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INCIDENCE AND YIELD LOSS OF LEAFSPOT DISEASE OF STRAWBERRY IN TASHKENT REGION

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ABSTRACT

The article presents the data on prevalence and development of leafspot (white spot) disease of strawberry in the farms of Tashkent region. The influence of the age of the strawberry plantation on the accumulation of infection of the pathogen has been revealed herein. It has been also noted that strawberry has the highest incidence of leafspot disease during the vegetation period.

KEY WORDS: *leafspot, fungus, infection, conidium, varieties, incubation period, tissue, pure culture, nutrient media, pathogen, saprophyte.*

INTRODUCTION

The common fungal diseases of strawberry have been thoroughly studied by a number of scientists around the world (Natalina 1963; Plakidas, 1964; Govorova, 1990, 2004,2015; Seemuller, Schmidle, 1979; Seemuller, 1984; Ellis, 1996; Govorova, Govorov, 2010).

Strawberry leafspot disease or white spot is a common, widely known and damaging disease. This disease is spread in Poland, Belarus, Ukraine, USA, Canada, Germany, India (Govorova, Govorov, 2010). This disease was identified in Russia for the first time by A.A. Yachevsky in grey soil areas and central parts of the country (Govorov, 2011). After that, this disease was studied in Russia by A.P. Sokolov (1934), V.V. Kotova (1958), G. F. Govorova, D. N. Govorov (2010). In 1961-1066, G.F. Govorova studied this disease in Krasnodar region. As a result of this researcher's study, it was found that leafspot caused great damage to strawberry plants in Maikon, Labinsk, and Sochi regions of Krasnodar territory, which are high humidity areas, and in some years it is observed that it reached the level of epiphytosis. In 1961, the disease reached the level of epiphytosis in the areas where disease-resistant Yuzhanka, Adgumskaya, and Lyubimitsa varieties of strawberries were planted, but no any commercial product was obtained from these varieties. But that year, an average yield of 14,3 tons of yield per hectare was obtained from “Chernobrivka” variety, which is resistant to leafspot. Disease development in this variety was equal to 29,0% this year. In the regions of Crimea with relatively dry and high temperature, the damage of the disease was less (Govorova, 1965,1966). The classification of the causative agent of disease was first given by Tyulan in 1863, who included this fungus in the genus Stigmated in the sac formation period and in Cylindrosporium genus in the period of conidia formation. During the study of this fungus, mycologists included it in different systematic groups and changed its name. Currently, the conidia formation period of this fungus is called Ramularia tulasnei Sacc. (named by Saccardo in 1880), sac formation period is called Mycosphaerella fragriae (Tul.) Lind (named by Lindau in the 19th century) (Govorova, 1966).

The period of conidia formation of the pathogenic fungus is called Ramularia tulasnei Sacc. which includes in hyphamycetes order. The fungus produces colorless mycelia and conidia band up to 30 µm long. They are unbranched, have no transverse septas, are 3-4 µm wide, come together and protrude from the leaf tops, sometimes they can break the leaf cuticle. Conidia form colorless cylindrical one-celled, sometimes 2-3-celled conidia in conidia bands, 15-45 × 2,5-4,5µm in size (Govorova, Govorov, 2004). Conidia are spread around by wind, insects, raindrops, then penetrate into the stomata or epidermis of strawberry leaves and damage it.

Z.I. Kolesnik (1969) observed and studied strawberry leafspot disease in the fields occupied by strawberries in the Tashkent region, also in the fields where 77 different strawberry varieties were planted in Research Institute of Horticulture, Viticulture and Winemaking named after R.R.Shreder and conducted vegetative experiments on testing chemical preparations

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against the disease at the experimental plot of Plant Protection Research Institute.

In the course of research, it was observed that the prevalence of strawberry leafspot disease in the conditions of Tashkent region was 8,3-29,8%, depending on the resistance of varieties. It has been determined that the disease occurs in spring due to conidia formed in sclerotia and mycelia. Development of leafspot disease has been reported to depend on rainfall. The development of leafspot is observed starting from March, reaching its maximum level by May, when strawberry fruits ripen. It has been found that the disease-causing fungus persists in surface of the leaves on the plant and leaves fallen on the soil surface.

In the conditions of the Republic of Georgia, R. G. Geladze (1970) identified 19 diseases caused by fungi in strawberries, and among them it was found that the most common and the most damaging is the leafspot disease. It is noted that R. tulasnei fungus, which causes strawberry leafspot, grows very slowly, and for its development the favourable temperature is 3-31°C, pH environment is 6,1-7,2. Fungal conidia have been found to germinate in dripping water and at 100% relative humidity. Conidia were observed to grow at 85-90% air humidity, but stopped growing at 80% humidity.

It is noted that the incubation period of the disease-causing fungus is 9 days when it penetrates into the tissue through mechanical cracks, and 11-13 days when there are no cracks on the plant.

