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THE SPREAD OF ALTERNARIA LEAF SPOT DISEASE IN CABBAGE VEGETABLE PLANTS, ITS DAMAGES AND THE EFFICACY OF FUNGICIDES USED AGAINST THEM

Allayarov Abdurakhmon Nazaralievich

Independent Researcher, Assistant of Agrobiotechnology Department, Tashkent Statet Agrarian University, Tashkent, Uzbekistan

Abdurakhmanova Sadoqat Bakhramovna

Teacher of Languages Department, Tashkent statet agararian university, Tashkent, Uzbekistan

Khakimov Albert Akhmedovich

PhD, Assistant of Professor Agrobiotechnology Department, Tashkent Statet Agrarian University, Tashkent, Uzbekistan

ABSTRACT

This article outlines the spread of alternaria leaf spot in the crops of cabbage plants (white cabbage, cauliflower, broccoli, red cabbage, leaf cabbage, Chinese cabbage), disease development and its harms in crop yields. Besides, the fungicides Bordeaux mixture, Akrobat®MS 69% WDG, Previkur®SL 72,2% WS, Proksanil® 45% SC have been applied against alternaria leaf spot disease, and the highest efficacy was observed in the variant of Previkur SL 72,2% WS fungicide application. Biological efficiency was 89,2% in leaf cabbage, 87,8% in red cabbage, 69,9% in broccoli, 86,3% in white cabbage, 85,8% in cauliflower and 85,6% in Chinese cabbage.

KEYWORDS: *cabbage vegetable plants, disease, Alternaria brassicae, spread of disease, harm, fungicides, biological efficacy.*

INTRODUCTION

Cabbage vegetables (white cabbage, cauliflower, broccoli, Chinese cabbage, Pekinese cabbage, leaf cabbage and etc.) have a significant value in world vegetable growing that is proved by abundant producing of cabbage in 2017 in the area of 2,5 mln hectares, the yield of cabbage vegetables made 71,45 mln tons [4].

In Uzbekistan fruit-vegetable growing potential is increasing year by year, as in 2017 23 million tons of fruit-vegetable products were produced [15]. At present, cabbage vegetables take the third place after tomato and onion plants by the areas under general vegetable plants cultivated in our republic [10] and in 2017 the amount of cultivation of cabbage vegetables was 900 thousand tons [4].

The origin of cabbage plants is Mediterranean regions and these plants belong to ancient crops [13]. Although cabbage doesn't contain rich nutrients, but it

is a source of minerals, vitamins, especially vitamin C [10].

Cabbage vegetable plants are affected and infected by numbers of diseases that arise viruses (Cauliflower mosaic virus, Turnip mosaic virus), bacteria (*Pseudomonas syringae. pv. maculicola*, *Erwinia spp*, *Xanthomonas campestris pv. campestris*) and fungi (*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*) during the growth, development and storage periods of cabbages. These diseases reduce not only the productivity of cabbage crops, but also cause to low quality. Therefore, development of effective control measures on diseases caused by harmful organisms is of vital significance for increasing crop productivity and improving the quality [5, 8].

Alternaria leaf spot or black leaf spot disease is wide-spread and more harmful disease compared to others. The occurrence of this disease starts in seed germination and continues during the whole vegetation period. The disease is observed in cabbage fields under production for consumption, seed and storage. Alternaria leaf spot mostly infects seed-producing parts of cabbages and causes considerable harm to the seeds. The leaves and heads of cabbage vegetables are affected less. Furthermore, several literatures illustrate data about alternaria leaf spot disease in cabbage vegetable fields [2, 9, 12, 14].

MATERIALS AND METHODS

In our experiments we have investigated type composition of the diseases which affect cabbage vegetable crops (white cabbage, cauliflower, broccoli, Chinese cabbage, red cabbage and leaf cabbage).

The experiments on the study of disease composition have been carried out in 2016-2018 on the farms “Yahyokhon Ziyon Nur”, “Rahmatkhujayev Toir” in Tashkent region, in the fields of vegetable growing farm “Fresh Rose” LLC and in the department of agricultural phytopathology and agrobiotechnology of Tashkent state agrarian university.

