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THE SPREAD AND DAMAGE OF POWDERY MILDEW DISEASE OF MULBERRY

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ABSTRACT

The spread, development and damage of mildew disease of mulberry have been studied in "Agropilla" LLCs specialized in mulberry growing in the districts and farms of Surkhandarya region, and the information has been revealed in this article about the impact of mildew disease on leaf yield and nutrition. In order to carry out the effective controlling measures against this disease, the study of disease spread, development and biological attributes of the pathogen, and on the base of this to develop disease control measures, have been revealed herein. Also it has been determined that the significant loss in the weight of mulberry leaves due to powdery mildew may affect negatively the production of silk raw material.

KEYWORDS: Mulberry, Fungus, Disease, Cutting, Powdery Mildew, Powder, Infection, Sprout, Seedling, Fungicide, Pathogenicity, Pathogen, Conidia, Spore, Mycelium.

1. INTRODUCTION

Further development of silkworm breeding in Uzbekistan is directly related to the continuous strengthening of its food base. The most important part of the mulberry tree for farm practices is the leaves, which are the only feed for silkworm. The natural climate and soil conditions of the Republic are favorable for the development of the silkworm breeding base. But in recent years, due to the fungal diseases for mulberry, not only the yield of leaf, but also its quality is decreasing. Thus, it is important to study the spread, development of diseases and biological attributes of their pathogen on mulberry, and on the base of this, to develop effective control measures against these diseases.

Powdery mildew disease is widespread in Italy, Japan, India, Indonesia, Burma, Madagascar, Mozambique, Thailand, Spain, China and the United States.[8] Scientific articles on the disease mainly cover the spread of the disease and the systemic status of its pathogen. However, there are few literary sources which reveal the biology of the pathogen, its hibernation, spread and control measures.

In Asian and African continents Phyllactina suffulta Sacc. (syn.ph.corylea) (Pers.) Karst pathogen types causes the powdery mildew disease on Morus alba, M.nigra, M.bombucis, M.stylosa mulberry species while in the USA Uncinula deniculata Gerard causes the disease on Morus rubra mulberry species, in Japan Uncinula mori Mufake causes the disease. The former fungus makes white powder on the back of the leaf while the latter two form powder on the surface of leaf.

S.Sundararaman and S.Hector stated that in 1926 and 1927[8], a strong spread of powdery mildew on mulberry was observed in Madras and Bengal provinces of India. The disease was caused by the monsoon winds. In May and December in Coonor Province, there were no any undamaged leaves of mulberry due to powdery mildew. In Bengal, the disease developed rapidly because of warm rainfall fog.

In 1924-1940, N.G.Zaprometov[8] determined on the damaged mulberry leaves collected from Tashkent, Fergana, Khujand regions of Central Asia and South Kirghizistan that the fungus pathogen Phyllaetinia suffulta Sacc. f moricola Gacz. had caused powdery mildew.

Only in August of 1920 Uncinula mori Miyake was discovered on the leaves infected with powdery mildew in Margilan district. However, this type of fungus was not identified in subsequent studies in Central Asia. Phyllaetinia suffulta Sacc. f moricola Gacz. fungus type was informed to cause powdery mildew on mulberry trees in Afghanistan and Iran.

The effects of temperature and humidity on mulberry mildew have been studied.[6] Studies have shown that the relative humidity of the air and the availability of the required temperature are the most important factors in the development of mildew disease.

In India, I. Illahi, V. Mittal, G.K. Ramegowda, A. Dhar, and M.A.Khan[5] investigated the spread of cercospora and mildew diseases in Kashmir valley. These investigations were conducted in five varieties of mulberry in 2006, 2007 and 2008 from July to October. The mildew was observed in DI and PDI varieties in August, and their index constituted 3,47% and 1,04%, respectively. By October, this index was 5,71% and 2,15%. The lowest index of mildew disease was recorded in Baramulda variety (5,4%), the highest in Goshoerah and Pampor varieties (41,57%). The disease index was found to be 18,47% (Baramulda) and 29,35% (Pampor), regardless of the variety of mulberry. And regardless of the region, the spread index of mulberry mildew was 9,71% for KNG variety and 35,39% for Tr-10, and it was reported in all regions of the study. The disease spread in mulberry was 9,12% and 2,66% for Mirgun variety, respectively 18,58% and 5,14% for the Pampor variety. The disease was observed in August, in the Pampor variety and later in Manasbal, with the highest spread index. The spots rate on infected leaves varied from 16,2% (in Srinagar) to 23,4% (in Kwazigun). Due to mildew disease caused by Phyllactinia corylea on mulberry, it was investigated that the leaf surface fully covered with spots and powder, and the loss of leaf yield made 50%. In autumn the infection of TR-10, S-1, S-146, S-13, S-1635, AR-12, AR-14, BR-2 varieties with powdery mildew was studied.[7]

