SCREENING OF SAFFLOWER ELITE MATERIAL FOR RESISTANCE TO FUSARIUM WILT

T. RAJESHWAR REDDY, SNCVL PUSHPAVALLI, C. SUDHAKAR, C. SUDHARANI

Abstract: Thirty Nine Safflower elite material (25 IVT and 14 IH-AVHT) received from Indian Institute of Oilseeds Research (IIOR) were screened for Fusarium wilt resistance in sick plot under natural conditions during *rabi* 2014-15 at Agriculture Research Station, Tandur. The screening revealed that, seven entries (IVT-14-01,18, 19, 25 & IH- AVHT-14-1,6,13) were observed immune to wilt and recorded zero wilting; one entry (IVT-14-22) was recorded moderately resistant with 0-10% mortality; one entry (IVT-14-9) was recorded tolerant and recorded 11-20% mortality; Eleven entries (IVT-14-1,5, 10,15,20, 23 &IH- AVHT-14-3, 4, 8,11,13) were recorded susceptible with 21-50% mortality; remaining entries were susceptible to wilt disease. Majority of entries were indicated susceptible and highly susceptible reaction to Fusarium wilt.

Key words: Safflower, Screening, Fusarium Wilt.

Introduction: Safflower (*Carthumus tinctorius* Linn.) is an important *Rabi* oil seed crop in India. Wilt caused by *Fusarium oxysporurn* f sp. *carthami* Klisiewicz and Houston is the major disease in safflower growing areas causing huge yield losses. It causes yield loss up to 93 % in susceptible varieties (Sastry and Ramchandram, 1994). The fungus persists in the soil and on plant debris, and is seed-borne in internal tissue of the hull and seed coat. The infected plants show symptoms such as complete and partial wilting, leaf yellowing and head blight (Weiss 1983). The disease can cause severe damage and yield reductions (Smith 1996). The disease is endemic in India particularly in Maharashtra and other safflower growing states with an incidence ranging from 5-40 per cent (Singh, 1975 and Deokar *et al.,* 1998). The disease has been reported to cause severe losses in Ranga Reddy district of Andhra Pradesh when the crop is grown in vertisols (Nageswara Rao, 2000). The repeated use of wilt-susceptible traditional varieties is a major factor causing increased wilt incidence in this crop (Sastry et al. 1993). The pathogen is both soil and seed borne nature. Being soil borne in nature, the fungus survives in the soil as chlamydospores in diseased plant debris without losing viability. The increase in disease incidence results from a continuous cultivation of Safflower i.e. monocropping and re-use of infected seeds harvested from wilt infected plants, which contributes to increasing the primary source of the inoculum. Disease severity seems to be directly related to the use of susceptible varieties and a large population of *Fusarium oxysporum f.sp. carthami* in the soil (Jarvis and Shoemaker, 1978). The seed treatment is effective only for 15-20 days and soil fumigation is neither feasible nor practicable. Hence screening for wilt resistance is essential. Thus, the present study was made to evaluate Safflower elite material for resistance against Safflower wilt.

Materials And Method: The experiment was conducted during *rabi* 2014-15 at Agriculture Research Station, Tandur to know of fusarium wilt resistance in elite material. 39 Safflower Elite material (25 IVT and 14 IH-AVHT) received from Indian Institute of Oilseeds Research (IIOR) were screened for Fusarium wilt resistance in sick plot under natural conditions. Each entry was planted in a single row of 5 m length with spacing of 45 cm between rows and 20 cm between hills, in a randomized block design with two replications. A susceptible check variety PBNS-12 and local tolerant check variety TSF-1 were planted after every five rows to ascertain uniformity in disease incidence across the sick plot. . The standard cultural practices were followed to raise a good crop. Percent mortality due to wilt was recorded from 35 days after sowing at an interval of 15 days till 120 days after sowing. The plant exhibiting wilt symptoms was designated susceptible while the one without wilt was designated as resistant. Wilt incidence was recorded as PDI (Percent Disease Incidence) [Number of wilted plants/total number of plants] x 100 as prescribed by Mayee and Datar (1986). For recording the disease intensity under field condition, 0 to 9 disease rating scale developed by Mayee and Datar (1986) was used (Table 1).

