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CHERRY SCAB IN THE CONDITIONS OF THE GANJA-KAZAKH GEOGRAPHICAL ZONE OF AZERBAIJAN

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Abstract

Scab is one of the most common and harmful diseases of cherries, found in all western regions (Ganja-Kazakh geographical zone of the country) of its cultivation. Mass damage to cherries by scab is often observed in wet years. The disease manifests itself on leaves and fruits causing a great harm to fruit-bearing cherry plantations. The harmfulness of cherry scab is expressed by a decrease in yield and a deterioration in its quality. The direct crop losses from scab on heavily affected cherry cultivars (for example, the cultivar "Shedraya") can reach 60-80%; the decrease in the yield of the first-class products is 90%. In the cherry orchards of Azerbaijan, the shortage of products from scab reaches 50-70%, and in the years of epiphytoties, the harvest may be completely absent.

In the affected leaves, photosynthesis decreases, they fall prematurely. The sick fruits are delayed in development, wrinkled, which reduces the yield and degrades the quality of products.

The article presents the results of the field research carried out on cherry scab (*Fusicladium cerasi* (Rabenh.) Sacc.) in the conditions of the western part of Azerbaijan in 2021-2022. In 2022, an assessment of the prevalence and intensity of scab in the region was done, and a scientifically based and improved control system was developed. For this purpose, the following preparations were tested in the fight against scab on cherries: Abiga Peak, VS (400 g/l copper oxychloride), Score, EC (250 g/l difenoconazole), Hom, SP (861 g/kg copper oxychloride), Chorus, FDG (750 g/kg cyprodinil) and a control without chemical treatment.

Keywords: cherry, scab, fungus, susceptibility, fungicides

INTRODUCTION

The ecological conditions in the Ganja-Kazakh geographical zone with a long (March-November) warm growing season are favorable for the cultivation of cherry culture (*Cerasus* Juss.) (Fig. 1-2). In amateur and industrial gardening of the country, cherry (*Cerasus* Juss.) occupies a leading place, in terms of area, second only to the apple tree (*Malus* Mill.) and pomegranate (*Punica* L.), and among the stone fruits - the first culture. Among stone fruits, cherries (*Cerasus* Juss.) are the most early-growing, early-ripening and productive crops. An important role in the cultivation of cherry culture (*Cerasus* Juss.) in the western part of Azerbaijan is played by early terms (May 15-30) of fruit ripening, which do not coincide with the busy harvesting period of other agricultural crops.

Obtaining high yields of cherries is limited to a large extent by diseases. Due to the change in the agro-climatic situation, the deviation from the average long-term values of a number of weather factors of the winter-spring period, which weaken fruit trees, there is a tendency to reduce their productivity and increase the harmfulness of diseases.

Fig. 1. Cherry tree in the phase of fruiting

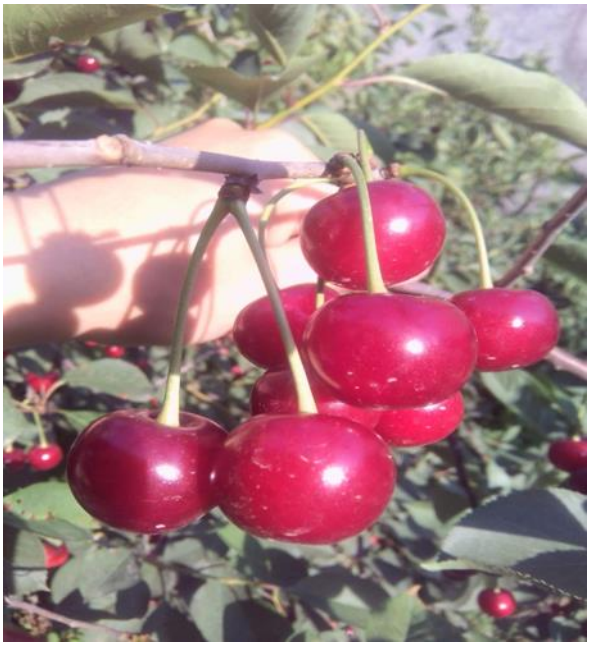

Fig. 2. Cherry cultivar "Shedraya"

As already noted, cherry (*Cerasus* Juss.) is affected by many fungal (mycoses), bacterial (bacterioses), phytoplasmic (phytoplasmoses), viral (viroses), viroid and non-infectious diseases. Among the most common diseases in the western part of the republic are: scab (*Fusicladium cerasi* (Rabenh.) Sacc.), coccomycosis (*Coccomyces hiemalis* Higgins.), powdery mildew (*Podosphaera tridactyla* DB. i. *cerasi* Jacz.), gray fruit rot or moniliosis (*Monilia cinerea* Bonord.), perforated spotting or clasterosporiasis (*Clasterosporium carpophilum* Adehr.), fusarium desiccation (fungi of the genus *Fusarium*, most often *Fusarium bulbigenum* Cke. et Mass.), cytosporosis desiccation (fungi of the genus *Cytospora*: *Cytospora leucostoma* Sacc. ; *Cytospora rubescens* Fr.: *Cytospora cincta* Fr.), etc. (Guliyev, Huseynova, 2021).

