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Screening of Diploid cotton genotypes against *Fusarium oxysporum* f.sp. *vasinfectum*

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ABSTRACT

Cotton wilt incited by *Fusarium oxysporum* f.sp. *vasinfectum* is one of the most serious disease inflicting unaccountable quantitative as well as qualitative losses. A total of 310 diploid cotton genotypes were evaluated under glasshouse and field conditions. Results showed that all the genotypes screened, exhibited varied degree of reactions against *F. oxysporum* f.sp. *vasinfectum*. Among 310 *Diploid* cotton genotypes, only six showed resistant reaction and twenty genotypes showed moderately resistance reaction in seedling resistance reaction. Out of these 26 cotton genotypes, 8 genotypes showed resistant reaction in Adult Plant Resistant Test.

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INTRODUCTION

Cotton (*Gossypium hirsutum*) is a well known fibre cash crop. It is of particular importance in the textile industry, medical field and is also for its essential seed oil.

During last six decades, the production of cotton has increased from 30 lakh bales in 1950-51 to an all time high of 170 lakh bales during 2009-10. Cotton productivity had stepped up from 317 to 850.3 kg/ha in 2009-10. Over the years, there has been only a marginal increase in the productivity of cotton in India. Consequently, India still lags behind in cotton productivity and ranks fourth with an average productivity of only 439 kg/ha in spite of the fact that the area under cotton in India is the largest in the world (Anonymous, 2005).

F. oxysporum f.sp. *vasinfectum* causes significant crop losses in several of the main cotton producing countries. The disease is widespread in the USA (Menlikiev, 1962) and China. Africa and Tanzania are the worst affected countries (Hillocks, 1981). Although losses nationally may not be great, estimated for instance at 0.2 per cent for the whole of the USA in 1989 (Blasingame, 1990), losses are much greater in localized areas and for individual farmers in areas where the disease is endemic.

Cotton commonly known as 'white gold' is an important fibre crop of global significance which is cultivated in different regions of the world. The fungus was identified as *Fusarium oxysporum* f.sp. *vasinfectum* (Atk.) Synder and Hansen (1940), after reference to Booth (1971) and Singh (1987). Pandey (1997) reported the cotton wilt as most destructive disease caused by *Fusarium oxysporum* f.sp. *vasinfectum* prevailing in all cotton growing countries of the world. In India, the disease occurs particularly on *Desi* cotton causing losses in the range of 40 to 60 per cent (Dastur *et al*., 1960).

F. oxysporum f.sp. *vasinfectum* is a soil-invading (Garrett, 1956), weak saprophyte that can remain dormant in the soil for long periods in the form of chlamydospores.

Crop rotations are often ineffective at reducing the soil

inoculum. Due to soil borne nature of the pathogen, the disease is very difficult to control. Development of resistant sources is the only surest and cheapest method to tackle this disease.

Keeping in view the importance of the disease the present study was undertaken *in vivo* and *in vitro* to evaluate the available varieties, cultivars, new genotypes and germplasma lines of diploid cotton against *Fusarium oxysporum* f.sp. *vasinfectum*.

The screening of genotypes was carried out in wilt sick soil under glasshouse as well as field conditions for ascertaining their reactions against the disease.

MATERIAL AND METHODS

The experiment was conducted during 2009-10 at glasshouse and in wilt sick plot of cotton project, Department of Plant Pathology, College of Agriculture, Pune to find out the sources of resistance in cotton genotypes against Fusarium wilt.

The Diploid cotton cultivars, varieties, new genotypes and germplasm lines were obtained from Project Co-ordinator, Coimbatore and AICCIP Centres of Bharuch, Ludhiana, Parbhani, Akola and Jalgaon. Total 310 genotypes were screened in glasshouse condition by Pune technique (Kulkarni, 1934).

Seedling resistance test :

The fresh isolates of *Fusarium oxysporum* f.sp. *vasinfectum* was isolated from the diseased plant and soil sample from difference locations, purified and tested for their virulence and then maintained on PDA slants for further studies. The inoculum was then multiplied on Richards medium. These flasks were incubated at 27°C for 7 days.

This inoculum was further multiplied on crushed cotton seed medium (350 g of crushed cotton seed + 125 ml water dispensed in 1000 ml flasks) and incubated at 27°C for 10-12 days. The soil and compost (2 : 1 by volume) was sterilized at 30 psi for 30 minutes for three successive days. The sterilized soil was then inoculated with inoculum grown on crushed cotton seed medium @1:5 v/v and the same mixture was further incubated in galvanized bins at room temperature for 6 weeks.