Rough nutrient media and moist chambers have been used for isolation of pure culture of disease-causing fungus types out of infected cabbage plant samples [7].

In order to determine disease-causing fungus types isolated from plants the MIKMED-5, MBS-2 binocular microscopes have been used.

For identification of fungus types the guides of N.M.Pidoplichko (1977), V.I. Bilay (1977) and others have been used.

Bordeaux mixture (as per Copper sulfate 6 kg/ha), Akrobat®MS 69% WDG (90 g/kg Dimethomorph & 600 g/kg mancozeb), Previkur®SL 72,2% WS (Propamocarb hydrochloride), Proksanil® 45% SC (400 g/l Propamocarb hydrochloride & 50 g/l cymoxanil) fungicides have been applied against alternaria leaf spot disease of cabbage plants.

Biological efficacy of used fungicides and biopreparations against the spread and development of alternaria leaf spot was achieved by the application of the methods of A.Ye. Chumakov and et al. (1984) and

M.I. Dementyeva (1985). Statistical analysis of research results has been carried out according to B.A. Dospekhov method (1985).

RESULTS AND DISCUSSION

In condition of Tashkent region it was observed that cabbage vegetable plants got sick with alternaria leaf spot from appearance of seed-leaves to seedpot appearance.

Alternaria leaf spot started on the first leaves with small yellow spots. These leaves of plants got fully yellow and then withered. In open area fields the disease firstly occurred on the leaves of plants by brownish spots, then it turned into black spots covering seedpot surface.

Alternaria leaf spot moved gradually from down leaves to top leaves of cabbage plants. On the surface of sick leaves there were observed firstly small and then big united brown spots. Later surface of these spots were covered with black dust which contained concentric mycelium, conidia and stylospores of disease-causing fungi. These leaves became yellow and then withered. It was noted that disease infected white cabbage, cauliflower, red cabbage, Chinese cabbage, broccoli, and leaf cabbage. Kohlrabi cabbage was not infected by alternaria leaf spot.

Analysis of infested samples of cabbage plants was conducted in laboratories. Plant samples were planted in moist chamber of Petri dish, Chapeka agar nutrient medium, potato dextrose agar and ale wort agar nutrient medium Petri dishes. The Petri dishes in which the infested samples planted, were put in thermostat under 24-26°C temperature for appearance of disease-causing fungus and they were observed from the third day. The fungi grown in infected samples were planted in wort agar nutrient medium in test-tubes.

Pure culture of isolated fungi was observed by microscope and it was detected that these fungus cultures belonged to *Alternaria brassicae* (Berk.) Sacc. species when measured the size and shape.

On the farms “Yahyokhon Ziyon Nur”, “Rahmatkhujayev Toir” of Tashkent region and in the fields of vegetable growing farm “Fresh Rose” LLC the spread, development and the harm of alternaria leaf spot disease of cabbage were studied thoroughly (table-1).

Table-1
The spread and harm of alternaria leaf spot disease of cabbage vegetables on the farms of Tashkent region (in 2016-2018)

