

Alternaria disease of cruciferous vegetable crops

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Abstract. The most pervasive and harmful illness is cruciferous black spot disease. This disease starts to show symptoms as soon as the seed emerges from the soil and continues all through the growth season. In regions designated for seeds, cabbages left for storage, and areas planted for human consumption, the disease is seen. The illness *Alternaria* mostly affects the cruciferous plants' organs responsible for generating seeds, and it severely damages the pods and seeds. The leaves and bulbs of crucifers are less impacted. Every region that grows cruciferous vegetable crops has *Alternaria* disease. In this article, the spread and development of *alternaria* disease in cruciferous vegetable crops (cabbage, cauliflower, broccoli, red cabbage, collard, Napa cabbage) and its damage by the fungus *A. brassicae*, which causes *alternaria* disease, and damage by *alternaria* disease and its causative agent, were determined. Due to the *Alternaria* disease, the yield loss of all vegetable crops was observed. Compared to a healthy plant, the loss of 14.3-17.4% of the yield of cabbage, followed by cauliflower - 8.3-12.1%, red cabbage - 10.0%, Napa cabbage - 10.0-12.2% and, broccoli 10.2-16.0% was reported.

Keywords. *Alternaria*, disease spread, cruciferous vegetables, fungus, powdery mildew, strains, *A. brassicae*.

1 Introduction

Among vegetables, cruciferous vegetable crops (cabbage, cauliflower, broccoli, Napa cabbage, bok choy, collard, etc.) occupy a special place [1], and in January 2022, the export volume of the main types of cabbage in Uzbekistan increased significantly [2]. 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 favorable for agricultural farms and experts growing cabbage, bok choy, cauliflower and broccoli [3].

Currently, cruciferous crops occupy the third place after tomatoes and onions in the total area of vegetable crops grown in Uzbekistan. According to the preliminary data of the Customs Committee of the Republic of Uzbekistan, in February 2022, the export volume of the main types of cabbage was as follows: Cabbage – 17,200 tons, Cauliflower and broccoli – 2,500, and Bok choy - 710 tons [4]. It can be seen that this indicator is 3.6 times more than in February 2021. The homeland of cruciferous is considered to be the coast of the Mediterranean Sea, and it belongs to the category of very ancient crops [5]. Although the

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composition of cabbage is not rich in nutrients, it is a source of minerals, vitamins, and especially vitamin C [6, 7].

Cruciferous vegetable crops are affected by a number of viral (*Cauliflower mosaic virus*, *Turnip mosaic virus*), bacterial (*Pseudomonas syringae. pv. maculicola*, *Erwinia spp.*, *Xanthomonas campestris pv. campestris*) and fungal (*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*) diseases during growth, development and storage [8, 9].

The excessive, uncontrolled and careless use of synthetic pesticides causes the soil to become contaminated with pesticides, and harmful organisms develop a high resistance to them. In addition, it causes a sharp increase in the amount of pesticide residues in consumer products, the death of organisms useful for mankind, and most importantly, it causes great harm to human health [10, 11]. To avoid such situations, synthetic pesticides should be used only when the harmful organism exceeds the economic threshold. Otherwise, to replace synthetic pesticides, it will be necessary to use biopreparations obtained on the basis of substances of biological origin based on microorganisms, microbial producers and colony-forming units [12, 13].

A number of scientists have provided information on the emergence of resistance of pathogens to synthetic fungicides [2-6, 14]. This, in turn, motivates the use of biofungicides against disease-causing fungi. Although phytopathological and mycological studies have been carried out in Uzbekistan for many years, they are dedicated to determining the pathogenicity of *A. brassicae* fungi, which cause *Alternaria* diseases in cruciferous vegetable crops.

2 Materials and methods

In order to describe the morphological characteristics of disease-causing fungi, preparations were prepared from the spots and bubbles formed in the affected tissues of the plant. MIKMED-5, Binocular BMS-2 microscopes were used to identify *Abrassicae* fungus [15]. Fungus mycelia or spores formed on the surface of the plant pieces were planted on a slant of agar medium in a pre-prepared test tube [16]. After the fungi in the test tube grew well, their type was determined. Pidoplichko, Bilay and other identifiers were used to identify the types of fungi [17]. Statistical analysis of the research results was carried out by the Dospekhov method [18].

Cruciferous black spot disease is the most widespread and damaging disease. Manifestation of this disease begins when the seed germinates from the soil and continues throughout the growing season [19]. The disease is observed in areas planted for consumption, reserved for seeds and cabbages left for storage. *Alternaria* infects mainly the seed-producing organs of cruciferous plants, and this disease damages the pods and seeds, causing great damage. Cruciferous leaves and bulbs are less affected. *Alternaria* disease is found in all areas where cruciferous vegetable crops are grown.