Results and Discussion: Results of the present study, revealed considerable variation towards disease reaction among Safflower elite entries (Table 2&3). Entries were grouped into six different groups in relation to their resistance reaction. Out of 39, Seven entries (IVT-14-01,18, 19, 25 & IH- AVHT-14-1,6,13) were observed Immune to wilt and recorded zero wilting; one entry (IVT-14-22) was recorded Moderately resistant with 0-10% mortality; one entry (IVT-14-9) was recorded tolerant and recorded 11-20% mortality; Eleven entries (IVT-14-1,5, 10,15,20, 23 &IH-AVHT-14-3, 4, 8,11,13) were recorded susceptible with 21-50% mortality; Remaining entries were susceptible to wilt disease. Majority of entries were indicated

susceptible and highly susceptible reaction to fusarium wilt. Per cent wilt mean incidence of susceptible check (PBNS-12) was 100.00 per cent (Table-2 & 3).This study confirms that differences in resistance to fusarium wilt exist in germplasm of safflower. Sastry et al. (2003) identified safflower germplasm lines, 86-93-36A, 237550, VI-92-4-2 and II-13-2A, as wilt resistant. A safflower line 96-508-2-90 was reported to be resistant to safflower wilt (Anjani et al., 2005). Three genotypes *viz.*, GMU-4814, GMU-4842 and GMU-4955 showed *fusarium* wilt (Akashe *et al.*, 2014). Further, these resistant accessions will be used as donors in future Safflower breeding programme for incorporation of resistance in agronomically desirable high yielding varieties of Safflower.

Table 1: Disease rating scale (Mayee and Datar, 1986).

Disease scale	Disease Incidence	Disease Reaction	IVT	IH- AVHT
0	No wilting symptoms	Immune	4 (IVT-14-01,18, 19, 25)	3 (IH- AVHT-14-1,6,13)
1	<1% plants wilted	Resistant	Nil	Nil
3	1-10% plants wilted	Moderately Resistant	1 (IVT-14-22) + TSF-1 (LC)	Nil
5	11-20% plants wilted	Susceptible	1 (IVT-14-9)	TSF-1 (LC)
7	21-50% plants wilted	Moderately Susceptible	6 (IVT-14-1,5, 10,15,20, 23)	5 (IH- AVHT-14-3, 4, 8,11,13)
9	>51% plants wilted	Highly Susceptible	13+ PBNS-12(SC)	6+ PBNS-12 (SC)
	Total		25 + PBNS-12 (SC) + TSF-1 (LC)	14+ PBNS-12 (SC)+ TSF-1 (LC)

SC- Susceptible check
LC- Local check

Table 2. Disease Intensity on selected elite material against wilt caused by *Fusarium oxysporum* f.sp. *carthami*.

