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PHYSICAL, CHEMICAL SCIENCES AND ENGINEERING

Manuscript info:
Received June 12, 2018., Accepted July17, 2018., Published August 20, 2019.

STUDY OF PHENOTYPIC SIGNS, GENERATIVE STRUCTURES AND PATHOGENICITY OF SPP.FUSARIUM VARIETIES AND COTTON LINES OF G.HIRSUTUM L. SPECIES

Kurbonov Abrorjon Yorkinovich[1],
PhD, senior scientist, Project manager
E-mail: kurbonov.abrorjon@mail.ru
Avtonomov Viktor Aleksandrovich[2],
DSc, professor, Head of Laboratory,
e-mail: avtonomovvik@mail.ru
1.2. Cotton Breeding, Seed Production and Agrotechnologies
Research Institute (CBSPARI), st. University, Qibray district,
Tashkent region, Republic of Uzbekistan

http://dx.doi.org/10.26739/2573-5616-2019-8-26

Abstract: Fusarium and Verticillium are some of the most harmful pathogens affecting yield and product quality. Species of the genus Fusarium Lk. cause seed damage from the moment of sowing, root rot at the pre-emergence stage, and also cause root rot of seedlings first and then of cotton seedlings (Elsalam et al., 2007).

The harmfulness of seed and seedling damage is aggravated by the fact that within 30 days from the date of emergence of seedlings, 80% of the future harvest is laid.

The purpose of research is to study of phenotypic characteristics, generative structures and pathogenicity of spp.Fusarium to shoots of varieties and cotton lines in various regions of Uzbekistan.

In the process of phytopathological examination of cotton crops in selected districts and farms in Tashkent, Bukhara, Kashkhadarya and Surkhandarya regions of Uzbekistan, 109 samples of infected plants were collected from which pure cultures of fungi spp. Fusarium.

As a result of the research, the morphological signs of the Fusarium Lk species were studied: F. solani, F. oxysporum, F. oxysporum f. sp. vasinfectum, F. equiseti, F. verticillioides, F.proliferatum, F. fujikuroi, F. sporotrihioides. The pathogenicity of certain types of collection cultures of Fusarium Lk was determined to varieties and promising cotton lines in laboratory and field conditions. Selected crops are used for screening in the creation of highly resistant hybrid combinations and new cotton varieties.

Key words: G. hirsutum L., spp. Fusarium, F. solani, F. equiseti, F.culmorum, F.oxysporum, F.chlamydosporum, F.proliferatum, F. fujikuroi, F. sporotrihioides, phenotypes, morphology, pathogenicity, strains.

Recommended citation: Kurbonov Abrorjon, Avtonomov Viktor. STUDY OF PHENOTYPIC SIGNS, GENERATIVE STRUCTURES AND PATHOGENICITY OF SPP.FUSARIUM VARIETIES AND COTTON LINES OF G.HIRSUTUM L. SPECIES. 7-8. American Journal of Research P. 260-268 (2019).

INTRODUCTION

Cotton - one of the most labor-intensive and profitable crops - grown in more than 80 countries around the world. Cotton culture, as evidenced by archaeological exploration in Central Asia, existed as early as the 6th century BC. (Nadykta & Ismailov et al., 2004).

One of the most common pathogens affecting cotton is a species of the genus Fusarium Lk. (King and Presley 1942; Hillocks, 1992). Genus Fusarium Lk. - extensive biologically heterogeneous set of fungi among which are obligate and optional parasites, as well as saprotrophs. There are practically no cultures in nature that are not affected by this pathogen (Gagkayeva, 1998). Genus Fusarium Lk. currently contains more than 100 species and the most common are: F. solani, F. equiseti, F. culmorum, F. oxysporum and F. chlamydosporum (Nelson et al., 1994).

The use of chemical pesticides in combating diseases is ecologically related and contributes to the development of pathogen resistance (Fernando et al., 2006). The loss of cotton shoots is one of the main problems of modern world cotton growing. (Hillocks, 1992; Kirkpatrick et al .; Rothrock et al., 2012).

As can be seen from the results of the research, many species of Fusarium Lk. pathogens to cotton shoots. Considering that at the beginning of shoots up to 80% of the crop of raw cotton is formed, its considerably yield losses are possible. So, in the United States, the assessment of losses from germination of shoots, for the period 1991-2000accounted for 27% of losses in cotton fiber with universal use of fungicides during seed treatment (DeVay, 2001).