N.D. Aghayeva, V.L. Abasova, S.Takamatsu[1] conducted investigation on the fungal mildew diseases caused by fungi belonging to Phyllactiniurum group in Azerbaijan. This fungus causes disease in 32 species of plants belonging to 11 families. In mulberry plants also this fungi species causes mildew disease.

Therefore, in Surkhandarya region where cocoon production is one of the highest in the country, the study of this problem is one of the crucial issues of sericulture sector.

2. MATERIALS AND METHODS

The research on fungal diseases of mulberry was carried out in mulberry plantations belonging to “Agropilla” LLC and in special feed-supplying mulberry plantations in districts of Surkhandarya region. Laboratory experiments were conducted in the laboratories of the Termez, Surkhandarya branch of the Tashkent state agrarian university. The investigations were performed to identify the spread, development and damage of fungal diseases of mulberry in Surkhandarya region, as well as to develop control measures by analyzing the biological attributes of their pathogen.

A number of methods have been used in the study of mulberry mildew disease. The spread and development of mulberry diseases was determined by the methods of M.I. Dementeva[4], A.E. Chumakov, T.I. Zakharova[3], and disease damage was studied by the methods of A.E. Chumakov and T.I. Zakharova.[3]

10 trees of each variety were observed in 50 ha mulberry plantation area for recording mildew disease and detection of its damage level. If there were less than 50 trees of a particular variety, all of the trees were examined.

A total of 100 leaf samples were obtained from four sides of 25 trees of the same height without selection that were under the record of disease. Infection rate and disease development were determined using the methods described above.

Four branches were selected from 4 sides of the tree and 25 leaves on each branch were observed for infection.

In order to identify the hibernation of powdery mildew causing fungus, after the fall of leaves in late autumn or in early spring before bud shoots, the damage level on the branches was determined by using the following scale:

0 – Healthy shoots;
1 – The tip of shoot slightly damaged;
2 – ¼ part of shoot is covered with fungus mycelium;
3 – Half of shoot is covered with fungus mycelium and spore;
4 – Shoot became stunted, with died top, fully covered with fungus mycelium.[2]

To determine the damage of the mildew, we measured the difference between the length of 10 infected shoots (branches) of each variety and 10 shoots of healthy trees of these varieties.
The following scale was used to determine the degree of damage of mildew disease on mulberry leaves:
1 point Leaf plate has several spots;
2 points Leaf plate has mixed spots, the surface of the leaf is covered with 50% powder;
3 points Leaf surface is completely covered with spots and powder.

3. RESULTS AND DISCUSSION

When the spread and development of powdery mildew on mulberry were studied in mulberry plantation in the districts of Surkhandarya region in 2015-2019, the highest rate of spread and development of disease were observed in Jarkurgan (57,7-51,4% and 30,8-28,8%), Angor (50,4-44,1% and 24,7-22,7%), Shurchi (49,3-44,6% and 28,6-26,6%), Termez (48,7-42,4% and 26,9-24,9%), Kumkurgan (45,9-39,6% and 23,7-21,7%), Sherobod (44,6-38,3% and 22,0-20,1%) districts, a bit less rate was noted in Uzun (22,9-19,0% and 7,4-6,2%) district (table 1). This difference on the spread of disease

among the places can be explained by different ages, particularly, old-aged plantations available in larger areas of these districts than in others (Jarkurgan 581,1 ha and Angor 292 ha) and in the result of this, high infectious pressure can be a reason for aforementioned high rate.

Powdery mildew disease is one of the diseases that has a significant negative effect on the growth and development of mulberry. Therefore, to investigate the influence of this disease on the growth of mulberry sprouts and seedlings, the studies were conducted on the farms in the districts (Angor, Denov, Jarkurgan, Sherobod, Shurchi, Kizirik, Kumkurgan) of Surkhandarya region, which provide with mulberry seedlings. In the years of observation, powdery mildew disease was not noted in germinated sprouts from seeds and seedlings of mulberry aged 1–2 years (Table 2). In the seedlings grown from the cuttings, the spread of powdery mildew disease was found to be 4,3-6,9%, and its development was 1,1-2,4%, these indications were 2,9-3,6% and 0,9-1,1% respectively in grafted seedlings. %. The main reason for this is the fact that the pathogen fungus of powdery mildew mostly develops in old cells of the leaf, the more is the age of mulberry tree, the more pathogen infects the plant due to the reduced plant resistance to hormones in the tissue cells.

