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Article

Results of Laboratory and Field Studies on The Resistance to Verticillium Dahliae In Interspecific Hybrids

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Abstract: This article presents the results of laboratory and field studies on the resistance of interspecific hybrids to *Verticillium dahliae*. The results indicated that the breeding lines L-138/16, L-95/16, L-200/16, L-588/16, and LSG-4/06 (O-87-94) demonstrated tolerance to *Verticillium dahliae Kleb* in both field and laboratory conditions. These lines serve as valuable donors for developing wilt-resistant materials.

Keywords: Interspecific, Hybrid, Cotton, Plant, Verticillium Dahliae, Combination, Variability, Laboratory, Resistant, Disease

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1. Introduction

It is well-known that Verticillium wilt is the most widespread and damaging of all cotton diseases. Severe infection with this wilt disease causes nearly all leaves to fall, the bolls to dry out and open prematurely, and a sharp decline in fiber quality, as well as reduced seed oil content and germination rates.[1] Field studies were conducted in the specially wilt-infected fields of the CBSARI, while laboratory research was carried out at the Institute of Genetics and Plant Experimental Biology of the Academy of Sciences. For the laboratory experiments, healthy leaf samples were collected from cotton plants. Under laboratory conditions, the samples were washed under running water for 2 hours. To sterilize the samples, the leaves were first held in a 1.5% sodium hypochlorite solution for 5-6 minutes, after which they were kept in sterile water for 15 minutes and thoroughly rinsed three times. [2][3]

2. Methodology

The leaf samples were then placed into special containers. Using a 0.5 cm diameter microbiological cork borer, inoculum of *Fusarium oxysporum* f.sp. *vasinfectum*, *Fusarium solani*, and *Verticillium dahliae* strains was taken from a PDA nutrient medium and placed onto the leaf samples. Subsequently, they were grown for 7 days in an artificial climate chamber at a temperature of 25–26°C with a 16-hour light / 8-hour dark cycle. The experiment was monitored daily, and changes in the leaf samples began to be observed after the first day. [4][5]

Daily observations were conducted on the experimental subjects, and those that had dried out were moistened with sterilized water. On the 7th day, the percentage of disease in the leaf samples was calculated using the following scale.[6][7]

3. Results

This table provides a comparative study of cotton infection by Verticillium dahliae under laboratory and field conditions. Under laboratory conditions, the plant's resistance was determined based on the level of infection according to the following criteria. [8] Specifically,

0-30% - (uninfected or showing resistance, healthy). Highly resistant

31-50% - (weakly infected); Moderately resistant

50-100% - (strongly infected); Highly susceptible

According to the data in the table above, the wilt resistance of the studied breeding materials was analyzed by infecting them with the *Verticillium dahliae* strain under laboratory conditions.[9] Based on the analysis results, the introgressive lines, which were the object of the study, were divided into 3 groups. Specifically, the group of highly susceptible plants, with an infection rate of 50-100% (severely infected), included 6 out of 20 introgressive lines: S-6524 (75%), L-BSG-2/06/16 (68%), L-4672-73/16 (65%), L-58/16 (60%), L-1979/16 (52%), and L-VSG/16 (68%). [10] The group of moderately resistant plants, with an infection rate of 31-50% (mildly infected), included 3 out of 20 lines: L-4684-86/16, L-4679-81/16 (50%), and T-4674-77/16 (45%). The remaining 11 of the 20 lines were classified in the highly resistant group, with an infection rate of 0-30% (uninfected or showing resistance, healthy). This group included lines L-138/16, LSG-2/06 (O-132-37) (10%), L-95/16 (7%), L-158/16 (9%), L-200/16 (2%), L-4747-48/16 (6%), L-588/16, LSG-4/06 (O-87-94) (3%), LSG-3/06 (O-733-44) (26%), LSG-3/06 (O-963-72) (15%), LSG-3/06 (O-1071-73) (25%), and LSG-22/06 (30%). When the introgressive lines studied in the laboratory were compared to the standard S-6524 cotton variety (which had a *Verticillium dahliae* infection rate of 75%), all breeding materials demonstrated between 2% and 73% higher resistance than the standard.[11][12] This indicates that the samples resistant to *Verticillium dahliae* under laboratory conditions also exhibited resistance in natural field conditions. Additionally, research was conducted on resistance to the *F. oxysporum* f.sp. *vasinfectum* strain under laboratory conditions. According to the research results, out of 17 lines, 4 were highly susceptible (L-BSG-2/06/16, L-588/16, L-175/248/16, L-470/1/16), 5 were moderately resistant, and the remaining 8 showed strong resistance (L-MVG-2/16, L-4747-48/16, L-200/16, L-1979/16, L-58/16, L-138/16, L-4684-86/16, L-4672-73/16). The research identified that among the introgressive lines, the breeding materials T-138/16 (10%), L-470/1/16 (5%), L-95/16 (7%), L-158/16 (9%), L-200/16 (2%), L-12/06/16 (25%), L-4747-48/16 (6%), L-588/16 (3%), and L-MVG-2/16 (26%) showed greater tolerance to *Verticillium dahliae* compared to other sources. The introgressive lines L-138/16, T-200/16, L-4747-48/16, and LSG-4/06 (O-87-94) demonstrated tolerance to various strains of wilt, including *Verticillium dahliae* and *F. oxysporum* f.sp. *vasinfectum*, and will serve as primary source material and valuable donors for breeding research.[13]