In the state of Alabama, up to 6% is annually lost, which in monetary terms amounts to 10,282,200 $ (Palmateer & Morgan-Jones, 2000). In Missouri, cotton seedlings were damaged in 1989 and 1997 yy. caused significant crop losses, the harmfulness was such as the pathocomplex affecting cotton during the past 20 years, while Fusarium species turned out to be significantly more than 50% than in samples from all areas in the pathocomplex of pathogens (Wrather et al., 2002).

According to researchers Manju rani, j. S. Rana, et al. (2013), in Northern India, the prevalence of cotton seedlings causes a percentage loss of 5-10% of the crop, and in Europe and the USA, losses are more than 24%.

One of the most common and most pathogens of the main complex of germination in cotton growing regions of the world are species of the genus Fusarium. In Pakistan (Diseases of Cotton & their control), Brazil (Pizzinatto, et al., 1991), throughout the US (Rothrock et al., 2012), in the states of Arkansas, Louisiana, Georgia, Minnesota, North Carolina (Steve Koenning), the state of Texas (Allen, 2001; DeVay, 2001), the state of Missouri, where Fusarium species are found on seedlings from

all areas collected in 1997 and 1998. (Wrather et al., 2002). In Upper Egypt, where cotton root rot is one of the most harmful diseases. The pathocomplex affecting cotton shoots in 11 districts in the Assiut region of Egypt included 3 species of F. solani, F. moniliforme and F. oxysporum. (Abdelmagid et al., 2013) There is in the world literature information about the defeat of seedlings in Nigeria, caused by spp.Fusarium. (Adeoti, 1990; Adeoti et al. 1992).

As a result of the pathogenic effect of spp. Fusarium on cotton plants during its growing season, the yield losses of raw cotton in certain areas of the Republic of Uzbekistan are significantly high (Egamberdiev et al., 2013). In a number of districts of the Bukhara region of Uzbekistan, over the past few years, an alarming phytosanitary situation has arisen related to the defeat of the Fusarious wilt of cotton, as in some where the crops are observed, seedling emergence reaches 40-50%, and before opening the first boxes, the attack reaches 71% (Hasanov , 2017).

According to the monitoring studies of 2015 - 2016, in two areas in the south of the Republic of Surkhandarya and Kashkhadarya areas, species of diseases of the Fusarium genus were identified in the pathocomplex of diseases of cotton seedlings (Egamberdiev et al., 2013).

In plant protection against disease, cultivating resistant varieties is most effective. The selection process of creating varieties is long and does not always keep pace with the adaptive variability of various phytopathogens. Defensive measures to combat the disease require early diagnosis and detection of pathogens on the plant, in the soil or in water.

MATERIALS AND METHODS

The research was conducted in the framework of the project A-KX-2019-15 funded by the Ministry of Innovation Development of the Republic of Uzbekistan.

The materials for the research were samples of plants of cotton G.hirsutum L. of varieties Sultan, Namangan - 77, Bukhara - 6, Bukhara - 8, Omad, C-6524, C-4727, and cultures of the monospore isolates of the genus Fusarium Lk., Isolated from the collected samples plants.

Mycological examination of samples was carried out according to the method of B. Khasanov and Glukhova L.A. (1992). Macromorphological signs of fungi of the genus Fusarium Link. were evaluated on potato - glucose / dextrose agar (KDA) with the addition of antibiotics: 0.3 g / l of streptomycin sulfate and 600 mg / l. chloramphenicol, micromorphological - on the environment of Nirenberg (1990), (Synthetic Nutrient Agar, SNA) (Nirenberg, 1990).

The color of the pigments secreted by the isolates was studied on a medium with the addition of 1.0 g/l Asparagine on the Bondartsev AS scale, 1954. (Bondartsev, 1954). Leaf-piece Agar

(Clove-leaf agar, GLA) (Fisher et al., 1982) was used to obtain more uniform in size and shape of macroconidia.

The study of the pathogenicity of F.solani (FS) and F.equiseti (FE) fungi was carried out using 6 FS strains: No. 319, 519, 520 and FE: No. 28, 139, 378 with molecular genetic characteristics (from the collection of phytopathogens of the Institute of Genetics and experimental plant biology of the Academy of Sciences of Uzbekistan). The level of pathogenicity of the isolates was measured according to the protocol of seed root inoculation in a conidial suspension with a titer of 1 x 106 conidia / ml for each strain separately on a four-point scale (1 - non-pathogenic, 2 - slightly pathogenic, 3 - medium pathogenic, and 4 - strongly pathogenic) (Ulloa et al., 2006).