No	Farms	Physiological state of plant	Disease spread, %	Disease development, %	Mean weight of a cabbage head or a plant, kgs	Yield loss relative to healthy plant, %
1	2	3	4	5	6	7
White cabbage						
1	Yahyokhon Ziyonur	healthy	-	-	2,30	-
		sick	50,7	36,2	1,90	17,4
2	Rahmatkhujayev Toir	healthy	-	-	2,40	-
		sick	45,2	31,1	2,0	16,7
3	"Fresh Rose" LLC	healthy	-	-	2,80	-
		sick	39	25,4	2,40	14,3
Cauliflower						
1	Yahyokhon Ziyonur	healthy	-	-	1,70	-
		sick	25,8	17,7	1,55	8,8
2	Rahmatkhujayev Toir	healthy	-	-	1,80	-
		sick	21,3	15,4	1,65	8,3
3	"Fresh Rose" LLC	healthy	-	-	1,90	-
		sick	31,1	22,8	1,67	12,1
Red cabbage						
1	Yahyokhon Ziyonur	healthy	-	-	1,60	-
		sick	30,5	19,4	1,40	10,0
Chinese cabbage						
1	Yahyokhon Ziyonur	healthy	-	-	1,20	-
		sick	42,1	29,6	1,08	10,0
2	Rahmatkhujayev Toir	healthy	-	-	1,40	-
		sick	47,3	33,5	1,23	12,2
3	"Fresh Rose" LLC	healthy	-	-	1,0	-
		sick	35,8	25,2	0,9	10,0
Broccoli						
1	Rahmatkhujayev Toir	healthy	-	-	410	-
		sick	24,5	19,6	468	10,2
2	"Fresh Rose" LLC	healthy	-	-	520	-
		sick	31,2	23,0	461	11,4
Leaf cabbage						
1	Yahyokhon Ziyonur	healthy	-	-	1,85 m ²	-
		sick	24,5	16,1	1,71 m ²	7,6
2	Rahmatkhujayev Toir	healthy	-	-	2,0 m ²	-
		sick	28,2	21,4	1,79 m ²	10,5
3	"Fresh Rose" LLC	healthy	-	-	1,88 m ²	-
		sick	20,0	12,3	1,58 m ² /g	16,0

Alternaria leaf spot was noted in all cabbage plant fields of experimental control except Kohlrabi cabbage field. The highest point of alternaria leaf spot spread and development was observed in white cabbage

fields where disease spread made 39,0-50,7%, development 25,4-36,2%, while in cauliflower this indication was 21,3-31,1% and 15,4- 22,8% relatively, in red cabbage 30,5% and 19,4%, Chinese cabbage 35,8- 47,3% and

Table-2
Efficacy of fungicides on alternaria leaf spot of cabbage vegetables

No	Fungicide applied experimental variants	Fungicide use norm	Disease spread, %	Disease development, %	Biological efficiency, %
1	2	3	4	5	6
White cabbage					
1	Control (Without fungicide)	-	44,9	30,7	-
2	Bordeaux mixture (Standard)	As per copper sulfate 6 kg/ha	12,5	9,4	69,3
3	Akrobat@MS 69% WDG,	2,0 kg/ha	7,7	5,8	81,1
4	Previkur@SL 72,2% WS	1,5 l/ha	5,6	4,2	86,3
5	Proksanil@ 45% SC	2,0 l/ha	13,1	9,8	68,1
Cauliflower					
1	Control (Without fungicide)	-	32,1	25,3	-
2	Bordeaux mixture(Standard)	As per copper sulfate 6 kg/ha	9,9	7,4	70,8
3	Akrobat@MS 69% WDG,	2,0 kg/ha	6,5	4,9	80,6
4	Previkur@SL 72,2% WS	1,5 l/ha	4,8	3,6	85,8
5	Proksanil@ 45% SC	2,0 l/ha	10,3	7,7	69,6
Red cabbage					
1	Control (Without fungicide)	-	27,2	18,9	-
2	Bordeaux mixture(Standard)	As per copper sulfate 6 kg/ha	7,2	5,4	71,4
3	Akrobat@MS 69% WDG,	2,0 kg/ha	4,4	3,3	82,5
4	Previkur@SL 72,2% WS	1,5 l/ha	3,1	2,3	87,8
5	Proksanil@ 45% SC	2,0 l/ha	6,8	5,1	73
Chinese cabbage					
1	Control (Without fungicide)	-	41,7	28,5	-
2	Bordeaux mixture(Standard)	As per copper sulfate 6 kg/ha	13,3	9,2	69,6
3	Akrobat@MS 69% WDG,	2,0 kg/ha	6,7	5,1	82,1
4	Previkur@SL 72,2% WS	1,5 l/ha	5,5	4,1	85,6
5	Proksanil@ 45% SC	2,0 l/ha	12,2	9,0	68,4
Broccoli					
1	Control (Without fungicide)	-	27,9	21,3	-
2	Bordeaux mixture(Standard)	As per copper sulfate 6 kg/ha	8,3	6,2	70,8
3	Akrobat@MS 69% WDG,	2,0 kg/ha	5,2	3,9	81,6
4	Previkur@SL 72,2% WS	1,5 l/ha	3,7	2,8	86,9
5	Proksanil@ 45% SC	2,0 l/ha	7,4	5,5	74,2
Leaf cabbage					
1	Control (Without fungicide)	-	24,2	16,6	-
2	Bordeaux mixture(Standard)	As per copper sulfate 6 kg/ha	5,9	4,4	73,5
3	Akrobat@MS 69% WDG,	2,0 kg/ha	3,1	2,3	86,1
4	Previkur@SL 72,2% WS	1,5 l/ha	2,4	1,8	89,2
5	Proksanil@ 45% SC	2,0 l/ha	5,3	4,0	75,9

