

Test on Wilt-Resistance of Simple Hybrides F7 and Beckross Hybrid Lines F6 B1 of *G. hirsutum* L. of Cotton to New Virulent Isolates of Fungus *Fusarium verticillioides* and *Verticillium dahliae*

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Abstract

The article presents the results of studies on the resistance of hybrid cotton lines to a new virulent isolate (strain) of the fungus *Fusarium verticillioides* upon inoculation of the host plant. Based on the studies, it was found that the complex genotypic resistance of the studied lines, when the host plants are inoculated with isolates of –100 *V. dahliae* Kleb fungus and 103 *Fusarium verticillioides* fungi, depends on the degree of resistance of the parental forms and their combination ability.

Keywords

Cotton, Wilt Resistance, *Fusarium verticillioides*, *Verticillium dahliae*, Hybrid Lines, Susceptibility, Isolate, Infectious Load

1. Introduction

The genetic basis of wilt tolerance of various varieties, forms, and types of cotton-plant was studied by Arutyunova L. G., Gesos K. F., Polotebnova T. U. [1], D. V. Ter-Avanesyan [2] [3], S. M. Mirakhmedov *et al.* [4], A. Abdullaev [5], R. G. Kim, A. Marupov *et al.* [6] [7]. It should be noted that in nature there is a constant conjugate evolution of the host plant and the parasite of the fungi *Verticillium* and *Fusarium*, which contribute to the emergence of new, more virulent pathogens (strains) of the fungus that can infect previously resistant varieties of cotton and thereby the search for new methods and donors of resistance to this complicated disease, and the creation of resistant and highly productive

varieties with a complex useful features are becoming more relevant. So according to the data presented by the doctor of agricultural sciences A. Marupov (from 2002 to present), in recent years there has been an increase in the incidence of inflatedness of medium-fiber varieties of cotton to new pathogens of the genus *Fusarium wilt* of the species *Fusarium verticillioides*, especially in varieties of Bukhara type, due to the violation and non-compliance, special anti-rotation schemes of crop rotation. Therefore, this species began to adapt to medium-fiber varieties of cotton.

It should be noted that the soil is one of the most suitable natural habitats for most *Fusarium* species. *Fusarium* fungi exist in active form in soil, colonize various plant debris, and grow in the rhizosphere and on the root surface, using their excretions, and in the form of surviving structures (chlamydospores). The overwhelming majority of them are rhizospheric and root inhabiting, and the constant accumulation of more virulent pathogen populations due to the constant alternation of crops and the associated evolution of the plant host and the parasite will inhibit the growth and development of the plant not only of the species of *G. hirsutum* L. but also of the species *G. barbadense* L. and thereby cause significant economic damage to the cotton industry of the Republic.

Fusarium verticillioides species have a wide range of adaptive responses. This causes their saprophytic growth phase in the soil of the rhizosphere, on dead cells, and then on the root surface, and when plants are weakened by many unfavorable factors of transition to parasitization on their tissues or growth in their organs (for example, vessels), virulent races adapted to the predominant cause the defeat of certain plants.

Therefore, the study of the resistance of variety specimens, wild and ruderal forms, varieties, lines, and hybrids of cotton of the species *G. hirsutum* L. to the fungus of the species *Fusarium verticillioides* is a very urgent problem of the present and future in cotton breeding with the aim of creating cotton varieties with a complex of resistance to verticillium and *Fusarium wilt*.

2. Research Objects and Methods

In the regard, methods are used in experimental biology and genetics of traditional plants [1] [2]. Monospore isolates of the fungus *Fusarium verticillioides* and the fungus *Verticillium* Kleb were isolated in UzNIIZR in the laboratory of the wilt under the direction of A. Marupov, Doctor of Agricultural Sciences.

Artificial infection of plants was carried out in early July in the phase of the beginning of budding on backcross hybrid plants F6B1 and F6, F7.

Inoculation at the root neck, hung a label on which the date of inoculation, the onset and degree of manifestation of the disease were noted on the inoculation plants.

3. Result and Discussion

The results of studies on the resistance of hybrid cotton lines to a new virulent

isolate (strain) of the fungus *Fusarium verticillioides* upon inoculation of the host plant are illustrated in **Table 1**.

