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Original Research Article

Germplasm Evaluation for Resistance against Major Lepidopteron Pest in Sunflower

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A B S T R A C T

Sunflower species are allelopathic in nature and this crop appears to have a bright future, especially if the scientists can translate the cutting-edge research into technologies that will reduce the reliance on synthetic herbicides, pesticides, and crop protection chemicals. The losses incurred due to pests and diseases have been a consistently reported feature. Changes in cropping patterns including the cultivation of high yielding varieties and hybrids have added to the problem in some areas. Innovation in agronomic practices, advent of chemicals for control, Screening for resistance sources and more recently genetic engineering tools have been providing new opportunities for reduction of crop losses due to these biotic pressures. Sunflower have been reported to attack by more than fifty insect species,So, present experiment was undertaken to screen the available hundred germplasm lines of sunflower for resistance to defoliators (*Spilosoma obliqua* Walker, *Spodoptera litura* Fabricius, and *Plusia orichalcea* Fab.), and capitulum borer (*Helicoverpa armigera* Hubner), which may be further utilize to develop resistant hybrids, in Augmented Block design consisting of 4.5 m row of each germplasm with infester row of susceptible check (morden). Among entries screened, the entries GMU 1004, 1008, 1011, 1018, 1041, 1045, 1047 and 1064 were found to be free from defoliator incidence. The capitulum borer (*Helicoverpa armigera*) entries viz., GMU 1005, 1033, 1037, 1047, 1055, 1059, 1060 and 1084 recorded lowest *H. armigera* infestation.

Keywords

Sunflower, Screening, Germplasm lines and defoliators and capitulum borer

Introduction

Sunflower (*Helianthus annuus* L.) belongs to the family Asteraceae. *Helianthus* genus contains 65 different species (Andrew *et al.*, 2013). The name *Helianthus*, being derived from *helios* (the sun) and *anthos* (a flower), has the same meaning as the English name Sunflower, which has been given these flowers from a supposition that they follow the sun by day, always turning towards its direct rays. In general, it is an annual plant which possesses a large inflorescence (flowering head), and its name is derived from the flower's shape and image, which is often used to depict the sun. (Khaleghizadeh, 2011). The heads consist of many individual flowers which mature into seeds on a receptacle base (Seghatoleslami *et al.*, 2012). Sunflower is the world's fourth largest oil-seed crop and its seeds are used as food and its dried stalk as fuel. It is already been used as ornamental plant and was used in ancient ceremonies (Harter *et al.*, 2004; Muller *et al.*, 2011). Additionally, medical uses for pulmonary afflictions have

been reported. In addition, parts of this plant are used in making dyes for the textile industry, body painting, and other decorations. Sunflower oil is used in salad dressings, for cooking and in the manufacturing of margarine and shortening (Kunduraci *et al.,* 2010). Sunflower is used in industry for making paints and cosmetics. The stems contain phosphorous and potassium which can be composted and returned to soil as fertilizer. Sunflower meal is a potential source of protein for human consumption due to its high nutritional value and lack of anti-nutritional factors (Fozia *et al.,* 2008).

Sunflower is grown in Andra Pradesh, Karnataka, Maharashtra and Tamil Nadu contributes about 90 per cent of total acreage and 78 per cent of total production (Chander Rao *et al.*, 2015) in India. Oilseeds form the second largest agricultural commodity after cereals, sharing 14 per cent of the country's gross cropped area, accounting nearly five per cent of gross national product and ten per cent of the value of all agricultural products (Shankergoud *et al.*, 2006). Though, India is the third largest producer of the oilseeds, the country is facing an acute shortage of edible oil. The per capita annual consumption of vegetable oils is only 9 kg in India as against 22.0 kg in the developed countries.

There are many reasons for low productivity of oilseeds crop among these attack of insect pest is major one, A diverse assemblage of both beneficial and harmful insect species is associated with the sunflower ecosystem. cutworms (*Agrotis* spp.), sucking pests, leaf and plant hoppers (*Amrasca biguttula biguttula* Ishida, *Empoasca* spp.), thrips (*Thrips palmi*), whitefly (*Bemisia tabaci* Gennadius), defoliators (*Spilosoma obliqua* Walker, *Spodoptera litura* Fabricius, and *Plusia orichalcea* Fab.), and capitulum borer (*Helicoverpa armigera* Hubner) are major pests of economic concern. Different parts of the sunflower plant are damaged by different pest at different phonological stages. Soil insects damage roots and emerging seedlings. Defoliators and sucking pests cause losses in food reserves. Inflorescence pests like *H. armigera* destroy floral parts and developing seeds and cause direct damage (Basappa, 1998).

