



## Susceptibility status of sunflower hybrids against whitefly, Jassid and head moth under natural field conditions in Pakistan

Muhammad Zubair<sup>1\*</sup>, Siraj Ahmed<sup>2</sup>, Sikandar Ali Cheema<sup>3</sup>, Muhammad Rizwan Bashir<sup>4</sup>, Naeem Arshad Maan<sup>5</sup>, Asad Aslam<sup>6</sup>, Muhammad Kamil Malik<sup>7</sup>

<sup>1-4</sup> Oilseeds Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

<sup>5</sup> Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

<sup>6,7</sup> Beekeeping and Hill Fruits Pests Research Station Rawalpindi, Pakistan

### Abstract

Insect pests are tremendously decreasing the yield of sunflower so the current research was conducted to screen the sunflower hybrid against insect pests under natural field conditions at Oilseeds Research Institute, AARI Faisalabad, Pakistan. Nineteen sunflower hybrids were screened to evaluate their susceptibility to major insect pests during the year 2017 with three replications by adopting Randomized Complete Block Design (RCBD) at experimental research area of Institute. Results represent that screened sunflower hybrids showed significant variation regarding the insect susceptibility. It is concluded that sunflower hybrids namely, FH-666 and FH-675 expressed resistant response against whitefly and head moth. Potential of these hybrids is further needed to be explored to make them resistant against Jassid and strengthen their existing resistance capability against Whitefly and Head Moth.

**Keywords:** screening, resistance source, sunflower, whitefly, Jassid, head moth

### Introduction

Sunflower is the major oilseed crop in Pakistan that is cultivated on an area of 2700871.976 hectare with maximum production of 446 thousand tonnes during 2016-17 (Pakistan Economic Survey, 2016-17) [12]. Protein concentrates and flours of sunflower have potential uses as food due to presence of white color, fat absorption properties and absence of antinutritive factors (Sosulski and Fleming, 1977) [21]. Sunflower oil is regarded as premium oil as unsaturated fatty acids are present at high levels and linolenic acid is absent. Sunflower oil possesses octane rating of 37 and its use as an alternative fuel source for diesel engines is being explored. Moreover, it is expected that blends of sunflower oil and diesel fuel may prove more efficient as compared to the burning of pure vegetable oil (Putnam *et al.*, 1990) [15]. Sunflower crop also possesses medicinal value because it provides protection against infection in infants. Studies represented that infants were 41% less likely to develop infections in hospitals who received daily skin treatment of sunflower oil. On the other hand, it can also be admitted that serious harms can be caused if sunflower oil is consumed in excess quantities as it contains Omega-6 and its higher quantities may cause joint pain in human beings. Enhancement of the production of Sunflower crop is easy as it suits the localized cropping system because it requires short duration for maturity and can be grown in two seasons; spring and summer (Shah *et al.*, 2005) [20].

Insect resistance in plant is an important component of Integrated Pest Management (IPM) program and requires no input in terms of money by farmers. Production of the crop

using less susceptible or resistant varieties is an important method for keeping the pest population below the Economic Threshold Level (ETL) which is an indicator that damage by insects pests has been started (Kavitha and Reddy, 2012) [7]. Sunflower is reported to be the host of various insects which damage it in the field as well as in the warehouses and cause severe losses (Mukhtar, I. 2009) [5]. Main Insects are whitefly and head moth which attack this crop severely (Aslam *et al.*, 2000) [1]. Attack of whitefly, Jassid and loopers has been previously reported on the crop on different genotypes in Pakistan (Rafiullah *et al.*, 1998) [16].

As the significant information regarding insect resistant germplasm is lacking, so, the objective of present study was to identify insect resistant sunflower hybrids among the available germplasm. The present study represents the incidence of insect pests which mainly affect the production of sunflower.

