resistant (R)
25.	LSFH-171 (Ch)	0.20	1.0	II	Resistant (R)
26.	Morden (Ch)	0.90	22.0	V	Highly susceptible (HS)

Similar work with different sunflower germplasm entries was carried by earlier workers like Suganthy and Uma (2007) [18] who screened five germplasm entries *viz*., GMU 407, GMU 415, GMU 424, GMU 473 and GMU 493 which were found promising to head borer of sunflower, also the entries GMU 415 and GMU 493 recorded the lowest grade of 0.1. Moreover, similar findings were reported by Kumar and Dhillon (2014) [14] who evaluated the eight sunflower germplasm lines *viz*., PSH 930, PSH 569, PSH 652, NSFH 36, PSFH 118, SH 3322, GKSFH 2002 and Jawalamukhi and found that the entries GKSFH 2002, PSH 652, SH 3322 and Jawalamukhi were promising against head borer. Also, Jayewar *et al*., (2017) [11] screened the germplasm lines of sunflower and found that among different entries screened, the population of head borer was ranged between 0.1 to 1.20 larvae/head and the germplasm lines GMU 942 and 948 has minimum incidence (0.1 larvae/head) of head borer. More or less similar results were obtained by Jayewar *et al*., (2018) [12] while screening hundred germplasm lines of sunflower and reported that among the germplasm entries screened, the entries *viz*., GMU 1005, 1033, 1037, 1047, 1055, 1059, 1060 and 1084 were recorded lowest *H. armigera* infestation. Although, the screening of sunflower done by these earlier workers matches with our present findings however some entries were found different. Similar work was also carried by AICRP centres at different stations across the country (Anonymous, 2000 [1], 2001 [2], 2002 [3], 2003 [4], 2004 [5], 2005 [6], 2006 [7] and 2011 [8]). However, the entries in present inspection cannot be compared with them as they screened different sunflower germplasms.

Defoliators

The data presented in table no. 4 disclosed that the larval count of defoliators (*Spodoptera litura* Fabricius and *Trichoplusia ni* Hubner) across the different entries ranged between 0.10 to 0.60 larvae/plant. Whereas, percent defoliation due to defoliators ranged from 18.65 to 43.10 percent throughout season. The germplasms IHT-1070, 1073, 1082, AHT-4, 5, 8 recorded the lowest (0.10 larvae/plant) number of larval population. While, entries IHT-1069 and IHT-1072 recorded the highest (0.60 larvae/plant) number of larval population. Among the germplasm lines screened, none of the entries were recorded highly resistant reaction against defoliators based on percent defoliator damage. The entries IHT-1073 (18.83%), IHT-1080 (18.77%), IHT-1081 (18.76%), AHT-5 (19.62%) and AHT-9 (18.65%) showed resistant reaction against defoliator larvae with the damage grade of II. Whereas, moderately resistant reaction was recorded by the entries IHT-1070 (29.27%), IHT-1071 (25.39%), IHT-1074 (27.41%), IHT-1077 (25.64%), IHT-1078 (28.05%), IHT-1082 (23.86%), IHT-1083 (27.54%), AHT-6 (25.78%) and AHT-8 (24.90%) with the damage grade of III. While, entries IHT-1069 (38.73%), IHT-1072 (34.16%), IHT-1075 (31.73%), IHT-1076 (38.89%), AHT-2 (37.38%), AHT-3 (33.40%), AHT-4 (34.85%) and AHT-7 (34.62%) showed susceptible reaction with damage grade of IV. Highly susceptible reaction was shown by the entries IHT-1079 (42.30%) and AHT-1 (43.97%) against defoliator larvae with the damage grade of V.

The check LSFH-171 recorded the lowest (0.10 larvae/plant) number of larval population with per cent defoliator damage of 19% (Damage grade of II) and categorized as resistant check. Whereas, the check Morden recorded the larval population of 0.40 larvae/plant, percent damage of 43.10% with damage grade of V and categorized as highly susceptible check.

Germplasm lines IHT-1073, 1080, 1081, AHT-5, 9 and LSFH-171 (Ch) showed promising reaction towards defoliators, therefore can be used further to accelerate resistant improvement and hybrid development programme.