Resistant breeding against insect pest is of prime importance Even a low level of tolerance in plants has a dramatic effect, which in fact reduces the need of insecticides. Use of resistant or less-susceptible cultivars is one of the most important methods of keeping insect populations below economic threshold levels (Kavitha and Dharma Reddy, 2012). So, present experiment was undertaken with objective to screen the available hundred germplasm lines of sunflower for resistance to defoliators (*Spilosoma obliqua* Walker, *Spodoptera litura* Fabricius, and *Plusia orichalcea* Fab.), and capitulum borer (*Helicoverpa armigera* Hubner), which may be further utilize to develop resistant hybrids.

Materials and Methods

A filed screening experiment with hundred germplasm lines (GMU-1001-1100) along with infester rows of susceptible check morden obtained from Indian Institute of Oilseeds Research and were screened for their resistance against defoliators (*Spilosoma obliqua* Walker, *Spodoptera litura* Fabricius, and *Plusia orichalcea* Fab.), and capitulum borer (*Helicoverpa armigera* Hubner) during *Kharif*, 2012-13 at Oilseeds Research Station, Latur, Maharashtra in Augmented Block design. Sunflower seeds were dibbled on the ridges at a spacing of 60 X 30 cm, fifteen plants

were maintained per row. A known susceptible check 'Morden' was maintained @ one row for every ten test accessions as infester rows. Two rows of the susceptible check were also sown around the experimental field as infester crop. Recommended agronomic practices were followed except plant protection measures. Observations on the number of defoliators and capitulum borer were made at weekly interval by as follow

Head borer: Randomly 5 plants were selected, % seed damage head and the larval number flower bud -1and flower head-1 were recorded.

Damage by defoliators: Defoliation by *Spilosoma obliqua* Walker, *Spodoptera litura* Fabricius, and *Plusia orichalcea* Fab were recorded by 5 randomly selected plants, counting the total and affected leaves and express their damage in percent. Using these data, the mean population per plant and mean per cent was worked out and further analysis and categorization of entries were made. Using scales to evaluate the level of resistance of the screened accessions, after some modification as furnished by *Kavitha and Reddy*, 2012 to interpret results.

Results and Discussion

The data recorded revealed that the infestation of defoliators across the different entries ranged between 0.0 to 1.8 per plant where as incase of The capitulum borer (*Helicoverpa armigera*) incidence ranged from 0.2 to 4.2/plant, the infestation of the defoliators was noticed right from the emergence and it was continued up to harvest of the crop whereas capitulum borer infestation started after 45 days of emergence and continued till harvest of the crop. Data presented in table 1, 2 and 3 revealed that, the germplasm lines The entries GMU 1004, 1008, 1011, 1018, 1041, 1045, 1047 and 1064 were found to be free from defoliator incidence during season which was above economic threshold level. GMU 1005, 1033, 1037, 1047, 1055, 1059, 1060 and 1084 recorded lowest *H. armigera* infestation mean per cent defoliation was in the range of 0.00 to 48.00 per cent whereas and Mean head damage per cent due to *H. armigera* was in the range of 2.46 to 21.86 per cent throughout season. The susceptible check Morden recorded highest mean per cent head damage per cent and highest mean per cent defoliation was recorded in the entry GMU-1044. The entries GMU 1005, 1033, 1037, 1047, 1055, 1059, 1060 and 1084 recorded moderately resistant reaction for head borer whereas entries GMU 1004, 1008, 1011, 1018, 1041, 1045, 1047 and 1064 recorded highly resistant, entries GMU 1005, 1033, 1037, 1047, 1059 and 1060 observed resistant and entries GMU 1006, 1012, 1030, 1031, 1052, 1055 and 1084 given moderately resistant reaction. No entry was susceptible for capitulum borer whereas for defoliators entries GMU 1007, 1009, 1010, 1013-1017, 1019-1029, 1032, 1034-1036, 1038-1040, 1042, 1043, 1046, 1049-1051, 1053, 1054, 1056-1058, 1061-1063, 1065-1073, 1075-1083 and 1085-1100 recorded susceptible reaction. Entries GMU-1001-1004, GMU-1006-1032, GMU-1034-1036, GMU-1038-1046, GMU-1048-1054, GMU-1056-1058, GMU -1061-1083, GMU-1085-1100 and Morden given highly susceptible reaction for capitulum borer whereas for defoliators entries 1044, 1074 and Morden showed highly susceptible reaction (Table 3).