	Percent wilt						
ENTRY	35 DAS	50 DAS	65 DAS	80 DAS	95 DAS	110 DAS	120 DAS
PBNS-12	91.3(74.1)	93.5(76.8)	95.4 (78.6)	96.6 (80.0)	100.0(90.0)	100.0(90.0)	100.0(90.0)
TSF 1	0.0(0.0)	2.9(9.8)	2.9(9.8)	2.9(9.8)	6.8(15.2)	6.8(15.2)	6.8(15.2)
IVT-14-01	3.8(8.1)	7.7(11.5)	14.9(21.9)	32.6(34.7)	43.6(41.2)	46.9(43.2)	46.9(43.2)
IVT-14-02	66.2(54.8)	66.2(54.8)	70.1(57.0)	73.9(59.3)	81.3(64.5)	92.3(78.4)	92.3(78.4)
IVT-14-03	58.5(49.9)	65.2(53.8)	76.4(60.9)	87.6(69.8)	95.5(81.2)	100.0(90.0)	100.0(90.0)
IVT-14-04	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
IVT-14-05	3.1(7.3)	3.1(7.3)	6.3(10.3)	16.0(23.5)	25.8(30.5)	32.3(34.6)	32.3(34.6)
IVT-14-06	55.5(48.1)	62.9(52.5)	74.2(59.4)	81.6(64.6)	89.0(70.8)	89.0(70.8)	89.0(70.8)
IVT-14-07	62.0(51.9)	69.0(56.1)	72.8(58.6)	79.8(63.4)	79.8(63.4)	86.8(69.1)	89.9(71.6)
IVT-14-08	26.9(31.0)	31.5(34.1)	39.6(39.0)	47.7(43.7)	55.8(48.3)	59.4(50.4)	68.5(55.9)
IVT-14-09	0.0(0.0)	12.9(20.7)	12.9(20.7)	12.9(20.7)	12.9(20.7)	12.9(20.7)	12.9(20.7)
IVT-14-10	0.0(0.0)	12.7(20.8)	12.7(20.8)	18.3(25.2)	27.4(31.4)	40.1(39.2)	49.2(44.5)
IVT-14-11	61.9(51.9)	69.6(56.6)	69.6(56.6)	73.2(58.8)	77.4(61.8)	88.7(70.5)	92.3(73.9)
IVT-14-12	70.0(59.0)	70.0(59.0)	76.7(68.4)	83.3(72.4)	83.3(72.4)	90.0(76.7)	96.7(82.5)
IVT-14-13	51.5(45.8)	58.1(49.7)	61.3(51.5)	74.0(59.5)	83.8(66.3)	90.2(72.1)	93.5(75.3)
IVT-14-14	71.0(57.4)	74.8(59.9)	79.4(63.0)	79.4(63.0)	79.4(63.0)	87.8(69.6)	91.6(73.1)
IVT-14-15	0.0(0.0)	3.6(7.7)	6.7(15.0)	6.7(15.0)	13.4(21.5)	16.5(23.9)	23.2(28.8)
IVT-14-16	56.9(49.0)	60.3(50.9)	66.9(55.3)	70.8(57.5)	74.1(60.1)	81.3(65.6)	81.3(65.6)
IVT-14-17	79.3(49.0)	86.2(68.2)	86.2(68.2)	89.8(71.6)	96.7(82.5)	96.7(82.5)	96.7(82.5)
IVT-14-18	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
IVT-14-19	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
IVT-14-20	3.6(7.7)	7.1(15.4)	14.3(22.2)	21.4(27.5)	28.6(32.1)	35.7(36.6)	42.9(40.8)

IVT-14-21	45.2(42.3)	45.2(42.3)	51.9(46.1)	58.3(49.9)	58.3(49.9)	61.7(51.9)	68.1(56.0)
IVT-14-22	3.6(7.7)	7.1(15.4)	7.1(15.4)	7.1(15.4)	10.7(18.8)	10.7(18.8)	10.7(18.8)
IVT-14-23	4.5(8.8)	4.5(8.8)	15.3(23.0)	19.9(26.1)	26.1(30.7)	30.7(33.5)	30.7(33.5)
IVT-14-24	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
IVT-14-25	56.1(48.5)	67.9(55.5)	71.8(58.0)	83.7(66.9)	87.5(75.0)	91.7(77.9)	100.0(90.0)
CD	17.777	17.759	19.202	16.364	18.484	16.336	13.857
CV	26.665	23.619	23.112	17.557	18.058	14.736	11.943

*Values in parenthesis are angular transformed values

Table 3. Disease Intensity on selected elite material against wilt caused by *Fusarium oxysporum* f.sp. *carthami*.