4. Discussion

According to the results of scientific field research conducted on a background of naturally occurring wilt infection at CBSARI, the total infection rate of plants with *Verticillium dahliae* Kleb was found to range from 3.1% (L-1979/16) to 20.3% (L-4747-48/16). When these breeding materials were

compared to the standard medium-staple cotton variety S-6524, which had an infection rate of 21.7%, all breeding materials demonstrated a tolerance level ranging from 1.4% to 18.6%. Further scientific investigation into severe infection revealed that the rate of severely affected plants ranged from 1.2% to 4.2%. It was determined that all breeding materials were more tolerant than the standard S-6524 variety, which had a severe infection rate of 8.6%. Furthermore, the absence of severe infection in the breeding materials L-4674-77/16, L-4679-81/16, L-4684-86/16, L-138/16, L-95/16, L-00/16, L-58/16, L-1979/16, L-588/16, and LSG-4/06 (O-87-94) indicates their resistance to *Verticillium dahliae* Kleb.[14][15]

Table 1. Indicators of Wilt Disease Resistance in Introgressive Lines under Field and Laboratory Conditions

No	Parental forms	Laboratory conditions				Field conditions (*Verticillium dahliae*)			
		Verticillium dahliae		*F.oxysporum* f.sp. *vasinfectum*		Number of plants, Piece	Diseased plants, pieces	Overall plant infection rate, %	Strongly affected plants %
		Degree of damage (%)	Durability rating	Degree of damage (%)	Durability rating				
1	S-6524	75	Strongly unstable	100	Strongly unstable	69	15	21,7	8,6
2	L-4672-73/16	65	Strongly unstable	43	Moderately resistant	75	15	20,0	4,1
3	L-4674-77/16	45	Moderately resistant	55	Strongly unstable	64	8	12,5	0
4	L-4679-81/16	50	Moderately resistant	55	Strongly unstable	58	10	17,2	0
5	L-4684-86/16	50	Moderately resistant	40	Durable	58	8	13,8	0
6	L-138/16	10	Highly durable	25	Highly durable	62	4	6,5	0
7	L-95/16	7	Highly durable	55	Strongly unstable	66	5	7,6	0
8	L-158/16	9	Highly durable	57	Strongly unstable	71	10	14,1	1,2
9	L-200/16	2	Highly durable	21	Highly durable	59	2	3,4	0
10	L-58/16	60	Strongly unstable	42	Moderately resistant	54	7	13,0	0
11	L-1979/16	52	Strongly unstable	44	Moderately resistant	64	2	3,1	0
12	L-4747-48/16	6	Highly durable	12	Highly durable	59	12	20,3	4,2
13	L- ВСГ /16	68	Strongly unstable	78	Strongly unstable	64	12	18,8	2,6
14	L-588/16	3	Highly durable	94	Strongly unstable	84	10	11,9	0

15	LSG-4/06 (O-87-94)	3	Highly durable	22	Highly durable	62	2	3,2	0
16	LSG-3/06 (O-733-44)	26	Highly durable	46	Durable	59	10	16,9	1,6
17	LSG-3/06 (O-963-72)	15	Highly durable	40	Durable	54	10	18,5	3,0
18	LSG-3/06 (O-1071-73)	25	Highly durable	60	Strongly unstable	56	8	14,3	2,2
19	LSG-22/06	30	Highly durable	40	Moderately resistant	65	10	15,4	3,0
20	LSG-2/06	10	Highly durable	30	Highly durable	57	9	15,8	3,2

5. Conclusion

In conclusion, our field and laboratory research on wilt has demonstrated that the breeding lines L-138/16, L-95/16, L-200/16, L-588/16, and LSG-4/06 (O-87-94) exhibit tolerance to *Verticillium dahliae* Kleb under both field and laboratory conditions. Consequently, they serve as valuable donors for developing wilt-resistant varieties

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