Table 4: Screening of sunflower germplasms against defoliators

Sr. No.	Name of Germplasm	No. of defoliator larvae/pl	% defoliator damage	Damage grade	Reaction
1.	IHT-1069	0.60	38.73	IV	Susceptible (S)
2.	IHT-1070	0.10	29.27	III	Moderately resistant (MR)
3.	IHT-1071	0.20	25.39	III	Moderately resistant (MR)
4.	IHT-1072	0.60	34.16	IV	Susceptible (S)
5.	IHT-1073	0.10	18.83	II	Resistant (R)
6.	IHT-1074	0.30	27.41	III	Moderately resistant (MR)
7.	IHT-1075	0.40	31.73	IV	Susceptible (S)
8.	IHT-1076	0.20	38.89	IV	Susceptible (S)
9.	IHT-1077	0.30	25.64	III	Moderately resistant (MR)
10.	IHT-1078	0.20	28.05	III	Moderately resistant (MR)
11.	IHT-1079	0.50	42.30	V	Highly susceptible (HS)
12.	IHT-1080	0.20	18.77	II	Resistant (R)
13.	IHT-1081	0.20	18.76	II	Resistant (R)
Sr. No.	**Name of germplasm**	**No. of defoliator larvae/pl**	**% defoliator damage**	**Damage grade**	**Reaction**
14.	IHT-1082	0.10	23.86	III	Moderately resistant (MR)
15.	IHT-1083	0.20	27.54	III	Moderately resistant (MR)
16.	AHT-1	0.40	43.97	V	Highly susceptible (HS)
17.	AHT-2	0.20	37.38	IV	Susceptible (S)
18.	AHT-3	0.20	33.40	IV	Susceptible (S)
19.	AHT-4	0.10	34.85	IV	Susceptible (S)
20.	AHT-5	0.10	19.62	II	Resistant (R)
21.	AHT-6	0.30	25.78	III	Moderately resistant (MR)
22.	AHT-7	0.20	34.62	IV	Susceptible (S)
23.	AHT-8	0.10	24.90	III	Moderately resistant (MR)
24.	AHT-9	0.30	18.65	II	Resistant (R)
25.	LSFH-171 (Ch)	0.10	19.00	II	Resistant (R)
26.	Morden (Ch)	0.40	43.10	V	Highly susceptible (HS)

More or less similar work was carried by earlier workers such as Suganthy and Uma (2007) [18] who screened the five sunflower germplasm lines *viz*., GMU 407, GMU 415, GMU 424, GMU 473 and GMU 493 and found that GMU 473 recorded the highest (3.0 larvae/plant) number of defoliator larvae with 25% defoliation as against 0 and 7 per cent defoliation in the check, TCSH 1 and Morden, respectively. Similar work was also carried out by Jayewar *et al*., (2017) [11] who found that among different sunflower entries screened, the population of defoliators was moderate ranged between 0.53 (GMU-973) – 1.48 (GMU-902) larvae/plant. Moreover, Jayewar *et al*., (2018) [12] screened the hundred germplasm lines of sunflower and found that among the germplasm lines screened, the entries GMU 1004, 1008, 1011, 1018, 1041, 1045, 1047 and 1064 were found to be free from defoliator infestation. Although, the screening of sunflower done by these earlier workers matches with our present findings however some entries were found different. Also, AICRP centres carried the similar work at different stations across the country (Anonymous, 2000 [1], 2001 [2], 2002 [3], 2003 [4], 2004 [5], 2005 [6], 2006 [7] and 2011 [8]). However, the entries in present inspection cannot be compared with them as they screened different sunflower germplasms.

Table 5: Rating of sunflower germplasm lines for head borer and defoliators

Sr. No	Score	Resistance rating	Resistance grade	Name of the entries (Head borer)	Name of the entries (Defoliators)
1	0-1	I	HR	---	---
2	>1-2	II	R	IHT-1070,1073,1074,1075,1077,1080,1081, 1083,AHT-4,5,6,8,9 and LSFH-171	IHT-1073,1080,1081,AHT-5,9 and LSFH-171
3	>2-3	III	MR	IHT-1071,1072,1078,1079,1082,AHT-1,3 and 7	IHT-1070,1071,1074,1077,1078,1082,1083, AHT-6 and 8
4	>3-5	IV	S	IHT-1069 and AHT-2	IHT-1069,1072,1075,1076,AHT-2,3,4 and 7
5	>5-9	V	HS	IHT-1076 and Morden	IHT-1079,AHT-1 and Morden

