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PATHOGENICITY EFFECTS OF THE FUNGUS ALTERNARIA BRASSICAE

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Abstract:

The data about the prevalence and the development of alternaria disease in Brassicaceae vegetables (white cabbage, cauliflower, broccoli, red cabbage, leafy cabbage, Chinese cabbage) and the results of artificial infestation with the Alternaria-causing fungus *A. brassicae* have been presented in this article. The obtained results show that isolated strains 8, 66, and 71 severely damaged Brassicaceae crops, that is, this indicator was 65,8%, 63,4%, 55,3%; 61,2%, 67,9%, 53,2%; 54,9%, 55,8%, 60,7% respectively.

Keywords: Brassicaceae vegetables, disease, fungus, powder, strains, *A. brassicae*, pathogenicity, cultures, inoculation

INTRODUCTION

Brassicaceae vegetables (white cabbage, cauliflower, broccoli, Chinese cabbage, bok choy cabbage, leafy cabbage, etc.) occupy a special place among vegetables, and therefore, in January 2022, the export volume of the main types of cabbage in Uzbekistan increased significantly. The reason for this is the sharp increase in demand for this product in foreign markets. In February, the situation in the main foreign markets was also favorable for farmers and experts in the production of white cabbage, Chinese cabbage, cauliflower and broccoli (East Fruit 2022). Brassicaceae crops occupy the third place after tomatoes and onions in the total area of vegetable crops grown in our republic (Ostonakulov, Zuev, Kodirkhojaev 2009). According to the preliminary data of the Customs Committee of the Republic of Uzbekistan, in February 2022, the volume of exports of the main types of cabbage crops was as follows: white head - 17,2 thousand tons, cauliflower and broccoli – 2,5 thousand tons, Chinese cabbage - 710 tons, and it can be seen that this indicator is 3,6 times more than in February 2021 (East Fruit 2022). [1]The area of origin of Brassicaceae is considered to be the shores of the Mediterranean Sea, and it belongs to the group of very ancient crops (Shokirov, Azimov, Lapasov 2017). Although the composition of cabbage is not rich in nutrients, it is a source of minerals, vitamins and especially vitamin C (Ostonakulov, Zuev, Kodirkhojaev 2009).

Brassicaceae vegetable crops are affected by a number of viral diseases (*Cauliflower mosaic virus*, *Turnip mosaic virus*), bacterial diseases (*Pseudomonas syringae. pv. maculicola, Erwinia spp, Xanthomonas campestris pv. campestris*) and fungal diseases (*Alternaria brassicae, Phoma lingam, Fusarium oxysporum f. sp. conglutinans, Verticillium dahliae, Sclerotinia sclerotiorum, Mycosphaerella brassicicola, Peronospora parasitica, Plasmodiophora brassicae, Pythium spp., Fusarium spp., Rhizoctonia solani*) at their growth, development and shelf life periods (Khasanov, Ochilov, Gulmurodov, 2009; Allayarov, Abdurakhmanova, Khakimov, 2019).

The overuse of synthetic pesticides without control and without thinking about their effects leads to soil pollution with pesticides, the emergence of extremely high resistance to them in harmful organisms, a sharp increase in the amount of pesticide residues in food products, the death of organisms useful to mankind, and most importantly, it causes great damage to human health. In order to avoid such situations, it is necessary to use synthetic pesticides only when the harmful organism exceeds the economic threshold, or to replace synthetic pesticides with substances of biological origin based on microorganisms, or biopreparations obtained on the base of microbial producers and colony-forming units (Khakimov, Omonlikov, Utaganov, 2020).

A number of scientists reported the emergence of resistance of pathogens to synthetic fungicides (Korolev, Mamiev, and Elad, 2010; Mamiev et al., 2013; Zuparov et al., 2020; Mamiev et al., 2020), in its turn, it encourages the use of biofungicides against disease-causing fungi.

Although phytopathological and mycological studies have been carried out for many years in the Republic of Uzbekistan (Kamilov et al., 2020), they are dedicated to determining the pathogenicity of *A. brassicae* fungi, which cause Alternaria diseases in Brassicaceae vegetable crops.

[1]EastFruit 2022 https://east-fruit.com/author/east-fruit/

MATERIALS AND METHODS

In order to describe the morphological characteristics of disease-causing fungi, preparations were made from the spots and powders formed in the infected tissues of the plant. MIKMED-5, Binocular BMS-2 microscopes were used to identify *A. brassicae* fungus. Fungal mycelia or spores formed on the surface of the plant parts were isolated and inoculated onto a slanted agar medium in a test tube prepared beforehand. After the fungi in the test tube grew well, their type was determined (Khokhryakov M.K. 1968). Determinants by N.M. Pidoplichko, V.I. Bilay and other determinats were used to identify the types of fungi. Statistical analysis of research results was carried out by the method of B.A. Dospekhov.

Cabbage black spot disease is the most widespread and the most damaging disease that ranks first in terms of damaging level. Manifestation of this disease begins when the seed germinates from the soil and continues throughout the growing season. The disease is observed in the cabbage heads grown for consumption, set aside for seed, and left for storage. Alternaria infects mainly the seed-producing parts of cabbage crops, vegetative buds and seeds too causing great damage. Cabbage leaves and heads are less damaged. Alternaria disease is found in all areas where Brassicaceae vegetable crops are grown (Gerasimov B.V., Osnitskaya E.A. 1961).