Alternaria disease can damage cruciferous plants at the beginning of their development. According to the data, brown stripes and spots appear on the leaves and stems of the sprouts grown from the seeds of cruciferous plants grown in conditions of high humidity. Such seedlings are covered with the mycelium of the causative agent and die. But such appearance of *Alternaria* disease in seedlings is rarely observed in natural conditions. The occurrence of leaf diseases and damage of seedlings was calculated based on the following scale [2-6]:

- 0 point - healthy;
- 1 point - there are spots with a diameter of 1-2 mm or damage up to 10%;
- 2 points - spots up to 2-3 mm and damage - 11-25%;

- 3 points - spots up to 3-5 mm and damage - 26-50%;
- 4 points - the diameter of the spots is larger than 5 mm, some leaves with the spots have turned yellow and died, and the seedlings have more than 50% spots.

3 Results and discussion

Alternaria or black spot disease often affects the seed-bearing organs and seeds of cruciferous vegetable crops. Relatively less, this disease is observed in cabbage leaves. In the conditions of the Tashkent region, it was observed that the seedlings of cruciferous crops are infected with this disease from the time they form seed leaves until the emergence of pods.

Alternaria disease was observed in the form of small, yellow spots on seed leaves and first leaves of cruciferous vegetable seedlings. The leaves of such seedlings turned yellow and withered. In the open field, the disease is first manifested by the formation of brown spots on the leaves of the plants, and later on the surface of the stems, spots covered with black dust were observed.

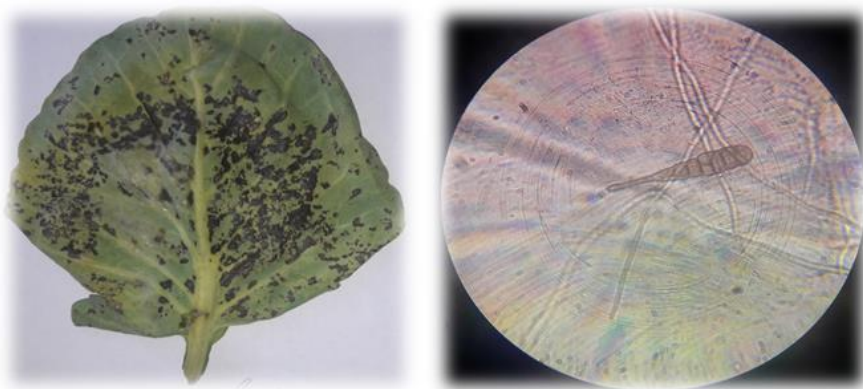


Figure 1. Cabbage leaf damage by Alternaria disease and its causative agent.

The disease started from the lower leaves of cruciferous crops and gradually moved to the upper leaves. On the surface of diseased leaves, brown spots were formed, which were first small and then became larger and merged with each other. The surface of the spots is covered with mycelia of the disease-causing fungus in a concentric pattern, conidia bands, and black powders consisting of conidia. Such leaves turned yellow, dried up and died. Cabbage, cauliflower, red cabbage, napa cabbage, broccoli and collard were affected by this disease. It was observed that kohlrabi cabbage is not affected by Alternaria.

Analysis of samples infected with alternaria disease of cruciferous vegetable crops was carried out in laboratory conditions. Plant samples brought for this purpose were planted in Petri dishes with Chapek agar, beer wort with agar, and potato nutrient media with agar in a humidity chamber in a Petri dish under sterile conditions. Petri dishes planted with diseased specimens of cruciferous crops were placed in a thermostat at a temperature of 24-26°C for the growth of the pathogen, and they were observed from the third day. Fungi grown from infected samples were planted in test tubes on beer wort medium with agar.

Pure cultures of isolated fungi were observed under a microscope and their sizes were determined. These fungus cultures were determined to belong to the species *Alternaria brassicae* (Berk) Sacc. Mycelium of this species penetrates the substrate surface and inside. The hyphae have septa, are smooth, colorless, and their thickness is 4-8 µm. Conidial bundles from hyphae in clusters of 2-10, straight, sometimes curved, mostly thicker, with septa, light gray-brown, smooth, 6-11 µm thick, up to 170 µm long. The conidia are single, sometimes

up to 4, and have a chain-like appearance. Conidia are straight, nodular, with 8-10 transverse and 1-7 longitudinal septa. Its snout is 68-310 µm long, 18-28 µm wide, light brown, mostly smooth, 75-350 µm long, 20-30 µm wide, and 5-9 µm thick.