Field studies were conducted in 2012-2014. on the fields of the CBSPARI in the Tashkent region, laboratory - in the Center for Genomics and Bioinformatics, Academy of Sciences of Uzbekistan in 2013 according to Mauricio Uolla methods, (2006) (Ulloa et al., 2006).

RESULTS AND DISCUSSION

During phytopathological examination of cotton crops, mainly in the seedling stage, in farms of certain areas of Bukhara, Tashkent, Surkhandarya and Kashkhadarya regions, pathogens of the Fusarium species present in the pathocomplex of pathogens of diseases were isolated from the collected samples of sick plants.

Of the 4 areas of the Bukhara region in the period 2009-2012 years, 42 isolates of fungi from the genus Fusarium were isolated from soil, seeds and various parts of plants during the cotton growing season, mainly in the seedling stage. It was established that 100% mortality of cotton seedlings of the Bukhara-6 variety in individual farms in 2011 caused the pathogen F.solani.

In 3 districts of the Tashkent region from cotton plants in the period 2012 - 2014 38 isolates of fungi from the genus Fusarium were isolated, mainly in the seedling stage: F.sporotrichioides F.fujikuroi, F.solani, F. oxysporum f.sp. vasinfectum, F.oxysporum, F.verticillioides (F.moniliforme), F.proliferatum.

In the process of monitoring cotton crops in 2015 - 2016 in two regions in the south of the Republic of Surkhandarya, isolated 29 isolates of the genus Fusarium Lk., represented by the species F.oxysporum, F.solani, F.verticillioides, F.proliferatum, F equiseti.

In field experiments 2012 - 2014 in CBSPARI in the Tashkent region of Uzbekistan, with artificial infection of plant seedlings with a suspension of the culture of the fungus F.fujikuroi, collection strains 502 and 509, turned out to be highly pathogenic to the production varieties "Namangan-77" and "C-4727", to the variety "C-6524" strain 509 showed high pathogenicity, strain 502 showed medium pathogenicity. Both strains showed

medium pathogenic effect on the Omad variety. The collection strain 404 of the fungus F.sporotrichioides showed high pathogenicity to cotton varieties "Namangan-77", "Omad", "C-4727", "C-6524".

The high incidence of the F.equiseti fungus, up to 90%, and its virulence to cotton G.hirsutum L., slightly inferior to the indicated signs of F. solani in Nigeria in 1992 and 1993, presents data in the B. Chimbekujwo study (2000). The article noted that the high pathogenicity of these varieties in cotton seedlings is consistent with the work of Johnson L.F. et al. (1978), Klich M. (1986), and Solymani M.J. et al. (1993). However, it is considered that there may be an error in the diagnosis of F.equiseti due to the nutrient medium used and isolate cultivation conditions.

Studies carried out under controlled conditions of phytotron at the Center for Genomics and Bioinformatics, Academy of Sciences of Uzbekistan showed that when cotton plants were inoculated with three varieties in the phase of two true leaves with a liquid suspension of six - new collection strains of fungus cultures with molecular genetic characteristics, F.solani showed pathogenicity to cotton seedlings, F.equiseti had no effect. This indicates the pathogenicity of the fungus F.equiseti in relation to cotton. (Rajabov et al., 2015)

The study of the pathogenicity of strains of fungi F. solani (FS) and F. equiseti (FE). The results showed high virulence of the FS strains and non-pathogenicity of the FE strains. Thus, isolates No. 520, 319, 519 showed a high pathogenicity index for the tested varieties - 3.8; 3.1; 2.8, respectively. But strain 519 with respect to the Omad variety showed an average pathogenicity index coefficient was 2.2 points. All FE strains were non-pathogenic with respect to the tested varieties (Rajapov et al., 2015)

Field and laboratory studies to assess the sustainability of production varieties and hybrid combinations of cotton to collection strains spp.Fusarium.

- strain № 404 F. sporotrichioides showed strong pathogenicity to regional varieties of cotton Namangan-77 "Omad", "C-4727", "C-6524" in field experiments 2012 - 2014 with artificial infection of plant seedlings with a suspension of fungal culture.

