Vilt resistance of cotton varieties while inoculation with various isolates of the fungus *Verticillium dahliae kleb*. in an artificial climate of Uzbekistan

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**Abstract.** This article addresses the studies on the resistance of cotton varieties to *Verticillium dahliae* Kleb on an artificial infectious background. It is shown that resistance indicators depend on the origin of varieties. *V. dahliae* isolates isolated from varieties C-6524, Namangan-77, Barkhayot, Shodiyona, Omad and C-8290 showed different virulence; isolates allocated from varieties C-6524, Namangan-77, Barkhayot, Shodiyona and Omad showed the highest virulence.

1. **Introduction**

To assess breeding material for resistance to various diseases, it is advised to create an artificial infectious background. An artificial infectious background is necessary to assess the resistance of the breeding material, especially under conditions when the natural development of the infection is suppressed or the prevalence of the pathogen is reduced for various reasons. Knowledge of the composition of the inoculum is of great importance. For the selection of isolates, it is required to select the most pathogenic of them. The results of numerous studies indicate that the infectious material must be represented by the local population of the pathogen, including the main virulent and most aggressive races (Figure 1) [1, 2, 3].

Estimates for resistance in conditions of an artificial infectious background are of great importance, since they correspond to the data obtained in conditions of natural epiphytotes, they make it possible to identify potential and stable resistance, increasing the efficiency of the assessment and accelerating the selection process. Field assessments of breeding material against natural and artificial infectious backgrounds should be supplemented by assessments in an artificial climate, that is, in greenhouses or climatic chambers.

Zeleneva Yu.V. et al. [1] to substantiate the qualitative composition of the biomaterial, providing a relatively objective immunological characteristics of varieties, studied the pathogenic properties of isolates of the fungus *S. nodorum*, which have a high sporulating ability. To create an artificial infectious background in winter wheat, isolate 148-09 was recommended as the most highly pathogenic. There is evidence that *S. nodorum* isolates with different colony morphotypes may differ in pathogenicity in different wheat varieties [2-5].
Figure 1. Infestation of cotton varieties with V. dahliae isolates under conditions of an artificial infectious background [1, 2, 3].
L.P. Sochalova [5] notes that one of the most important reasons for an increase in the harmfulness of diseases is the homogeneity of varieties widely used in crops in a genetic relation, which immediately leads to the appearance and spread of pathogens in natural populations up to the size of epiphytoties. An effective way to solve this problem is to ensure selection by genetically diverse donors of resistance. Another direction is the creation of heterogeneous (component) varieties. Of interest for breeding are forms with group resistance to phytopathogens, but they are very rare, which is associated with a constant race-forming process [6-12].

Afanasenko O.S. [13] indicates that when creating infectious nurseries for the assessment of varieties for the pathogen Stagonospora nodorum, it is necessary to monitor pathogenicity annually, to select the most pathogenic isolates.

At present, numerous studies are being carried out all over the world to study the characteristics of the disease of varieties, lines and hybrids of V. dahliae cotton and to create breeding materials that are resistant to this disease. Research is carried out in such priority areas as the creation of new varieties using biotechnology methods, cell selection, genetic engineering in the creation of cotton varieties resistant to diseases, elimination of inconsistencies in the long hybridization of plants with different chromosomes, the establishment of defining markers of precious economic mark in varieties ... Climate change, as well as an increase in temperature in different years, has a negative impact on the development of the fungus. Also, in the field, the fungus does not develop evenly and this causes certain difficulties in the selection of plants resistant to this disease. Solving these problems requires research to improve cotton immunity [14, 15].

The main task of the agricultural sector in Uzbekistan is to increase yields and, as a consequence, increase the gross harvest of raw cotton. Cotton diseases, especially during epiphytotics, can significantly reduce the yield of raw cotton. One of these dangerous diseases is verticillium wilt. Verticillium wilt is one of the most common and harmful diseases in Uzbekistan, affecting medium-fiber varieties of cotton. Sometimes a significant part of the harvest is lost as a result of an acute disease of cotton with verticillium wilt, and in subsequent years, sowing cotton in these fields is extremely dangerous. The causative agent of verticillium wilt easily adapts to new varieties of cotton, and races with increased virulence, pathogenicity and aggressiveness appear. In this regard, breeding studies carried out on artificial and natural infectious backgrounds and devoted to the study of cotton immunity, aggressiveness of new isolates (strains) of the fungus V. dahliae, wilt resistance of the starting material, hybrids and varieties are distinguished by novelty and relevance.