Brassicaceae vegetables can be damaged by Alternaria disease at the initial stage of development. According to the information, brown lines and spots appear on the leaves and stems of seedlings sprouted from cabbage seeds in conditions of high humidity. It has been noted that such seedlings are covered with mycelium of the causative agent and then die. But such appearance of Alternaria disease in seedlings is rarely observed in natural conditions (Sharma M., Deep S., Bhati D. S., Chowdappa P., Selvamani R., Sharma P. 2013).

The pathogenicity characteristics of the fungus *A. brassicae* strains obtained for the study were also studied in laboratory conditions. The strains selected above were used for the experiment. To propagate the selected strains, they were planted in 500 ml sterile flasks with nutrient media such as Czapek, beer wort and potato broth in laminar boxes, and the flasks were placed in thermostats at a temperature of 24-26°C for the growth of pathogenic fungi. The strains were grown in these flasks for 10 days. Then, after determining the spore titer in these flasks in the Goryaev chamber, it was determined that 1 ml of culture fluid contained $1 \cdot 10^3$ to $1 \cdot 10^4$ cfu/ml, depending on the type of crop. The culture fluid of the strains was filtered and separated into separate flasks.

5 pots with 4 seedlings in each were taken for each option from the seedlings of Brassicaceae vegetable crops selected for the experiment, and they were grown in laboratory rooms under a film at a temperature of 24-26°C and a humidity of 70-80%. These seedlings were infected artificially, that is inoculated with culture fluids obtained from *A. brassicae* strains. Culture fluids with a titer of $1 \cdot 10^3$ cfu/ml were used for infection. Seedling inoculation was carried out by spraying the culture liquid on the plants.

The occurrence of disease symptoms on the leaves and damage of seedlings was recorded based on the following scale:

0 score – healthy;

1 score – there are spots with a diameter of 1-2 mm or damage up to 10%;

2 scores – spots with a diameter of 2-3 mm – damage up to11-25%;

3 scores – spots with a diameter of 3-5 mm – 26-50% damage;

4 scores – spots diameter is larger than 5 mm, some leaves with confluent spots turning yellow, seedlings with more than 50% spots are dying.

RESULTS AND DISCUSSION

The first symptoms of the disease were observed in seedlings of inoculated cabbage crops from 3-5 days. Yellow spots appeared on the surface of the affected leaves, then the surface of the spots was covered with ooze or slightly gray powders consisting of mycelia of the fungus. Over time, these fungal spores turned black.

Table 1 shows the results of artificial inoculation of seedlings of cabbage vegetable crops with the alternaria-causing fungus *A. brassicae*.

As a result of the experiments, it was found that strains 8, 66, and 71 isolated from white cabbage, cauliflower and Chinese cabbage, which were previously planted in local conditions, strongly damaged these types of crops, that is, this indicator was 65,8%, 63,4%, %, 55,3%; 61,2%, 67,9%, 53,2%; 54,9%, 55,8%, 60,7% respectively. Leaf cabbage, red cabbage and broccoli, which are new type of crop for vegetable farming of the Republic, were less damaged and this indicator for them was 17,2%, 19,2%, 15,1%; 29,1%, 30,3%, 28,4%; 21,3%, 22,7%, 12,5% respectively (table 1).

Table-1
Pathogenecity performance of *A. brassicae* strains isolated from different types of Brassicaceae vegetable crops

No	*A.brassicae* species		Brassicaceae vegetable crops					
	Strain number	Host plant	White cabbage	Leaf cabbage	Red cabbage	Cauliflower	Chinese cabbage	Broccoli
			Disease development, %					
1	8	White cabbage	65,8	17,5	29,1	61,2	54,9	21,3
2	22	Leaf cabbage	46,2	39,4	27,8	40,5	39,0	11,6
3	54	Red cabbage	51,1	12,3	37,2	47,3	42,5	13,4
4	66	Cauliflower	63,4	19,2	30,3	67,9	55,8	22,7
5	71	Chinese cabbage	55,3	15,1	28,4	53,2	60,7	12,5
6	103	Broccoli	50,2	10,7	28,0	43,1	41,6	25,3

On the contrary, it was observed that the strains isolated from the last vegetable species damaged relatively more the host plant. Among them, strains 22, 54, 103 were reported to damage white cabbage up to 46,2%, 51,1%, 50,2%, respectively, cauliflower up to 40,5%, 47,3%, 43,1%, Chinese cabbage up to 39,0% , 42,5%, 41,6% respectively, while the leafy cabbage was affected by these strains up to 39,4%, 12,3%, 10,7%, red cabbage up to 27,8%, 37,2%, 28 ,0%, and broccoli 11,6%, 13,4%, 25,3% respectively.

CONCLUSION

Based on the results of the study, it can be concluded that the strains of *A. brassicae* fungus isolated from Brassicaceae vegetable crops infected with alternariosis manifested high pathogenicity on previously planted Brassicaceae vegetable seedlings, while on new Brassicaceae vegetable species for our conditions they showed less pathogenicity.

As for the germination of seeds under the influence of *Alternaria brassicae* strains, 50,0% germination was observed in white cabbage and 43,0% in cauliflower, respectively, compared to the control, while the stem of seedlings was reported to grow 21,9-26,4%, 33,9-39,2%, 42,3-56,5% and the root increased by 32,5-68,0%, 27,4-51,7%, 52,1-70,3% respectively.

When the seedlings of Brassicaceae vegetable crops were artificially infested with the fungus *A. Brassicae,* that is the causative agent of Alternaria disease, it was observed that the previously cultivated crop types were strongly damaged and the seedlings of new crop types were less damaged.

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