25,2-33,5%, broccoli 24,5-31,2% and 19,6-23,0%, leaf cabbage 20,0-28,2% and 12,3%-21,4% relatively.

Due to alternaria leaf spot the yields of all vegetables were lost. Comparing to healthy cabbage plant, it was identified that white cabbage yield

decreased to 14,3-17,4%, cauliflower 8,3-12,1%, red cabbage 10,0%, Chinese cabbage 10,0-12,2%, broccoli 10,2-16,0%.

Cabbage vegetable crops are infected by alternaria leaf spot in all stages of development [9, 14]. We noted

that cabbage plants were mostly infested by alternaria leaf spot in seed producing period in the first and even in the second years in Tashkent region condition [9]. A number of researchers investigated that application of fungicides against this disease showed effective results [6].

The impact of some fungicides, which are allowed to use in the republic of Uzbekistan, has been studied on alternaria leaf spot disease.

Vegetation experiments on the study of the impact of fungicides upon this disease were conducted on the farm "Fresh Rose" LLC in Urtachirchik district of Tashkent region. Annual cultivation of cabbage plants and yields in greenhouses and open fields of this farm led to infectious ground arrangement for disease-causing fungi. And this condition for our experiments was the needed factor to measure properly the influence of fungicides on this disease.

Each experiment variant was controlled in five repetitions and in 10 m² area. As we mentioned above there are some fungicides that are allowed to be tested in Uzbekistan conditions, but none of these fungicides have been allowed to be applied against alternaria leaf spot disease of cabbage plants in the republic of Uzbekistan. However, we tested suggested norms of fungicides against alternaria leaf spot disease of other agricultural crops. Bordeaux mixture was chosen as a standard variant.

All fungicides taken for experiment showed effective results (table-2). The highest efficacy was noticed in Previkur®SL 72,2% WS fungicide used variant. In this variant biological efficacy in leaf cabbage consisted 89,2%, in red cabbage 87,8%, in broccoli 69,9%, in white cabbage 86,3%, in cauliflower 85,8% and in Chinese cabbage 85,6%.

According to this indication Akrobat®MS 69% WDG fungicide got the second place and its biological efficacy was 86,1% in leaf cabbage, in red cabbage 82,5%, in Chinese cabbage 82,1%, in broccoli 81,6%, in white cabbage 81,1% and in cauliflower 80,6%. Proksanil 45% SC fungicide's biological efficacy made 68,1-75,9%. It nearly does not differ from Bordeaux mixture used as a standard variant (69,3-73,9%).

CONCLUSION

The reason of the difference in the spread and development of alternaria leaf spot disease of cabbage plants and its harm to yield, as for our view, can be regarded as the cultivation of various crops that are new for our republic conditions and arrangement of qualitative agrotechnical measures on the farms.

Allowed and recommended fungicides to be applied against alternaria leaf spot disease of agricultural crops in the republic of Uzbekistan gave effective results when they were applied against alternaria leaf spot disease of cabbage plants. Among them Previkur SL 72,2 % WS fungicide in 1,5 l/ha norm showed the highest indication on the application against alternaria leaf spot disease of cabbage plants and that's why it was recommended to be used against this disease.

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