The aim of the study was to study the nature of the disease by the fungus V. dahliae of medium-fiber cotton varieties under conditions of an artificial infectious background. In 2015-2017, we analyzed the incidence of cotton plant varieties with the V. dahliae fungus under conditions of an artificial infectious background in the Fitotron selection and greenhouse complex of the Scientific Research Institute of Breeding, Seed Production and Agricultural Technology of Cotton Growing (SRIBSPATCG).

2. Materials and Methods
The object of the study was cotton varieties of the species G. hirsutum L.: C-6524, Sulton, Bukhoro-6, Bukhoro-102, Andijan-36, as well as isolates of the fungus V. dahliae isolated at the Research Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan from diseased plants of cotton varieties C-6524 (1-isolate), Namangan-77 (2-isolate), C-6524 (3-Beech isolate), C-6524 (4-Beech isolate), Sulton (6-isolate), Bukhoro-6 (8-isolate).

The studies were carried out at SRIBSPATCG on an artificial (Fitotron) infectious background. We used the methodological instructions “Creation of artificial infectious backgrounds and its use in breeding work” developed by Yu. Ikramov and others [14]. Plants were grown in plastic cups under Fitotron conditions. Inoculation with various isolates of the fungus was performed by inoculation. Each isolate was inoculated with 75 cotton plants. The degree of manifestation of wilt was determined visually - healthy, diseased plants and from them to a strong degree. The degree of plant disease with verticillium wilt was determined according to a 4-point scale. The experiment was carried out in triplicate. Statistical processing of the results of all practical studies, digital indicators of signs, variational-statistical analyzes was carried out according to B.A. Dospekhov [15].
3. Results and Discussion

The data obtained in the two-way analysis of variance of the incidence of cotton varieties with the fungus V. dahliae under the conditions of an artificial infectious background show that the average incidence rates of varieties (factor A) were 80.5-97.9% and were higher than the average indicators of the studied isolates (factor B).

When cultivars C-6524 and Namangan-77 were inoculated with isolates of the fungus V. dahliae isolated from diseased plants of cultivars C-6524, Namangan-77, and Shodiyona, 100% plant damage was observed in total. The average values of the virulence of isolates (factor-B) isolated from varieties C-6524, Namangan-77 and Barkhayot were 90.0-93.3%, in those isolated from varieties Shodiyona, Omad 88.7-86.6% and the lowest indicator 70.7% of the isolate isolated from the S-8290 variety was noted. Significant differences in the mean values of isolates (factor-B) were obtained between isolates isolated from varieties S-6524, Namangan-77 and other isolates. Differences in the average indicators of varieties (factor-A) between varieties Barkhayot, Shodiyona and Omad are not significant. In the studied varieties, the Ff (factor-A) indicator was Ff A = 79.1, the isolate indicator (factor-B) was Ff B = 69.71 and there were no significant differences between the factors. The interaction of the studied factors was at a low significant level Ff AB = 4.6.

Average indicators of disease of varieties in a strong degree (factor-A) amounted to 19.0-58.8%, average indicators of isolates (factor-B) were in the range of 11.2-42.7%, average indicators of disease of varieties in a strong degree (factor-A) were 7.8-16.1% higher. The highest virulence was observed in isolates isolated from cultivars C-6524, Namangan-77 and Barkhayot. The greatest damage to plants by the fungus V. dahliae was noted in varieties C-6524, Namangan-77 in which the indicators of plant damage were 25.3-30.0% higher than in other varieties.

When studying the incidence of cotton varieties with the fungus Verticillium dahliae Klebahn at different air temperatures in an artificial infectious background, it was found that the degree of virulence of isolates of the fungus V. dahliae isolated from varieties C-6524, Namangan-77, Barkhayot, Shodiyona, Omad and C-8290 depends on temperature conditions during research. The study of morbidity and individual selection of resistant plants should be carried out in April-May under conditions of an artificial infectious background and inoculation of plants with isolates of the fungus V. dahliae.