### Materials and Methods

#### 1. Collection and sowing of germplasm

19 sunflower hybrids (FH-655, FH-657, FH-658, FH-659, FH-661, FH-663, FH-666, FH-670, FH-671, FH-674, FH-675, FH-676, FH-677, FH-678, FH-680, FH-681, FH-682, FH-684 and FH-685) were collected from experts working on development of sunflower hybrids and sown at Research Farm of Oilseeds Research Institute, Ayub Agricultural Research Institute Faisalabad, Punjab, Pakistan. Randomized complete block design was adopted and hybrids were sown in three replicates. Appropriate agronomic practices such as hoeing, thinning and weeds removal etc. except plant protection measures were carried out at Oilseeds Research Institute,

Ayub Agricultural Research Institute, Faisalabad.

## 2. Data Recording

Five plants were randomly selected for data recording and data regarding insect infestation was recorded weekly on per plant basis; (upper, middle and lower leaves of plants were examined) in case of whitefly and Jassid while larvae of Head moth were counted when founded in the heads of sunflower plants already selected.

## 3. Statistical Analysis

Data was analyzed, analysis of variance (ANOVA) was constructed and the Least Significant Difference (LSD) was performed for the differentiation of means among inbred lines of sunflower hybrids.

## Results

### Whitefly (*Bemisia tabaci*)

Two hybrids, namely FH-666 and FH-675 showed their response to be resistant against whitefly having LSD value of 1.0000 while the other ones showed a great amount of variability in their potential of resistance against whitefly. Eight hybrids which include FH-670, 671, 674, 676, 677, 678, 680 and FH-681 expressed moderate resistance to whitefly as they represented LSD values of 1.4000, 2.0000, 1.8000, 1.8000, 1.2000, 2.0000, 1.8000 and 1.4000. Five sunflower hybrids were highly susceptible to the attack of whitefly as they represented significant difference when comparison was made. FH-655 (4.2000), FH-657 (4.0000), FH-661 (3.4000), FH-682 (3.2000), and FH-685 expressed LSD value of 3.7000 (Table 5 and 6).

### Jassid/Plant Hopper (*Amrasca biguttula*)

Thirteen sunflower hybrids (FH-655, FH-657, FH-658, FH-659, FH-661, FH-663, FH-670, FH-671, FH-674, FH-675, FH-676, FH-678 and FH-680) were highly susceptible to Jassid as they represented high LSD values which were 6.8000, 7.0000, 5.0000, 6.8000, 5.4000, 4.6000, 3.6000, 4.8000, 4.2000, 3.2000, 3.6000, 3.6000 and 3.8000. Hybrids namely FH-666, FH-677 and FH-681 expressed susceptibility as in case of these hybrids, LSD value was 3.0000. FH-682 also showed susceptibility to Jassid as LSD value was 2.8000. FH-684 and FH-685 were found to be moderately resistant to Jassid as LSD value was 1.6000 and 1.1000 respectively. No sunflower hybrid was found resistant against Jassid. (Table 5 and 6).

### Head Moth (*Helicoverpa armigera*)

Eight sunflower hybrids were found to be resistant against

head moth as their respective LSD values were below 1. These include FH-666, FH-674, FH-676 and FH-678 which showed LSD value of 1.000. Beside these, LSD values for FH-675 and FH-680 were also 0.8000. FH-677 expressed LSD value of 0.6000 and this value was 0.2000 in case of FH-681. Response of eleven hybrids namely, FH-655, FH-657, FH-658, FH-659, FH-661, FH-663, FH-670, FH-671, FH-682, FH-684 and FH-685 was moderate resistant as they showed LSD values of 2.0000, 1.6000, 1.2000, 2.0000, 1.4000, 1.2000, 1.4000, 1.2000, 1.1000, 1.2000 and 1.4000 respectively. Screened sunflower hybrids represented greater amount of resistance to this particular insect pest. No hybrid was categorized in Susceptible or Highly Susceptible category. (Table 5 and Table 6).