MATERIALS AND METHODS

Record keeping on strawberry leafspot disease was carried out during flowering and fruiting stages. The following scale was used for this:

0 score – healthy leaves;

1 score – weakly damaged leaves with around 10 small spots;

2 scores – medium damaged leaves, with spots covered 25% of the surface and fungal spores on the surface of spots are clearly visible;

3 scores – strongly damaged leaves with larger spots covering 25-50% of the surface, many spores were formed on the surface of the spot;

4 scores – very strongly damaged leaves with large spots covering more than 50% of the leaf surface, formed many spores, the leaves began to dry (Govorova, Govorov, 2010).

One of the most widely used methods – the moisture chamber method was used to isolate pure cultures of strawberry disease-causing fungi. Filter paper was placed on the bottom of Petri dishes to form a moisture chamber and the dishes wrapped with paper, then were sterilized in an autoclave at 1 atm pressure and at 121°C temperature for 30 minutes. After taking from the autoclav, Petri dishes were cooled up to 30-25°C, the filter papers were wetted with sterile water in a laminar box.

Infected samples of strawberry were planted in these Petri dishes. For this purpose, the samples of strawberry plant were washed thoroughly in running water one by one and then water was poured over them for 15-20 minutes before conducting laboratory tests. Each of these samples was cut by 5-8 mm, then to clean them from strange microorganisms they were sterilized by immersing in 0.5% sodium hypochlorite (NaOCl) solution for 30 minutes and thoroughly washed 2-3 times in sterile water before planting them in Petri dishes in a laminar box. Following to the rules of sterilization, they were placed in Petri dishes by 5-10 pieces.

To facilitate microscopic observation of the samples, the cut pieces were placed at least 1 cm from the edge of the Petri dishes and evenly spaced without touching each other. When cutting the samples into pieces, it was noted that there was a little more healthy tissue than the damaged part.

In order to facilitate the pure isolation of pathogenic fungi that cause disease in strawberries and to prevent samples from being a focus of saprophytic fungi, Petri dishes planted with diseased samples were placed in thermostats with a temperature of 18-20°C. At this temperature, it took 8-12 days for the fungi to grow.

Fungi grown in samples in Petri dishes were planted in laminar boxes in test tubes filled with agar wort and agar potato broth media, and these test tubes were placed in a thermostat with a temperature of 24-26°C for fungal growth and development. After the fungi were fully grown and germinated, they were observed under a microscope and the required dimensions were recorded and their types was determined using specifiers.R

RESULTS AND DISCUSSION

As mentioned above, leafspot is considered one of the common diseases of strawberries, and it was found that this disease affects leaves, leaf stems, stolons, pedicel, calyx, flowers and fruits of strawberry in Tashkent region. On the surface of damaged strawberry leaves, round spots with a diameter of 0,8 - 6 mm and elongated and irregular spots formed around leaf veins with a length of up to 10 mm were found.

On young leaves of the plant, appeared brown spots without a border whereas on old leaves appeared spots with a reddish border, and whitish center. First, brown spots appeared on the leaf stems too, and then appeared there elongated spots with a whitish center. Dark brown spots with an unclear shape were observed on the leaf stem and petals.

It was noted that the seeds in the affected strawberry fruits turned dark and sunk into the fruit, and dark brown spots appeared around this part.

In the conditions of the Tashkent region, it was found that the leafspot disease of strawberry develops during the entire growing season, and its maximum development occurred in March-May. While the disease progressed during the flowering period, its development reached its maximum level during the fruit ripening

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period. The peak of the disease in this period can be caused by the favorable temperature for the development of the disease-causing fungus, sufficient rainfall, and high humidity due to strawberry watering.

At the end of the harvest period, the number of diseased leaves decreased, which was caused by the drying of old leaves during the yield formation. After the strawberry yield was completely harvested, it was observed that from June the young leaves began to grow rapidly. During this period, the increase in temperature and decrease in air humidity caused the disease to decrease by 8,1-38,7%. By September, the decrease in temperature and increase in air humidity stimulated the development of leafspot disease again, and its development continued until late autumn.

In 2017-2019 during the study of leafspot disease in strawberry fields of the farms of Tashkent region, the most common incidence of the disease was observed in "Sharofboy Nurov" farm. In this farm the prevalence of the disease was 18,6-38,1 %, its development 7,0-26,3% (see table-1). The least incidence of the disease was noted in "Rikhsiboyobod" farm, where disease prevalence made 10,3-26,7% and development was 3,7-15,4%.