Germplasm lines GMU 1005, 1033, 1037, 1047, 1055, 1059, 1060 and 1084 promising reaction towards defoliators and capitulum borer, therefore can be utilized for further

resistant improvement and hybrid development programme.

Suganthy and Uma (2007) screen the promising germplasm entries of sunflower for confirmation of reaction to key pests *viz*. leafhoppers, thrips, whiteflies, defoliators and head borer. Results revealed that all the five germplasm entries *viz*., GMU 407, GMU 415, GMU 424, GMU 473 and GMU 493 were promising to the key pests of sunflower. GMU 473 recorded the maximum of 5.0 thrips and 3.0 *S. litura* larvae per plant with the defoliation of 25 per cent as against 7 and 0 per cent defoliation in the checks, Morden and TCSH 1, respectively**.**

Sarwan Kumar and S. K. Dhillon(2014), evaluated the reaction of 8 sunflower hybrids viz. PSH 930, PSH 569, PSH 652, NSFH 36, PSFH 118, SH 3322, GKSFH 2002 and Jawalamukhi to insect-pests infestation during spring 2006 and 2007 at Punjab Agricultural University, Ludhiana. During the early stage of crop growth sucking pests viz. jassid and white fly were abundant . Among the 08 hybrids evaluated, PSH 569 and GKSFH 2002 harboured lower population of jassid nymphs than the rest of the hybrids while Jawalamukhi, PSH 652, GKSFH 2002 and PSH 652 were found promising against whitefly.

Similarly, GKSFH 2002, PSH 652, SH 3322 and Jawalamukhi were promising against head borer. Among the different hybrids, the population of leafhopper, whitefly and head borer was lower on GKSFH 2002 than the other hybrids**.** Similarly, entries GKSFH 2002, SH 3322 and PSH 652 recorded lower population (0.08, 0.08 and 0.09 larvae/plant, respectively) of head borer than PSH 569 (0.2 larvae/plant) (Anonymous, 2004a).

Table.1 Scale to categorize germplasm lines

Larvae /plant	Resistance grade	Resistance rating
0	I	HR
0.0 1-1	II	R
1.1 – 2.5	III	MR
2.6-3.5	IV	S
3.6 and above	v	HS

Table.2 Scale to categorize germplasm lines

Leaf	Flowers	Head	Score	Score	Grade	Mechanism
0-10	0-5	0.00	1	0-1	1	Highly resistant (HR)
>10-20	>5.1-10	>0.1-2	3	>1-2	3	Resistant (R)
>20-30	>10.1-15	>2.1-5	5	>2-3	5	Moderately resistant (MR)
>30-40	>15.1-20	>5.1-8	7	>3-5	7	Susceptible (S)
>40	>20	>08	9	>5-9	9	Highly susceptible (HS)