**Table 1:** Analysis of variance for source of resistance against whitefly on sunflower

Source	DF	SS	MS	F	P
Varieties	18	53.9526	2.99737	324.40	0.0000*
Error	36	0.3326	0.00924		
Total	56	61.7126			

\* = Significant at  $P < 0.05$

**Table 2:** Analysis of variance for source of resistance against jassid on sunflower

Source	DF	SS	MS	F	P
Varieties	18	145.222	8.06789	1662.18	0.0000*
Error	36	0.175	0.00485		
Total	56	153.182			

\* = Significant at  $P < 0.05$

**Table 3:** Analysis of variance for source of resistance against head moth on sunflower

Source	DF	SS	MS	F	P
Varieties	18	10.1526	0.56404	37.38	0.0000*
Error	36	0.5432	0.01509		
Total	56	17.4326			

\* = Significant at  $P < 0.05$

**Table 4:** Scale to categorize germplasm lines\*

Insect Population/Plant	Resistance Grade	Resistance Rating
0-1	I	Resistant (R)
1.01-2	II	Moderately Resistant (MR)
2.01-3	III	Susceptible (S)
Above 3	IV	Highly Susceptible (HS)

\* = Katti (2007) used the scale to categorize the attack of insect pests

**Table 5:** Status of sunflower hybrids' resistance to whitefly, Jassid and head moth during 2017 under field conditions

Sr. No.	Name of Hybrid	Whitefly	Response	Jassid	Response	Head Moth	Response
1	FH-655	4.2000a	HS	6.8000a	HS	2.0000a	MR
2	FH-657	4.0000a	HS	7.0000a	HS	1.6000b	MR
3	FH-658	2.8000d	S	5.0000c	HS	1.2000cd	MR
4	FH-659	2.2000e	S	6.8000a	HS	2.0000a	MR
5	FH-661	3.4000c	HS	5.4000b	HS	1.4000bc	MR
6	FH-663	2.0000ef	S	4.6000d	HS	1.2000cd	MR
7	FH-666	1.0000h	R	3.0000gh	S	1.0000de	R
8	FH-670	1.4000g	MR	3.6000f	HS	1.4000bc	MR
9	FH-671	2.0000ef	MR	4.8000cd	HS	1.2000cd	MR

10	FH-674	1.8000f	MR	4.2000e	HS	1.0000de	R
11	FH-675	1.0000h	R	3.2000g	HS	0.8000ef	R
12	FH-676	1.8000f	MR	3.6000f	HS	1.0000de	R
13	FH-677	1.2000gh	MR	3.0000gh	S	0.6000f	R
14	FH-678	2.0000ef	MR	3.6000f	HS	1.0000de	R
15	FH-680	1.8000f	MR	3.8000f	HS	0.8000ef	R
16	FH-681	1.4000g	MR	3.0000gh	S	0.2000g	R
17	FH-682	3.2000c	HS	2.8000h	S	1.1000cde	MR
18	FH-684	2.1000e	S	1.6000i	MR	1.2000cd	MR
19	FH-685	3.7000b	HS	1.1000j	MR	1.4000bc	MR

Mean values in a column sharing similar letters do not differ significantly as determined by the LSD test ( $P \leq 0.05$ ).

**Table 6:** Rating of Sunflower Germplasm Inbred Lines for Aphid, Whitefly and Head Moth\*

Sr. No.	Pest Population	Resistance Rating	Resistance Grade	Whitefly	Jassid	Head Moth
1	0-1	I	R	FH-666 and FH-675	No hybrid found resistant for this particular pest	FH-666, 674, 675, 676, 677, 678, 680 and FH-681
2	1.01-2	II	MR	FH-670, 671, 674, 676, 677, 678, 680, 681	FH-684 and FH-685	FH-655, 657, 658, 659, 661, 663, 670, 671, 682, 684 and FH-685
3	2.01-3	III	S	FH-658, 659, 663, 684,	FH-666, 677, 681 and FH-682	No hybrid found susceptible for this particular pest
4	Above 3	IV	HS	FH-655, 657, 661, 682, 685	FH-655, 657, 658, 659, 661, 663, 670, 671, 674, 675, 676, 678 and FH-680	No hybrid found highly susceptible for this particular pest

\* = Katti (2007) used the scale to categorize the attack of insect pests and this table represents the response of hybrid inbred lines to different insects categorically.