Medium - pathogenic properties of the Omad variety were shown by the strains F. solani №№ 319, 379, 422, 473, 519 and 520 and F.fujikuroi№ 502 and № 509, while the magnitude of the characteristic "pathogenicity" was in the range from 1.91 in isolate № 509 to 3.70 in isolate № 422.

Collection strains of F.fujikuroi, № 502 and 509, turned out to be highly pathogenic to the production varieties "Namangan-77" and "C-4727"; to the "C-6524" variety, one strain - № 509 showed high pathogenicity, the average pathogenicity showed strain 502. K Both strains exhibited a medium-

pathogenic effect on the Omad variety.

With regard to the Namangan-77 variety, F.solani strains № 473 and № 519 showed some pathogenicity, while the F.solani№№ 3119, 379, 422, 520, F.fujikuroi№№ 502 and 509 and F.sporotrichioides№ 404, while the magnitude of the sign "pathogenicity" ranged from 4.00 in strain № 319 (FS) to 4.92 in № 520 (FS).

In relation to the C-4727 variety, all strains were pathogenic.

In relation to variety "C-6524", isolates № 502 (FF) and № 519 (FS) showed moderate pathogenicity, and F.solani№№ 319, 379, 422, 473, 520, F.sporotrichioides№ 404, F.fujikuroi№ 509 strains were strongly pathogenic, while the average value of the sign "pathogenicity" ranged from 4.23 in strain № 379 (FS) to 4.93 in strain № 422 (FS).

In relation to the F5 hybrid [F4 (L-105 x L-106) x L-105], F.solani strains №№ 319, 422, 519, F.fujikuroi № 502 and 509, and F.sporotrichioides № 404, showed medium pathogenicity.

The remaining strains were classified as weakly pathogenic, while the mean value of the "pathogenicity" trait ranged from 0.73 in isolate № 379 to 1.33 in isolate № 473.

In relation to the hybrid F5 [F4 (L-101 x L-108) x L-102], the F. solani strains № 319, 422, 473, F.fujikuroi № 509 and F.sporotrichioides № 404 turned out to be medium pathogenic . The remaining isolates proved to be weakly pathogenic, while the value of the sign "pathogenicity" was in the range from 1.30 in strain FF № 502 to 1.57 in isolates FS № 379 and 519.

In relation to the hybrid F5 [F4(L-105 x L-106) x L-106], FS isolates № 319, FSP № 404, and FF № 502 were found to be medium pathogenic. The remaining isolates were classified as weakly pathogenic, while the average value of the "pathogenicity" trait ranged from 0.60 in strain FS № 520 to 1.80 in strain FS № 422.

CONCLUSIONS

As a result of the analysis of the research, it should be noted that:

- the family isolated from the F4 hybrid [F4(L-101 ? L-108) ? L-102] was used as a parental family in the breeding of a new variety of cotton C-6580, which was transferred for study to the state test from 2018;

- under laboratory conditions, hybrids F5 [F4(L-101 ? L-108) ? L-102], F5 [F4 (L-105xL-106) ? L-105] and F5 [F4 (L-105xL-106) ? L-106] turned out to be more resistant to the group of pathogens of the genus Fusarium as compared with the Omad, Namangan-77, C-4727 and C-6524 varieties and recommended for further selection in order to create cotton-resistant varieties that are highly ultra early maturity (110- 115 days), the yield of raw cotton (40-45 c/ ha), fiber output (37-38%) and the quality of IV type fiber, that is, significantly

surpass the world analogues in early maturity and resistance to patogen group and have high values of cotton yields, ensuring high values of the quantity and quality of fiber.

REFERENCES

1. Abd-Elsalam KA, Omar MR, El-Samawaty AR, Aly AA (2007) Response of Commercial Cotton Cultivars to F.solani. Plant Pathology Journal 23(2):62-69.