Table 1
The Incidence of Leafspot in Strawberry

Farms	In 2017			In 2018			In 2019		
	Leafspot								
	Disease incidence, %	Disease severity, %	Disease index, %	Disease incidence, %	Disease severity, %	Disease index, %	Disease incidence, %	Disease severity, %	Disease index, %
"Rikhsiboyobod"	26,7	15,4	4,1	10,3	3,7	0,4	20,3	8,7	1,8
"TURDIBOEV KURBONBOY"	30,2	19,1	5.8	12,5	4,9	0,6	23,9	10,5	2,5
"Sharofboy Nurov"	38,1	26,3	10,0	18,6	7,0	1,3	28,6	13,0	3,7
IAC SUE at TashSAU	32,5	21,7	7,1	17,4	5,8	1,0	25,4	11,8	3,0

Table 2
The Impact of Leafspot On Strawberry Yield

Farms	Physiological condition of strawberry	Disease			Strawberry yield, c/ha	Yield loss relative to healthy plant	
		Disease incidence, %	Disease severity, %	Disease index, %		ц/га	%
"Rikhsiboyobod"	healthy				37,4		
	infected	19,1	8,7	1,7	35,8	1,6	4,2
"TURDIBOEV KURBONBOY"	healthy				35,1		
	infected	21,2	9,5	2,0	33,0	2,1	6,0
"Sharofboy Nurov"	healthy				36,8		
	infected	27,4	15,0	4,1	32,6	4,2	11,4
IAC SUE at TashSAU	healthy				38,5		
	infected	23,5	13,1	3,1	35,1	3,4	9,1

When leafspot prevalence and development was analyzed, under favorable condition in 2017, i.e optimal temperature and air humidity for the development of disease-causing fungi, disease prevalence was 26,7-38,1% while development was 15,4-26,3%, but in 2018 when there was unfavorable condition for disease-causing fungus these indicators were 10,3-18,6% and 3,7-7,0% relatively.

The observation of such a difference in the spread and development of leafspot disease led to the conclusion

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that it depends on the variety of strawberry planted here, the years of cultivation and the amount of precipitation.

The most yield loss due to leafspot was observed in "Sharofboy Nurov" farm where this disease was spread mostly. Yield loss index relative to healthy plants in this farm was 11,4%, i.e 4,2 c yield per hectare was lost (see table-2). The least index of yield loss was noted in "Rikhsiboyobod" farm, where this indicator was 4,2%, i.e 1,6 c yield per hectare was lost. Such a difference between farms in strawberry yield loss may depend on the agrotechnical measures implemented and the strawberry varieties as well.

It was found that the infection of the disease increases with the age of the strawberry plantation. The highest incidence of the disease was observed in plants left in the third year. In a three-year-old strawberry field, it was observed that up to 50 spots appeared on one leaf affected by the disease, and up to 20 spots appeared on a leaf in two- and one-year-old fields. Its most frequent occurrence during the growth period was observed in the fruit ripening period and during the emergence of new leaves in autumn. Disease incidence of 3,2-10,5% was observed in strawberry planted fields in the first year while in the second year this indicator was 5,5-19,8% and in the third year 12,3-27,1%. The same situation was observed in the development of the disease, and this indicator was noted as 0,2-4,1%, 5,5-19,8% and 3,8-11,6%, respectively (see table- 3).

Table 3
Development dynamics of leafspot disease of strawberry

Development phases of the plant	Strawberry field								
	The 1st year			The 2nd year			The 3rd year		
	Leafspot disease								
	Disease incidence, %	Disease severity, %	Disease index, %	Disease incidence, %	Disease severity, %	Disease index, %	Disease incidence, %	Disease severity, %	Disease index, %
Flower-bud formation period	3,2	0,2	0,006	5,5	1,3	0,07	12,3	3,8	0,5
Flowering and fruit formation period	5,9	2,8	0,2	11,3	4,4	0,5	18,2	8,4	1,5
Fruit ripening period	10,5	4,1	0,4	19,8	8,2	1,6	27,1	11,6	11,5
Fully harvested period and period of rapid formation of new leaves	5,7	0,9	0,05	10,4	3,8	0,4	20,6	8,7	1,8
Period of rapid formation of stolons of plant	4,3	0,3	0,01	7,7	2,0	0,2	16,5	7,1	1,2
Period of bud formation and slow formation of leaves	6,2	2,7	0,2	12,2	4,3	0,5	21,8	9.4	2,0
Period of rapid formation of new leaves	7,8	3,4	0,3	14,8	6,4	0,9	23,1	10,0	2,3

CONCLUSION

In the conditions of the Tashkent region, it was observed that all above-ground parts of strawberry were affected by leafspot disease. It was found that the development of leafspot disease depends on the strawberry variety, the years of cultivation and the amount of precipitation. 4,2-11,2% yield loss due to the disease was recorded.

Strawberry leafspot disease was noted in all strawberry cultivating farms of Tashkent region.

It was observed that all above-ground parts of strawberry plant were infected by leafspot disease.

It was found that the spread of strawberry white spot disease depends on strawberry variety, the years of strawberry cultivation and the amount of precipitation.

It was found that the infection of the disease-causing fungus increased with the age of the strawberry plantation. The highest incidence of the disease was observed in plants left in the third year.

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