Distribution, development and impact of *Alternaria* disease of cruciferous vegetable crops in Tashkent region, Uzbekistan are presented in Table 1.

Table 1. Distribution and damage of *Alternaria* disease of cruciferous vegetable crops in farms located in Tashkent region of Uzbekistan.

#	Farms	Physiological state of plant	Disease prevalence, %	Disease progression, %	Average weight of one cabbage or plant, kg	Yield loss compared to healthy, %
Cabbage						
1	Erkin Muruvvat	Healthy	-	-	2.30	-
		Diseased	50.7	36.2	1.90	17.4
2	Zafarobod-agro produkt	Healthy	-	-	2.40	-
		Diseased	45.2	31.1	2.0	16.7
3	“Fresh Rose” Ltd.	Healthy	-	-	2.80	-
		Diseased	39	25.4	2.40	14.3
Cauliflower						
1	Erkin Muruvvat	Healthy	-	-	1.70	-
		Diseased	25.8	17.7	1.55	8.8
2	Zafarobod-agro produkt	Healthy	-	-	1.80	-
		Diseased	21.3	15.4	1.65	8.3
3	“Fresh Rose” Ltd.	Healthy	-	-	1.90	-
		Diseased	31.1	22.8	1.67	12.1
Red cabbage						
1	Zafarobod-agro produkt	Healthy	-	-	1.60	-
		Diseased	30.5	19.4	1.40	10.0
Napa cabbage						
1	Raxmatxojaev Toir	Healthy	-	-	1.20	-
		Diseased	42.1	29.6	1.08	10.0
2	Zafarobod-agro produkt	Healthy	-	-	1.40	-
		Diseased	47.3	33.5	1.23	12.2
3	“Fresh Rose” Ltd.	Healthy	-	-	1.0	-
		Diseased	35.8	25.2	0.9	10.0
Broccoli						
1	Yahyoxon Ziyon Nur	Healthy	-	-	410	-
		Diseased	24.5	19.6	468	10.2
2	TSAU “Innovative development center” SUE	Healthy	-	-	520	-
		Diseased	31.2	23.0	461	11.4
Collard						
1	Erkin Muruvvat	Healthy	-	-	1.85 kg/m ²	-
		Diseased	24.5	16.1	1.71 kg/m ²	7.6
2	Yahyoxon Ziyon Nur	Healthy	-	-	2.0 kg/m ²	-
		Diseased	28.2	21.4	1.79 kg/m ²	10.5
3	Raxmatxojaev Toir	Healthy	-	-	1.88 kg/m ²	-
		Diseased	20.0	12.3	1.58 kg/m ²	16.0
	EKF ₀₅			2.48		

Alternaria disease was recorded in all fields, except for kohlrabi cabbage, in farms with cruciferous vegetable crops. *Alternaria* was observed the most in fields planted with cabbage, where the spread of the disease was 39.0-50.7%, and its development was 25.4-36.2%. This indicator is 21.3-31.1% and 15.4-22.8% respectively in cauliflower, in red cabbage - 30.5% and 19.4%, in Napa cabbage 35.8-47.3% and 25.2-33.5%, 24.5-31.2% and 19.6-23.0% in broccoli, and 20.0-28.2% and 12.3%-21.4% in collards it has been.

Due to *Alternaria* disease, the yield loss of all vegetable crops was observed. Compared to a healthy plant, the yield of cabbage is 14.3-17.4%, cauliflower is 8.3-12.1%, red cabbage is 10.0%, Napa cabbage is 10.0-12.2% and 10.2-16.0% loss of broccoli was found.

We believe that such differences in the spread and development of *Alternaria* disease and crop loss among cruciferous vegetable crops are due to the different levels of quality of agrotechnical measures carried out in the cultivation of new crop species for the conditions of Uzbekistan.

4 Conclusions

In conclusion, it can be said that in the farms occupied with cruciferous vegetable crops, it became clear that *Alternaria* disease was recorded in all fields, except for the field planted with kohlrabi cabbage.

Alternaria was observed the most in fields planted with cabbage, where the spread of the disease was 39.0-50.7%, and its development was 25.4-36.2%. This indicator was accounted for 21.3-31.1% and 15.4-22.8% respectively in cauliflower, 30.5% and 19.4% in red cabbage, 35.8-47.3% and 25.2-33.5% in Napa cabbage, 24.5-31.2% and 19.6-23.0% in broccoli, and 20.0-28.2% and 12.3%-21.4% in collards.

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