2. Allen, S. J. 2001. Black root rot. Pages 16-17 in: Compendium of Cotton Diseases. T. L. Kirkpatrick and C. S. Rothrock, eds. American Phytopa-thological Society, St. Paul, MN.,

3.Ahmed Abdelmagid, Abdel-Moneim Amein, Mohamed Hassan, Hamdy E. Hares.(2015)Random amplified polymorphic dna (rapd) analysis to determine the genetic variability among virulent and less virulent isolates of Fusarium moniliforme, Fusarium oxysporum and Fusarium solani isolated from infected cotton seedlings.International Journal of Phytopathology ISSN: 2312-9344 (Online), 2313-1241 (Print) Vol 4, No 3 (2015) http://escijournals.net/index.php/phytopath/article/view/1468

4. Amy Davidson http://www.anbg.gov.au/cpbr/summer-scholarshi p/2003-projects/image49-big.jpgNative Fusarium and Cotton in Australia. Centre for Plant Biodiversity Research. Supervisors: Augusto Becerra & Bo Wang. Dec 2002 - Jan 2003 http://www.anbg.gov.au/cpbr/summer-scholarshi p/2003-projects/davidson-fusarium.html

5. Adeoti, A.A., A. M. Emechebe, M. D.Alegbejo & M.A.T. Posdroal. 1992. Cropping scheme meeting: Report on fibre research programme, Institute research for Agricultural Samaru, Ahmadu Bello University, Zaria, Nigeria. p.59-62

6. Adeoti, A.A. 1990. Cropping scheme meeting: Report on fibre research programme, Institute for. Agricultural Research Samaru, Ahamadu Bello University, Zaria, Nigeria. Pg. 40-44, 68-69.

7. Bondartsev A.S. Scale of colors. Moscow; Leningrad: USSR Academy of Sciences, 1954. p. 27.

8. B.Chimbekujwo. Frequency and pathogenicity of fusarium wilts (Fusarium solani and Fusarium equiseti) of cotton (Gossypium hirsutum) in Adamawa in Nigeria. Biol. trop v.48 n.1 San Jos? mar. 2000.

9. Diseases of Cotton & their control http://www.sindhagri.gov.pk/cotton-disea.html)

10. DeVay, J. E. (2001). Seedling Diseases. Page 13-14 In: Compendium of Cotton Seedling Diseases. T. L. Kirkpatrick, and C. S. Rothrock, eds, APS Press, St. Paul, MN.

11. Egamberdiev S, Ulloa M, Saha S, Salakhutdinov I, Abdullaev A, Glukhova L, Adylova A, Scheffler B, Jenkins J, Abdurakhmonov I (2013)Molecular Characterization of Uzbekistan Isolates ofFusarium oxysporum f.sp vasinfectum. Journal of PlantScience Molecular Breeding. doi: 10.7243/2050-2389-2-3.

11. Fernando, W., Nakkeeran, S., Zhang, Y., 2006. Biosynthesis of Antibiotics by PGPR and its Relation in Biocontrol of Plant Disease. In: Siddiqui, Z. (Ed.), PGPR: Biocontrol and Biofertilization. Springer, Netherlands, pp. 67e109.

12. Fisher, N. L., L. W. Burgess, T. A. Toussoun, and P. E. Nelson. 1982. Carnation leaves as a substrate and for preserving cultures of Fusarium species. Phytopathology 72: 151-153. (2, 4); Snyder, W. C., and H. N. Hansen. 1947. Advantages of natural media and environments in the culture of fungi. Phytopathology 37: 420-421. (2, 4)

13. Gagkayeva, T.Yu. International Workshop on Fusarium Fungi // Mycology and Phytopathology. 1998. - Vol. 6. - T. 32. - p. 94-95.

14. Hillocks, R.J. 1992. Cotton diseases. CAB. International, Wallingford, United Kingdom.1-38, 127-160p.

14. Johnson, L.F. D.D. Baird, A.Y. Chambers & N.B. Shamiyeh. 1978. Fungi associated with postemergence seedling disease of cotton in the soils. Phytopathology 68: 917-920.

15. King, C.J. & C Presley. 1942. A root rot of cotton caused by Thielopviopsis basicola. Phytopathology 32: 752-761.

16. Kiray Z., Klement Z., et al. Phytopathology methods. / / M., 1974, p. 180.

17. Kurbonov A.Y., Avtonomov V.A., Egamberdiev Sh.Sh. The study and identification of highly resistant varieties and interline hybrid combinations of cotton of the species G.hirsutum L. to the pathogens of the genera Fusarium and Verticillium. Uzbekistan Biological Journal. Special issue. Tashkent. 2016. P.64-66

18. Klich M. 1986. Mycoflora of cotton seed from the southern USA a three year study of distribution and frequency. Mycology 78: 706-712

19. Mauricio Ulloa, Robert B. Hutmacher, R. Michael Davis, Steven D. Wright, Richard Percy, and B. Marsh 2006.Breeding for Fusarium Wilt Race 4 Resistance in Cotton under Field and Greenhouse Conditions. The Journal of Cotton Science 10:114-127 (2006) http://journal.cotton.org, © The Cotton Foundation 200.