In 2016, under the conditions of an artificial infectious background, the dynamics of the incidence of varieties C-6524, Sulton, Bukhoro-6, Bukhoro-102 and Andijan-36 with different genotypes was studied when they were inoculated with various isolates of the fungus V. dahliae. The plants were inoculated with isolates isolated from the following varieties: C-6524 (1-isolate), Namangan-77 (2-isolate), C-6524 (3-Beech isolate), C-6524 (4-Beech isolate), Sulton (6-isolate), Bukhoro-6 (8-isolate). The research included three isolates isolated from the C-6524 variety. Namely, 1 isolate was isolated from diseased plants selected at NIISSAVKh on a natural contaminated background, 3 and 4 isolates were isolated from diseased plants selected in the Buka district of the Tashkent region. It was found that all three isolates isolated from the C-6524 variety are characterized by varying degrees of virulence.

Analysis of the data obtained showed that during the first observation among the studied isolates, isolates 2, 4, 6 were distinguished by the highest virulence.

In the second observation, in contrast to the first, plants were noted to be strongly infected with the fungus V. dahliae. 3 and 8, isolates are characterized by the lowest virulence compared to other isolates.

The weak virulence of isolates 3 and 8 is clearly distinguished. Plants heavily affected (3 points) in the experimental variant inoculated with isolate 3 were observed only in the Sulton variety (2.5%). The number of plants with damage of 2 points was not large and amounted to 1.4-3.8% of the total number of plants. In the variety Andijan-36, no damage to plants in the 2 and 3 points was observed. A similar picture was observed after inoculation with isolate No. 8.

The highest morbidity was observed with inoculation with isolates 2, 4 and 6. In these variants of the experiment, the number of severely affected plants of 3 points was 2.8-27.5%, with damage of 2 points, the number of plants was 4.3-40.5%.

The highest indices of the number of diseased plants were noted in the varieties Sulton and Bukhoro-6, in which this indicator with the defeat of plants of 1 point was 17.8-39.5%. Among these variants of the experiment, isolate-6 was distinguished by the highest virulence.
The data obtained during the second observation showed that 1-isolate has an average virulence. In most variants of the experiment, the greatest damage to plants was observed in the Sultan variety.

From the histogram shown in Figure 1, it can be seen that during the third observation the number of severely diseased plants increased. The largest number of healthy plants was observed after inoculation with 3 and 8 isolates. In these variants of the experiment, the number of healthy plants was 8.3-29.2%, which compared to other studied varieties was 9.5-10.0% lower.

In most varieties, with the exception of the Andijan-36 variety, the number of plants affected by 1 point when inoculated with isolate No. 2 was 18.8-23.8%, in the Andijan-36 variety 44.2%, when inoculated with isolate No. 4 19.0-32.4%, 33.3% for the Andijan-36 variety and with the inoculation with isolate No. 6 it was 26.3-33.3% and 34.7%, respectively.

4. Conclusions

For the first time, genotypic resistance of varieties inoculated with isolates of the fungus V.dahliae isolated from diseased plants of various varieties on an artificial infectious background was determined. It has been proven that against an artificial infectious background, more reliable data can be obtained in comparison with a natural infectious background.

On the basis of multivariate analysis of variance, it was found that the resistance of cultivars to the studied isolates of the fungus V.dahliae was different, there were no differences in the effect of genotype and isolate on the incidence of plants in general, there was a greater influence of the genotype of cultivars on morbidity to a large extent.

Varieties C-6524, Namangan-77, Barkhayot, Shodiyyona, Omad and C-8290 isolated from the isolates of the fungus V.dahliae showed different virulence, isolates isolated from varieties C-6524, Namangan-77, Barkhayot, Shodiyyona and Omad.

Under conditions of an artificial infectious background, early plant disease with the fungus V.dahliae was noted in cultivar C-6524; during the second observation, when inoculated with most isolates, the incidence rates of plants increased and did not have large differences, this was especially noted in the third observation. Due to the fact that the virulence of the isolates depends on the temperature of the air, the study of the incidence and selection of resistant plants should be carried out in April-May and August-September under conditions of an artificial infectious background and inoculation of plants with isolates of the fungus V.dahliae.

Under the conditions of an artificial infectious background during inoculation with isolates of the V.dahliae fungus isolated from different varieties, in most of the studied varieties, a greater number of highly diseased plants were observed in variants inoculated with isolates No. 2, 4, 6. The lowest rate of highly diseased plants was observed in the Andijan-36 variety.

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