## Discussion

There are many factors which affect production of the sunflower crop. Insects are major ones of it. About 43 insect species have been reported to attack the sunflower crop in India (Sandhu *et al.*, 1973) [18]. This finding is also in line with (Makhdoomi *et al.*, 1984) [10] who also reported that 43 insect species attack this crop whereas (Hassan *et al.*, 1984) [3] identified 19 insect species for the same. There is an evidence of insects which invade the sunflower crop plants significantly. *Helicoverpa armigera*, *Aphis gossypii* Glover, *Bemisia tabaci* Gennadius, *Amrasca devastans* (Ishida) and *Atractomorpha crenulata* (Fabricius) are reported to attack the sunflower crop (Sattar *et al.*, 1984) [19]. The following insects: *Bemisia tabaci* (Gennadius), *Amrasca devastans* Dist., *Aphis gossypii* Glover and semilooper (unidentified) have been found attacking the sunflower crop. Piracha (1989) [14]. Results of the present study supported these findings as there is variability among the susceptibility of screened out inbred lines of sunflower hybrid to Whitefly, Jassid and Head Moth. Whitefly (*Bemisia tabaci*) is an important insect pest of the sunflower crop (Saleem *et al.*, 2017) [17]. About 100 years in past, it was regarded as a tobacco crop's pest in Greece. Later, it has been regarded as one of the major insect pest of various crops like Sunflower, Cotton, Brinjal and tomato etc. Its polyphagous nature has been confirmed various times (Greathead, 1986) [2]. Results of the present study also represent that only two sunflower hybrids, namely FH-666 and FH-675 out of nineteen screened hybrids have been found resistant against this insect pest.

Jassid or plant hopper (*Amrasca biguttula*) is one of the serious pests of cotton (Kittiboonya *et al.*, 2002) [8]. Ecosystem of sunflower crop is also being disturbed by its activity of sucking cell sap (Jayewar *et al.*, 2018) [4]. Previously, it was considered as a pest attacking at vegetative

stage of the plants but now it has attained the status of serious pest at the time of reproductive stage, thus it has become a major limiting factor in the productivity of the crop (Manjula *et al.*, 2018) [11]. Findings of present study also support this scenario as no sunflower hybrid was found resistant against this particular insect pest.

Head moth (*Helicoverpa armigera*) is listed among seriously devastating insect pests. Heavy yield losses have been reported on different crops by many researchers. It is a widespread pest and feeds on about 180 plant species (Kassi *et al.*, 2018) [5]. Its control and management practices are much difficult owing to a number of reasons which may include: higher mobility, fecundity, survival rate and ability to develop resistance against insecticides (Kumar *et al.*, 2017) [9]. So, the evaluation was made and germplasm proved effective against this insect pest as eight hybrids were found resistant to this insect pest.

## Conclusion

Screened sunflower hybrids showed significant susceptibility to the different insect pests which are responsible for the loss in yield and for huge expenditures met by the farmers concerned in order to adopt measures to control them. Whitefly (*Bemisia tabaci*), Jassid/Leaf Hopper (*Amrasca biguttula*) and Head moth (*Helicoverpa armigera*) are the most notorious pests of the sunflower crop. In this experiment of screening, no inbred line was found resistant against the above mentioned three insect pests. But, some of these hybrids showed greater amount of resistance against two of the three main insect pests. FH-666 and FH-675 were significantly resistant against whitefly and head moth. FH-666 showed susceptibility to Jassid while FH-675 showed its high susceptibility to the attack of Jassid. However, FH-684 and 685 represented moderate resistance to the Jassid and Head

Moth followed by susceptibility and highly susceptibility in case of whitefly respectively. It can be admitted that FH-666 and FH-675 expressed resistance to the insect pests greatly and these sunflower hybrids are further in need to be explored in order to make them resistant against Jassid.

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