Entry	Percent wilt						
	35 DAS	**50 DAS**	**65 DAS**	**80 DAS**	**95 DAS**	**110 DAS**	**120 DAS**
PBNS-12	96.6(79.6)	96.6(79.6)	100.0(90.0)	100.0(90.0)	100.0(90.0)	100.0(90.0)	100.0(90.0)
TSF-1	0.0(0.0)	1.1(4.3)	4.1(8.4)	6.4(13.9)	10.9(19.2)	12.0(20.1)	12.0(20.1)
IH AVHT-14-1	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
IH AVHT-14-2	48.5(44.1)	55.0(47.9)	61.5(51.7)	71.0(57.4)	77.5(61.7)	84.0(66.5)	86.9(69.5)
IH AVHT-14-3	0.0(0.0)	0.0(0.0)	3.1(7.3)	3.1(7.3)	6.3(10.3)	22.3(27.7)	22.3(27.7)
IH AVHT-14-4	3.6(7.7)	11.0(19.2)	14.6(21.8)	22.0(27.7)	25.5(29.9)	29.4(32.7)	33.2(35.2)
IH AVHT-14-5	3.3(7.5)	13.1(20.5)	19.6(25.9)	32.5(34.6)	39.0(38.5)	55.0(47.9)	61.5(51.7)
IH AVHT-14-6	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
IH AVHT-14-7	39.7(39.0)	50.3(45.1)	57.4(49.3)	64.6(53.5)	71.8(58.0)	79.0(62.9)	86.2(68.6)
IH AVHT-14-8	0.0(0.0)	3.6(7.7)	11.0(19.2)	14.6(21.8)	14.6(21.8)	18.4(25.3)	22.3(28.1)
IH AVHT-14-9	6.3(10.2)	55.0(47.9)	65.1(53.8)	72.1(58.1)	79.1(62.8)	86.1(68.1)	89.9(71.6)
IH AVHT-14-10	54.2(47.4)	63.3(52.7)	72.5(58.4)	81.7(64.6)	100.0(90.0)	100.0(90.0)	100.0(90.0)
IH AVHT-14-11	0.0(0.0)	12.5(15.0)	19.6(26.1)	23.2(28.8)	26.8(31.2)	30.4(33.3)	45.8(42.6)
IH AVHT-14-12	17.4(24.7)	35.2(36.2)	48.1(43.9)	56.8(48.9)	69.7(56.6)	78.4(62.3)	78.4(62.3)
IH AVHT-14-13	0.0(0.0)	0.0(0.0)	3.8(8.1)	7.7(11.5)	15.4(22.4)	23.1(28.4)	26.9(30.7)
IH AVHT-14-14	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
CD	9.446	13.988	11.946	12.619	14.118	13.568	15.245
CV	26.059	26.224	18.490	16.891	16.500	14.059	14.817

*Values in parenthesis are angular transformed values

References:

1. Anjani. K., Harvir Singh and Prasad, R. D., 2005. Performance of multiple resistant line of safflower (*Carthamus tinctorius* L.). Indian J Agricultural Science, 75(3), 178-179.
2. Deokar C D, Akashe V B, Deshmukh D D and Sawant P H 1998 Disease situation of safflower in different agro-climatic regions in India. Sesame and safflower News letter 6 : 108 – 109.
3. foot and root rot of tomato. Phytopathology, 1978; 68: 1679-1680.
4. Ismail M, Irfan Ul-Haque M, Riaz A (2004). Seed-borne mycoflora of safflower (*Carthamus tinctorius* L.) and their impact on seed germination. *Mycopath*ology 2:51-54.
5. Jarvis, W. R and Shoemaker, R. A. Taxonomic status of Fusarium oxysporum causing
6. Khanam M (1993). Seed-borne fungi associated with safflower and their effect on germination. Sarhad J. Agric. 9:153-156.
7. Mayee C D and Datar V V 1986 Diseases of safflower, *Phytopathometry,* M.A.U. Parbhani. pp. 100-104.
8. Nageshwar Rao T G 2000 Standardization of Laboratory screening technique against safflower wilt. Sesame and safflower News Letter 15 : 90 – 91.
9. Sastry R K and Ramachandram M 1994 Effect of wilt on yield attributes of safflower. *Indian Phytopathology,* 47(2): 108-110.

10. Singh A K, Chakrabarti D K and Basuchaudhary K C 1975 Two new diseases of safflower from India. Current Science 44 : 397 – 399.
11. Smith, J.R. 1996. Safflower. AOCS Press, Champaign, IL, USA. 624 p
12. Weiss, E.A. 1983. Oilseed crops. Chapter 6. Safflower. Longman Group Limited, Longman House, London, UK. Pp. 216-281.

T. Rajeshwar Reddy, SNCVL Pushpavalli, C. Sudhakar, C. Sudharani
Agricultural Research Station, Tandur, Professor Jayashankar Telangana State Agricultural University,