It can be seen as in **Table 1**, the studied lines mainly have an equal degree of susceptibility to the studied isolate (strain) of *Verticillium* fungus both in the phenotypic manifestation of the disease and in the cut-section of the stem. The total number of diseased plants after inoculation of plants was from 0 to 100 percent. There are no differences between the phenotypic measurement and the evaluation by the cut-section of the stem, *i.e.* the phenotypic manifestation of wilt during the inoculation of plants with isolate-103 of the fungus *Fusarium verticillioides* corresponds to the number of diseased plants by the cut of the stem. The lines L-272, L-362, L-931/2146 show high wilt resistance to isolate-103 of the fungus *Fusarium verticillioides*, which was isolated from An-Bayaut-2 variety in the Navai region. After inoculation, after the inoculation wilt diseased plants were not found during the entire growing season, among both by the plant phenotype and by the cut of the stem. This indicates that these lines are highly immune to this isolate *i.e.* they have a hypersensitivity reaction.

Relatively high resistance to the new virulent isolate-103 of the fungus *Fusarium verticillioides* has L-1037, L-396, L-2771 and L-660/2, in which the phenotypic manifestation of wilt after inoculation of the host-plant was from 20 to 30 percent. A similar amount of diseased plants was obtained by cutting the stem. This suggests that these lines do not possess genotypic immunity to virulent isolate-103.

Table 1. Wilt resistance of backcross hybrid F6B1 lines and F6 - F7 hybrid families to the new virulent isolate-103 of the fungus *Fusarium verticillioides* (2010).

Hybrid combinations	Number of registered plants (pcs.)	Phenotypic manifestation of wilt on 10.09 (%)				Total	The total number of inflated plants by cut stem (%)	Difference between phenotype and stem cut (%)
		Weak degree	Medium degree	Strong degree				
L-863-F ₆ (F ₁ B ₁ L-1708 × C-621) × L-1708	30	-	33.3	10	43.3	43.3	0	
L-1037-F ₆ F ₁ B ₁ L-1708 × L-44) × L-1708	30	-	20	10	30	30	0	
L-1063-F ₆ (F ₁ B ₁ L-1708 × C-771) × L-1708	30	20	20	60	100	100	0	
L-396-F ₆ L-1708 × L-614	30	3.3	20	-	23.3	23.3	0	
L-1303-F ₆ (F ₁ B ₁ L-155 × C-6771) × L-155	30	-	40	60	100	100	0	
L-1244-F ₆ (F ₁ B ₁ L-155 × L-44) × L-155	30	-	6.7	36.7	43.4	43.4	0	
L-362-F ₆ L-155 × C-6771	30	-	-	-	-	-	-	
L-382-F ₆ L-155 × L-614	30	-	20	20	40	40	0	
L-660/2-F ₇ L-155 × C-5621	30	-	6.7	20	26.7	26.7	0	
L-660-F ₇ L-155 × C-5621	30	-	40	-	40	40	0	
L-2771-F ₆ L-162 × L-44	30	-	20	-	20	20	0	
L-272-F ₆ C-8284 × C-5621	30	-	-	-	-	-	-	
L-431/2146-F ₇ Omad × C-6771	30	-	-	-	-	-	-	
St-C-6524	100	20	20	40.0	80.0	-	-	

High susceptibility to the isolate-103 of the fungus *Fusarium verticillioides* is observed in lines L-1063 and 1303, which are affected 100 percent in total and in strong form by 60 percent as in the phenotype plants, and along the cut of the stem. There are no differences between the phenotypic measurement of diseased plants and the assessment of stem section.

The lines L-863, L-1244, L-382, and L-660/2, with the number of diseased plants after inoculation from 40-43.4 percent, turned out to be medium resistant to the isolate-103 of the *Fusarium verticillioides* fungus. The analysis of **Table 2** shows that the lines L-1244, L-272, L-660 and L-931/2146 have a high genotypic resistance to isolate-100, which was isolated from the Bukhara-6 variety in the Gijduvan district of the Bukhara region. After inoculation, no wilt affected plants were observed during the entire growing season both in the phenotype of the plant and in the cut of the stem.

This indicates that these lines are highly immune to this isolate, *i.e.* they have a hypersensitivity reaction. L-1037, L-1063, L-362, L-396 and L-2771 lines to *Verticillium* fungus isolate 100, in which the number of diseased plants after plant inoculation was 20 percent, have high phenotypic resistance to fungus. The quantitative difference between the phenotypic assessment of diseased plants and the assessment of stem cut-section was from 0 to 33.3 percent. This indicates that the studied lines have a different genotypic nature of the resistance to wilt, which depends on the resistance of the parental forms and their combination ability to transmit this trait to their hybrid offspring.