Table 1: Spread and development of powdery mildew in mulberry plantation, %.

№	Districts of Surkhandarya region	2017			2018			2019		
		Spread of disease, %	Development of disease, %	Disease index, %	Spread of disease, %	Development of disease, %	Disease index, %	Spread of disease, %	Development of disease, %	Disease index, %
1	Angor	50,4	24,7	12,4	46,3	23,4	10,8	44,1	22,7	10,0
2	Boysun	30,2	13,5	4,1	27,7	12,6	3,5	26,3	12,1	3,2
3	Denov	31,9	11,3	3,6	29,4	10,4	3,1	28,0	9,9	2,8
4	Jarkurgan	57,7	30,8	17,8	53,6	29,5	15,8	51,4	28,8	14,8
5	Muzrabod	36,0	16,2	5,8	33,5	15,3	5,1	32,1	14,8	4,8
6	Oltinsoy	34,7	14,5	5,0	32,2	13,6	4,4	30,8	13,1	4,0
7	Termez	48,7	26,9	13,1	44,8	25,6	11,4	42,4	24,9	10,6
8	Uzun	22,9	7,4	1,7	20,4	6,5	1,3	19,0	6,2	1,1
9	Sherobod	44,6	22,0	9,8	40,5	20,7	8,4	38,3	20,1	7,7
10	Shurchi	49,3	28,6	14,1	46,8	27,3	12,8	44,6	26,6	11,9
11	Kizirik	40,3	19,1	7,7	36,2	18,2	6,6	34,8	17,7	6,2
12	Kumkurgtan	45,9	23,7	10,9	41,8	22,4	9,4	39,6	21,7	8,6
Average:		41,0	19,9	8,8	37,8	18,8	7,7	36,0	18,2	7,1

Table 2: The spread and development of powdery mildew in seedling nurseries, %.

№	Districts of Surkhandarya region	Sprouts germinated from the seeds			1-2 year old seedlings germinated from the seeds			Seedlings grown from cuttings			Grafted seedlings		
		Spread of disease, %	Development of disease, %	Disease index, %	Spread of disease, %	Development of disease, %	Disease index, %	Spread of disease, %	Development of disease, %	Disease index, %	Spread of disease, %	Development of disease, %	Disease index, %
1	Angor	-	-	-	-	-	-	6,3	2,1	0,1	3,1	1,0	0,03
2	Denov	-	-	-	-	-	-	4,3	1,1	0,05	-	-	-
3	Jarkurgan	-	-	-	-	-	-	6,9	2,4	0,2	3,6	1,1	0,04
4	Sherobod	-	-	-	-	-	-	4,9	1,5	0,07	-	-	-
5	Shurchi	-	-	-	-	-	-	5,6	1,9	0,1	3,0	0,9	0,03
6	Kizirik	-	-	-	-	-	-	4,7	1,0	0,06	-	-	-
7	Kumkurgan	-	-	-	-	-	-	5,1	1,7	0,09	2,9	0,9	0,03

In order to define whether this view is true or false, powdery mildew appearance was studied in different aged mulberry plantations.

Analysis and obtained data revealed that the spread and development of powdery mildew disease in mulberry tree plantations of Surkhandarya region increased with

the increase of age. The spread and development of powdery mildew disease was noted to be 23,1–35,2% and 5,5-12,3% in mulberry trees aged 5–10 years while in 10–25 years old trees these figures were 26,8–44,2% and 8,1–16,9% relatively, as well as, in mulberry trees over the age of 25 years they constituted 28,5–43,1% and 9,9–21,6%, respectively (Table 3).

Table 3: The spread and development of powdery mildew in mulberry plantations, %.