Table.3 Germplasm lines screened for pest resistance/ tolerance in Sunflower

Name of Germplasm	Av. Defoliators /pl	Av. Head borer/Pl	Name of Germplasm	Av. Defoliators /pl	Av. Head borer/Pl	Name of Germplasm	Av. Defoliators /pl	Av. Head borer/Pl	Name of Germplasm	Av. Defoliators /pl	Av. Head borer/Pl
GMU-1001	0.2	2.6	GMU-1027	0.2	1.2	GMU-1053	1.4	2.2	GMU-1079	1.4	1.0
GMU-1002	0.4	**4.2**	GMU-1028	1.0	2.6	GMU-1054	**1.8**	1.2	GMU-1080	0.6	2.2
GMU-1003	0.2	3.0	GMU-1029	0.2	2.0	GMU-1055	0.6	0.4	GMU-1081	1.0	1.6
GMU-1004	**0.0**	1.8	GMU-1030	0.4	2.0	GMU-1056	0.4	1.6	GMU-1082	0.2	1.4
GMU-1005	0.2	0.4	GMU-1031	0.6	2.4	GMU-1057	0.2	1.6	GMU-1083	0.8	1.4
GMU-1006	0.4	1.8	GMU-1032	1.0	2.2	GMU-1058	0.8	1.0	GMU-1084	0.2	0.2
GMU-1007	0.4	2.4	GMU-1033	0.2	0.6	GMU-1059	0.2	0.4	GMU-1085	0.2	1.8
GMU-1008	**0.0**	2.4	GMU-1034	0.4	2.8	GMU-1060	1.0	0.6	GMU-1086	0.6	1.4
GMU-1009	0.2	1.8	GMU-1035	0.2	2.2	GMU-1061	0.6	1.8	GMU-1087	0.4	1.2
GMU-1010	0.2	2.8	GMU-1036	0.2	1.8	GMU-1062	0.4	1.2	GMU-1088	0.2	1.0
GMU-1011	**0.0**	1.4	GMU-1037	0.2	0.6	GMU-1063	1.0	2.0	GMU-1089	0.2	1.0
GMU-1012	0.2	1.4	GMU-1038	0.2	2.0	GMU-1064	**0.0**	1.2	GMU-1090	0.0	1.0
GMU-1013	0.4	1.6	GMU-1039	0.2	1.8	GMU-1065	0.8	1.6	GMU-1091	0.0	1.8
GMU-1014	0.2	2.0	GMU-1040	0.4	2.2	GMU-1066	0.2	2.2	GMU-1092	1.2	1.6
GMU-1015	0.2	2.6	GMU-1041	**0.0**	3.2	GMU-1067	1.2	1.0	GMU-1093	0.2	1.2
GMU-1016	0.4	2.8	GMU-1042	0.2	2.4	GMU-1068	0.4	1.4	GMU-1094	0.2	1.4
GMU-1017	0.2	2.8	GMU-1043	0.6	2.0	GMU-1069	0.4	1.8	GMU-1095	0.4	1.0
GMU-1018	**0.0**	3.2	GMU-1044	**0.0**	1.8	GMU-1070	0.8	1.8	GMU-1096	0.2	1.2
GMU-1019	0.4	3.0	GMU-1045	**0.0**	1.4	GMU-1071	0.6	1.2	GMU-1097	0.0	1.4
GMU-1020	0.2	3.8	GMU-1046	0.6	1.6	GMU-1072	0.8	1.8	GMU-1098	0.2	1.0
GMU-1021	0.2	2.4	GMU-1047	**0.0**	0.6	GMU-1073	0.6	2.8	GMU-1099	0.2	1.2
GMU-1022	0.6	1.8	GMU-1048	0.4	1.6	GMU-1074	0.8	1.6	GMU-1100	0.2	1.4
GMU-1023	0.4	1.8	GMU-1049	0.2	1.4	GMU-1075	0.4	2.2	Morden(SC)	1.2	2.8
GMU-1024	0.2	1.4	GMU-1050	0.4	1.6	GMU-1076	1.0	1.2			
GMU-1025	1.0	1.8	GMU-1051	0.2	1.6	GMU-1077	0.6	1.0			
GMU-1026	0.8	1.2	GMU-1052	1.4	3.0	GMU-1078	1.2	1.4			