Table 2. Failure resistance of backcross hybrid F6B1 lines of hybrids or families upon inoculation of the F6 - F7 Plant to a new virulent Isolate-100 of *V. dahliae* Kleb fungus (2010).

Hybrid combinations	Number of registered plants (pcs.)	Phenotypic manifestation of the wilt 10.09 (%)				Total number of diseased plants by stalk cut (%)	Difference between phenotype and stalk cut (%)
		Weak degree	Medium degree	Strong degree	Total		
L-863-F ₆ (F ₁ B ₁ L-1708 × C-5621) × L-1708	30	6.7	33.3	20	60	83.3	23.3
L-1037-F ₆ (F ₁ B ₁ L-1708 × L-44) × L-1708	30	20		-	20	53.3	33.3
L-1063-F ₆ (F ₁ B ₁ L-1708 × C-6771) × L-1708	30	20		-	20	36.7	16.7
L-396-F ₆ L-1708 × L-614	30	-	20	-	20	20	0
L-1303-F ₆ (F ₁ B ₁ L-155 × C-6771) × L-155	30	-	40	60	100	100	0
L-1244-F ₆ (F ₁ B ₁ L-155 × L-44) × L-155	30	-	-	-	-	-	-
L-362-F ₆ L-155 × C-6771	30	-	-	20	20	20	-
L-382-F ₆ L-155 × L-614	30	-	13.3	46.7	60	60	0
L-660/2-F ₇ L-155 × C-5621	30	10	30	20	60	66.7	6.7
L-660-F ₇ L-155 × C-5621	30	-	-	-	-	-	-
L-2771-F ₆ L-162 × L-44	30	-	20	-	20	20	0
L-272-F ₆ C-8284 × C-5621	30	-	-	-	-	-	-
L-431/2146-F ₇ Omad × C-6771	30	-	-	-	-	-	-
St C-6524	100	13.0	25.0	55.0	93.0	0	

A high phenotypic manifestation of wilt is observed in lines L-863, L-1303, L-382 and L-660/2 when plants are inoculated with isolate-100 of *Verticillium* fungus. The number of diseased plants according to phenotype was from 60 to 100 percent. The diseased plants along the stem cut-section of these lines were 83.3, 100, 60, and 66.7 percent, respectively.

It should be noted that a weak latent-tolerant wilt resistance to isolate-100 is observed in lines L-863, L-1037, L-1063, in which the quantitative difference between the phenotypic assessment and the estimate for the cut-section of the stem was 6.7 percent - 33.3 percent. The highest degree of susceptibility to isolate-100 has the line L-1303 both in phenotype and in cut-section of the stem. The number of diseased plants after inoculation is 100 percent. This suggests that this isolate is very aggressive for the L-1303 line, as well as for the L-863, L-382 and L-660/2 lines. The high degree of susceptibility of these lines to isolate-100 of *Verticillium* fungus, apparently, is explained by the fact that they participate in relatively weakly resistant varieties C-5621 and C-6771. However, it should be noted that wilt-resistant varieties and lines do not always produce hybrid-resistant offspring when crossed, and vice versa, *i.e.* unstable varieties produce highly resistant offspring. So, for example, in hybrid combinations C-8284 × C-5621, L-155 × C-5621 and Omad × C-6771, where weakly resistant varieties S-5621 and C-6771 are involved, and the wilt resistant lines to this isolate are distinguished. This once again proves the correctness of the theory of academician S.M. Mirakhmedov that in the process of breeding it is possible to obtain highly resistant families, lines and varieties of cotton when crossed with weakly resistant varieties and lines.

4. Conclusions

Thus, the complex genotypic resistance of the studied lines to the inoculation of the host plants with isolates of –100 of the fungus *V. dahliae* Kleb and 103 of the fungus *Fusarium verticillioides* depends on the degree of resistance of the parental forms and their combination ability, as well as on the orientation of the selection, on the physiological state of the plants, the size of the degree of infectiousness, specific physiological activity of the pathogen, its aggressiveness and toxicity.

The lines L-222 and L-431 have a high integrated resistance to both studied *Fusarium verticillioides* and *V. dahliae* Kleb isolates. The lines L-396, L-362 and L-2771 turned out to be relatively stable.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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