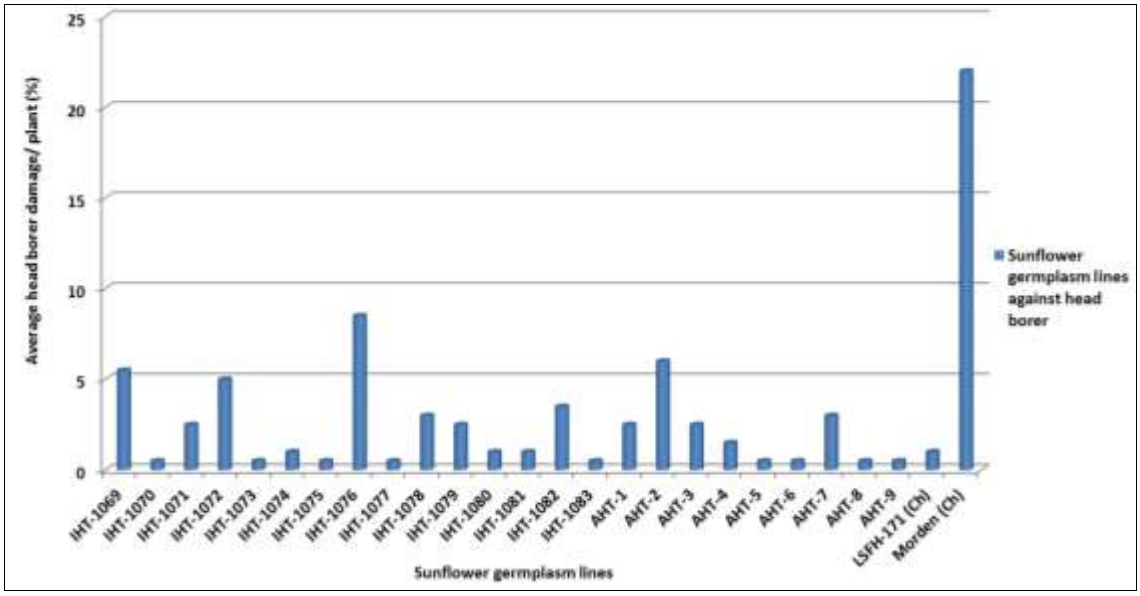

Fig 1: Screening of sunflower germplasm lines for resistance/tolerance to head borer

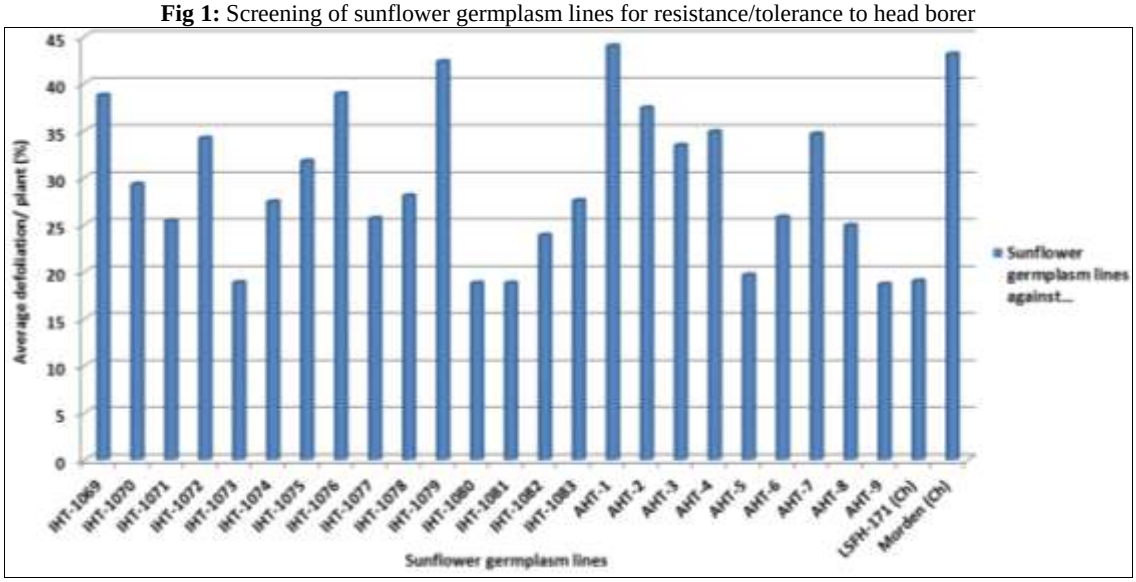

Fig 2: Screening of sunflower germplasm lines for resistance/tolerance to defoliators

Conclusion

In conclusion it can be stated that in the present investigation, Among 24 germplasm lines screened for head borer and defoliators incidence, none of the entry showed 'Highly Resistant' reaction against head borer while 13 germplasm lines showed 'Resistant' reaction. Eight germplasm lines were found as 'Moderately Resistant'. Two germplasm lines *viz*., IHT-1069 and AHT-2 were found as 'Susceptible' and one germplasm line i.e. IHT-1076 showed the 'Highly Susceptible' reaction against head borer. Whereas, none of the germplasm recorded 'Highly Resistant' reaction against defoliators while five germplasm lines *viz*., IHT-1073, 1080, 1081, AHT-5 and 9 were categorized as 'Resistant' germplasms. Nine germplasm lines were found 'Moderately Resistant' and eight as 'Susceptible' against defoliators. Two germplasm lines *viz*., IHT-1079 and AHT-1 showed 'Highly Susceptible' reaction against defoliators. The check LSFH-171 was found 'Resistant' whereas, check Morden was found as 'Highly Susceptible' to head borer and defoliators.

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