Table.4 Germplasm lines screened for pest resistance/tolerance in Sunflower

Name of Germplasm	Av. Head borer damage /Pl(%)	Av. Defoliation /pl (%)	Name of Germplasm	Av. Head borer damage /Pl(%)	Av. Defoliation /pl (%)	Name of Germplasm	Av. Head borer damage /Pl(%)	Av. Defoliation /pl (%)	Name of Germplasm	Av. Head borer damage / Pl(%)	Av. Defoliation /pl (%)
GMU-1001	14.12	32.58	GMU-1027	10.24	36.48	GMU-1053	12.24	31.24	GMU-1079	10.68	34.12
GMU-1002	16.48	56.48	GMU-1028	12.88	34.32	GMU-1054	14.48	32.38	GMU-1080	12.56	36.48
GMU-1003	18.48	30.54	GMU-1029	14.56	38.42	GMU-1055	04.24	24.12	GMU-1081	12.24	38.48
GMU-1004	14.96	**0.00**	GMU-1030	15.72	28.84	GMU-1056	12.20	34.14	GMU-1082	12.20	34.96
GMU-1005	02.54	18.46	GMU-1031	15.86	24.80	GMU-1057	12.86	36.96	GMU-1083	16.86	38.54
GMU-1006	14.48	28.62	GMU-1032	12.42	34.96	GMU-1058	14.00	35.86	GMU-1084	4.00	24.48
GMU-1007	14.34	32.12	GMU-1033	04.86	18.96	GMU-1059	04.46	18.86	GMU-1085	14.46	34.34
GMU-1008	18.48	**0.00**	GMU-1034	10.42	36.86	GMU-1060	03.46	19.68	GMU-1086	18.42	38.48
GMU-1009	18.24	34.00	GMU-1035	10.88	34.46	GMU-1061	12.18	34.86	GMU-1087	16.32	38.24
GMU-1010	14.20	38.24	GMU-1036	12.56	34.86	GMU-1062	16.42	35.84	GMU-1088	16.96	34.20
GMU-1011	18.86	0.00	GMU-1037	04.48	19.86	GMU-1063	14.86	36.96	GMU-1089	16.86	38.86
GMU-1012	18.00	24.20	GMU-1038	14.86	36.16	GMU-1064	14.12	**0.00**	GMU-1090	16.72	38.00
GMU-1013	18.46	34.86	GMU-1039	14.00	34.24	GMU-1065	14.66	36.86	GMU-1091	16.66	38.96
GMU-1014	12.00	35.00	GMU-1040	16.46	36.18	GMU-1066	16.36	38.86	GMU-1092	14.36	38.00
GMU-1015	19.18	36.96	GMU-1041	14.00	**0.00**	GMU-1067	12.48	36.12	GMU-1093	18.58	39.48
GMU-1016	16.24	34.00	GMU-1042	12.18	32.62	GMU-1068	12.34	36.86	GMU-1094	18.86	36.24
GMU-1017	18.86	36.28	GMU-1043	16.42	30.84	GMU-1069	12.48	38.24	GMU-1095	11.12	38.86
GMU-1018	19.12	**0.00**	GMU-1044	12.86	**48.00**	GMU-1070	16.24	38.28	GMU-1096	12.66	39.12
GMU-1019	18.66	32.96	GMU-1045	19.72	0.00	GMU-1071	14.52	39.48	GMU-1097	11.36	38.66
GMU-1020	12.36	35.48	GMU-1046	12.66	38.62	GMU-1072	16.86	36.86	GMU-1098	12.48	32.36
GMU-1021	14.48	34.24	GMU-1047	**02.46**	**0.00**	GMU-1073	12.00	32.46	GMU-1099	16.38	34.48
GMU-1022	12.12	34.86	GMU-1048	12.76	36.86	GMU-1074	12.86	41.00	GMU-1100	14.86	32.12
GMU-1023	12.42	38.12	GMU-1049	12.18	34.46	GMU-1075	14.00	38.46	Morden(SC)	**21.86**	42.82
GMU-1024	14.34	39.66	GMU-1050	19.24	38.84	GMU-1076	16.18	38.00			
GMU-1025	18.48	34.68	GMU-1051	18.46	38.24	GMU-1077	18.24	34.46			
GMU-1026	18.24	32.66	GMU-1052	19.96	28.48	GMU-1078	18.14	38.64			

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

Sr.No.	Score	Resistance rating	Resistance grade	Name of the accessions (Head borer)	Name of the accessions (Defoliators)
1	0-1	I	HR	---	GMU 1004,1008,1011,1018,1041,1045,1047 and 1064
2	>1-2	II	R	---	GMU 1005,1033,1037, 1047,, 1059 and 1060
3	>2-3	III	MR	GMU 1005,1033,1037, 1047,1055, 1059,1060 and 1084	GMU 1006,1012,1030, 1031,1052, 1055, and 1084
4	>3-5	IV	S	--	GMU 1007,1009,1010, 1013-1017,1019-1029,1032,1034-1036,1038-1040,1042,1043,1046,1049-1051,1053,1054,1056-1058,1061-1063,1065-1073,1075-1083 and 1085-1100
5	>5-9	V	HS	GMU-1001-1004, GMU-1006-1032,GMU-1034-1036,GMU-1038-1046,GMU-1048-1054,GMU-1056-1058,GMU-1061-1083,GMU-1085-1100 & Morden.	1044, 1074 and Morden.

Jayewar *et al.,* (2017), evaluated 100 germplasm lines 901-1000 and concluded that the entries GMU-973 and GMU-924 recorded minimum defoliator population and defoliation per cent, while the entry GMU-942 recorded minimum capitulum borer population and Mean head damage per cent (Table 4 and 5). The entries GMU-924, 943, 965, 980 and 990 recorded resistant reaction whereas for head borer entries GMU-904, 924,942 and 992 given resistant reaction. Germplasm lines GMU-904, 905, 914, 919, 922, 925, 927, 934, 940, 956 and 992 recorded moderately resistant reaction for defoliator; for capitulum borer GMU-905, 914, 925, 927, 934, 944, 947, 960, 964 and 965 gives moderate resistant reaction**.**

Similar work has been carried out at various stations across the country by AICRP centres (Anonymous, 2000, 2001, 2002, 2003, 2004, 2005, 2006 and 2011). However these entries were different from the present investigation and hence, cannot be compared.

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