20. Manju rani, j. S. Rana, k. K. Dahiya and Vikas Beniwal. Molecular characterization of Rhizoctonia solani ag-7 causing root rot on cotton crop in India. Int J Pharm Bio Sci 2013 Apr; 4(2): (B) 703 - 712
http://www.ijpbs.net/cms/php/upload/2306_pdf.pdf

21. Nadykta V.D., Ismailov V.Y. et al. 2004. Biological Plant Protection as a Basis for stabilizing Agroecosystems. Issue 2. Ed. by Proceedling of International Scientific and Practical Conference. September 29 - October 1, Krasnodar 2004. p. 432.

22. Nelson PE, Dignani MC, Anaissie EJ. Taxonomy, biology, and clinical aspects of Fusarium species. Clin Microbiol Rev 1994;7(4):479-504.

23. Nirenberg, H. I. 1990. Recent advances in the taxonomy of Fusarium. Studies in Mycology 32: 91-101).

24. Pizzinatto, M. A.; Menten, J. O. M. Pathogenicity of eight Fusarium species isolated from seeds to cotton seedlings. Journal Summa Phytopathologica 1991. Vol. 17 No. 2 pp. 124-134 ISSN 0100-5405 Record Number 19932331051 http://cabdirect.org/abstracts/19932331051.html;jsessionid=0F8D6AC87D9118720116F0034C777517

25. Palmateer, McLean, Morgan-Jones. Researches Identify Fungi Involved in the Seedling Disease Complex on Alabama Cotton. AAES Highlights/ A Magazine of Research from the Alabama Agricultural Experiment Station at Auburn University, 2000. http://aaes.auburn.edu/comm/pubs/highlightsonline/fall01/fall-palmateer.html

26. Popkova, K.V., Shkalikov, V.A., Stroynov, Yu.V. and others. General phytopathology. Textbook for High Schools - 2 ed., Moscow. Bustard. 2005. -p. 445.

27. Rothrock C. S. , Colyer P. D., Buchanan M. L., Gbur E. E. 2012. Cotton Seedling Diseases: Importance, Occurance and Chemical Control.

28. Radzhapov F.S., Egamberdiev Sh.Sh., Mullahunov B.T., Kurbonov A.Y.. The study of the pathogenic properties of isolates Fusarium solani and Fusarium equiseti in relation to cotton. Bulletin of Agrarian Science of Uzbekistan "3 (61) 2015. P.22-25.

29. Seedling Diseases. Page 13-14 In: Compendium of Cotton Seedling Diseases. T. L. Kirkpatrick, and C. S. Rothrock, eds, APS Press, St. Paul, MN.

30. Steve Koenning. Cotton Disease Information Note No. 1.Norton Carolina University Plant Pathology Extension
https://www.ces.ncsu.edu/depts/pp/notes/Cotton/cdin1/cdin1.htm)

31. Soleymani, M.J., G.A. Hedjaroude. & J. Zad. 1993. Studies on pathogenicity of some seedborn Fusarium species on cotton seedling. Iran. J.of Pl. Pathol. 29:19-20.

32. Wang B, Brubaker CL and Burdon JJ: Fusarium species and Fusarium wilt pathogens associated with native Gossypium populations in Australia. Mycol Res 2004, 108:35-44.

33. Wrather, J. A., Phipps, B., and Rothrock, C. S. 2002. Fungi associated with postemergence cotton seedling disease in Missouri. Online. Plant Health Progress doi:10.1094/PHP-2002-0722-01-RS.

http://www.plantmanagementnetwork.org/pub/php/research/cottonseedling/

34. Khasanov B.A. Fusarium cotton wilt and modern methods for the identification of fungi of the genus Fusarium. Tashkent - 2017. p.133.

35. Khasanov B.A., Glukhova L.A. Guidelines for the isolation, identification of pathogens and the creation of artificial infectious background barley. Tashkent, ed. Fan, 1992. P.8 - 12.