№	Districts of Surkhandarya region	Mulberry plantations aged 5-10 years			Mulberry plantations aged 10-25 years			Mulberry plantations aged over 25 years		
		disease			disease			disease		
		spread, %	development, %	index, %	spread, %	development, %	index, %	spread, %	development, %	index, %
1	Angor	35,1	11,8	4,1	43,0	16,5	7,1	42,0	20,9	8,8
2	Boysun	26,0	8,1	2,1	4,5	10,2	3,5	34,9	12,3	4,3
3	Denov	24,1	6,3	1,5	27,5	9,4	2,6	30,8	10,7	3,3
4	Jarkurgan	35,2	12,3	4,3	44,2	16,9	7,5	43,1	21,6	9,3
5	Muzrabod	26,3	9,6	2,5	35,6	12,7	4,5	37,9	14,8	5,6
6	Oltinsoy	25,4	7,1	1,8	28,9	10,8	3,1	32,9	11,8	3,9
7	Termez	31,8	11,0	3,6	41,2	15,1	6,2	40,9	18,6	7,6
8	Uzun	23,1	5,5	1,3	26,8	8,1	2,2	28,5	9,9	2,8
9	Sheobod	29,5	9,7	2,9	38,1	13,4	5,1	38,9	16,1	6,3
10	Shurchi	32,6	11,7	3,8	42,4	15,6	6,6	41,4	19,8	8,2
11	Kizirik	27,5	9,7	2,7	36,0	12,7	4,6	38,2	14,9	5,7
12	Kumkurgan	29,5	10,1	3,0	39,3	13,5	5,3	39,8	16,9	6,7

Table 4: The influence of powdery mildew on the yield of leaves of mulberry.

№	Districts of Surkhandarya region	Mulberry plantations aged 5-10 years			Mulberry plantations aged 10-25 years			Mulberry plantations aged over 25 years		
		Yield of healthy mulberry leaves, g	diseased		Yield of healthy mulberry leaves, g	diseased		Yield of healthy mulberry leaves, g	diseased	
			Yield of mulberry leaves, g	Yield loss relative to healthy leaves, %		Yield of mulberry leaves, g	Yield loss relative to healthy leaves, %		Yield of mulberry leaves, g	Yield loss relative to healthy leaves, %
1	Angor	138,5	115,4	16,7	136,1	112,8	17,1	134,8	109,2	18,5
2	Boysun	123,5	108,6	15,5	127,1	106,6	16,1	125,7	104,0	17,3
3	Denov	124,8	106,0	15,1	122,3	103,1	15,7	121,0	100,6	16,9
4	Jarkurgan	140,0	116,5	16,8	137,8	114,1	17,2	135,9	110,6	18,6
5	Muzrabod	130,4	110,1	15,6	128,5	107,6	16,3	126,3	104,2	17,5
6	Oltinsoy	126,7	107,3	15,3	125,0	105,1	15,9	123,9	102,7	17,1
7	Termez	135,4	113,2	16,4	134,1	111,4	16,9	131,9	107,8	18,3
8	Uzun	122,3	104,1	14,9	120,9	102,2	15,5	119,1	99,2	16,7
9	Sherobod	133,7	112,0	16,2	131,2	109,3	16,7	128,8	105,7	17,9
10	Shurchi	136,9	114,2	16,6	135,1	112,1	17,0	133,4	108,9	18,4
11	Kizirik	132,4	111,5	15,8	131,3	109,6	16,5	128,0	105,4	17,7
12	Kumkurgan	134,3	112,9	16,0	133,0	110,7	16,8	129,8	106,3	18,1

The influence of powdery mildew on the yield of mulberry leaves that are basic feed for silkworm was also studied in mulberry plantations in the districts of Surkhandarya region. It was determined that leaf yield of the mulberry tree was significantly lost because of this disease.

According to the results of the studies, it was determined that the loss of leaf biomass by 14,9-18,6% was due to the powdery mildew disease. This definitely means that a significant loss of mulberry leaf weight due to powdery mildew may also have an adverse effect on the production of silk raw materials.

4. CONCLUSIONS

It has been established that the spread and development of powdery mildew disease in mulberry trees of Surkhandarya region increases with age.

The spread and development rate of powdery mildew were noted as 23,1-35,2% and 5,5-12,3% in 5-10 years old mulberry trees, as for 10-25 years aged trees these indications were 26,8-44,2% and 8,1-16,9%, and in the trees aged over 25 years the index was 28,5-43,1% and 9,9-21,6% respectively.

Due to powdery mildew the loss of leaf yield constituted 14,9-16,8% in the mulberry plantations aged 5-10 years, in 10-25 years old plantations 15,5-17,2%, while in the mulberry tree plantations aged over 25 years the indication was noted to be 16,7-18,6 %.

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