After developement of enough white mycelial cottony growth of Fusarium inoculum in the soil, the earthen pot of 15×15 cm size were filled and dibbled with 10 seeds /pot. The germination count was recorded after 7 day of sowing and the seedlings were observed for wilting upto 6 weeks. The virulence of Fusarium was determined by "Pilot test" in which highly susceptible cultivar of DH2 was sown. When cotton seedlings of susceptible cultivars showed more than 80 per cent wilting within 6 weeks, wilting per cent of seedling was worked out by the following formula :

$$\text{Per cent wilt} = \frac{\text{Total nos. of wilted plants}}{\text{Total nos. of germinated plants}} \times 100$$

The disease reaction was recorded as per the grading system as following :

- Immune (I) : No infection.
- Resistant (R) : Slight yellowing and no defoliation. Less than 5 per cent plants showing wilting.
- Moderately resistant (MR) : Yellowing and browning of leaves. 6- 15 per cent plant showing wilting.
- Moderately suspectible (MS) : Yellowing, browning and discolouration of leaves. Some leaves fall off, of late partial wilting may occur and 16-25 per cent plants showing wilting.
- Susceptible (S) : In early infection seedlings wilt, adult plants show yellowing, browning and dropping off the leaves, finally plants wilt, above 25 per cent plant showing wilting.

Adult plant resistance test (APRT) :

Seedling showing resistant reaction (< 15 % wilt incidence) in glasshouse at SRT were transplanted in wilt sick plot. Maximum 20 plants were maintained and wilting was observed and recorded till plants attained maturity. Further, the plants which did not show wilting up to maturity were uprooted and cut opened longitudinally for recording vascular discoloration. The discoloration was graded as :

Resistant : >50 per cent plants showing hyaline reaction,

Susceptible : <50 per cent plants showing hyaline reaction.

RESULTS AND DISCUSSION

Out of 310 cotton genotypes screened in glasshouse against Fusarium wilt, only 6 genotypes showed resistant reaction(R) and 20 genotypes showed moderately resistant reaction(MR). The details are shown in Table 1.

Adult plant test :

Six cotton genotypes showing resistant and twenty cotton genotypes showing moderately resistant reaction to Fusarium wilt at seedling stage in pots were transplanted in the wilt sick field with earthen ball intact along with DH-2 as susceptible check. Maximum number of plants /genotypes were observed for their reaction to wilt up to maturity of the crop (Shrivastava and Agarwal, 2010; Somu *et al.*, 2013 and Kurundkar and Mahajan, 2011).

From the data presented in Table 2, it is revealed that out of twenty six genotypes in which wilt incidence was recorded less than 15 per cent in seedling resistance test, genotypes showed more than 50 per cent vascular discoloration in adult plant resistance test (APRT). These genotypes were found to

Table 1 : Summary of screening of cotton genotypes against Fusarium wilt at seedling stage (SRT) 2009-10 received from different centres

Sr. No.	Location of centre	No. of genotypes	R (< 5%)	MR (6-15%)	S (> 25%)
1.	Project Co-ordinator, Coimbatore	43	01	04	38
2.	RCRS, NAU, Maktampur, Bharuch, Gujarat	16	02	04	10
3.	Ludhiana, Punjab	14	01	04	09
4.	Cotton Project, Parbhani	08	02	03	03
5.	AICCIP, Dr. P.D.K.V., Akola	03	00	03	0
6.	Oilseed Research Station, Jalgaon	226	00	02	224
	Total	310	06	20	284

Table 2 : Reaction of cotton genotypes to Fusarium wilt in seedling resistance test and adult plant resistant test (2009-10)

Sr. No.	Cotton genotype	Seedling resistance test		Adult plant resistance test			Remark
		Wilting %	Reaction	Discolored%	Hyaline %	Reaction	
1.	PA 528	9.52	MR	60	40	S	S
2.	AKA 5	7.14	MR	80	20	S	S
3.	AKA 7	6.81	MR	30	70	R	R
4.	AKA 8	10.25	MR	70	30	S	S
5.	PA 255	7.5	MR	70	30	S	S
6.	PA 141	9.09	MR	60	40	S	S
7.	PA 532	11.11	MR	80	20	S	S
8.	PA 646	8.57	MR	70	30	S	S
9.	PA 402	2.32	R	70	30	S	S
10.	PA 182	4.54	R	30	70	R	R
11.	PA 686	4.65	R	80	20	S	S
12.	LD 929	12.5	MR	70	30	S	S
13.	LD 733	12.5	MR	70	30	S	S
14.	LD 876	11.76	MR	90	10	S	S
15.	LD 937	5.88	MR	80	20	S	S
16.	LD 949	8.11	MR	80	20	S	S
17.	LD 960	3.33	MR	70	30	S	S
18.	GBhv 271	7.14	MR	20	80	R	R
19.	GBhv 274	4.54	R	30	70	R	R
20.	GBhv 277	6.00	MR	30	70	R	R
21.	GBhv 270	2.27	R	30	70	R	R
22.	GBhv 284	5.12	MR	20	80	R	R
23.	BGAS 104	12.82	MR	80	20	S	S
24.	DLSA1006	6.82	MR	80	20	S	S
25.	AKA 2004/29	10.84	MR	70	30	S	S
26.	Digvijay	15.00	MR	30	70	R	R
	DH 2		S				S

be susceptible, while rest of 8 genotypes showing less than 50 per cent vascular discoloration were found to be resistant. Similar work related with the present topic was also done by Khokhar (2012) on fenugreek, Mahalakshmi and Yesuraja (2013) and Kuldhar *et al*. (2013) on carnation and Kandoliya and Vakharia (2013) on chickpea and their results are more or less similar with the findings of the present investigation.

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