Scab is one of the most harmful diseases on cherry (*Cerasus* Juss.), as it not only drastically reduces the fruit yield, but also leads to a complete loss of tree productivity. Scab is a local lesion of the integumentary tissues of bulk plant organs in the form of scabs on their surface. It can be infectious and less often non-infectious.

In Azerbaijan, cherry scab (*Fusicladium cerasi* (Rabenh.) Sacc.) was first discovered by L.A. Huseynova in 2020.

As already noted, scab is the most common and harmful disease of cherries (*Cerasus* Juss.), especially in years with heavy summer rainfall and moderate temperatures. Scab (*Fusicladium cerasi* (Rabenh.) Sacc.) affects mainly the leaves and fruits of the cherry (*Cerasus* Juss.). The number of spots and their size both on the leaves and on the fruits depends on the variety, weather conditions and the age of the affected organ. When young fruits are infected, they become ugly and grow poorly. Scab (*Fusicladium cerasi* (Rabenh.) Sacc.) reduces the yield and the quality of fruits as a consequence of a decrease in the assimilation surface of the leaves, a sharp increase in transpiration, their premature fall, deterioration in fruit filling and a decrease in their sugar content, and the appearance of fruit ugliness. A severe damage caused by scab (*Fusicladium cerasi* (Rabenh.) Sacc.) leads to a decrease in growth, underdevelopment of kidneys, and a decrease in winter hardiness.

Small round spots (up to 0.3 cm in diameter) form on the leaves, often merging

with each other (Fig. 3). The spots are brownish-brown or dark olive in color, covered with a slightly velvety coating of conidial sporulation of the fungus (Fig. 4). On the fruits, the spots are dark brown, depressed, covered with the same velvety coating, often with small cracks. The affected fruits, underdeveloped, wrinkle and dry out.

The disease is mostly pronounced on the fruits of cherries during their ripening. At first, small light pink spots appear on the fruits, which after a while become covered with dark irregularly shaped pitted ulcers.

(Fig. 5-6). Scab-infested (*Fusicladium cerasi* (Rabenh.) Sacc.) cherries dry out and fall off.

Fig. 3. Small round scab spots

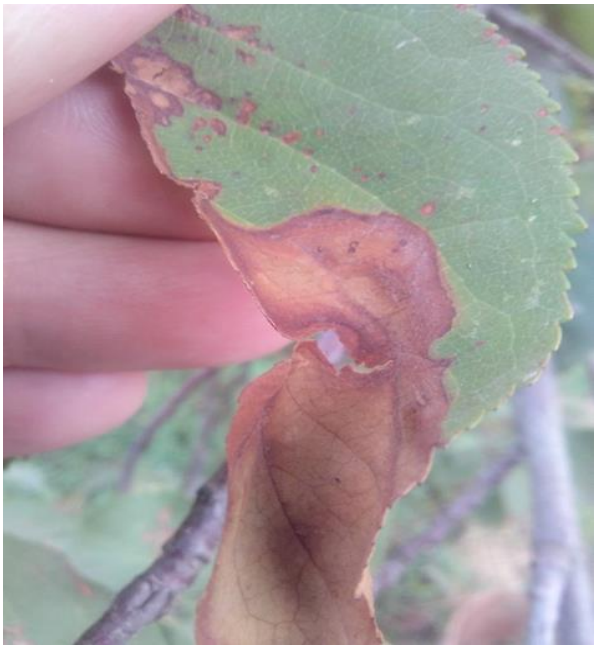

Fig. 4. Expanding and merging scab spots

Fig. 5. Light pink spots on the fruit

Fig. 6. Dark irregularly shaped pitted ulcer

The development of cherry scab is facilitated by the wet, rainy and windy weather. It is at this time that the spores of the fungus *Fusicladium cerasi* (Rabenh.) Sacc., which cause cherry scab, spread over long distances and thus infect cherry trees. As already noted, the cherry scab appears and develops most actively at high humidity or soil. Favorable conditions for the development of the cherry scab are as follows:

- Air temperature $+23^0$C;
- Air humidity 87-88%;
- Lack of phosphorus and potassium in the soil;
- High content of acid in the soil.

The spores of the fungus are quickly transmitted over long distances by wind (anemchoria), as well as by insects (entomochoria), through raindrops, dew, and through irrigation moisture (hydrochoria).

MATERIALS AND METHODS

The studies were carried out in 2021-2022 on the industrial cherry plantations in the conditions of the western part (Ganja-Kazakh geographical zone) of Azerbaijan. The prevalence and intensity of development of scab were studied on two cultivars of sour cherries ("Shedraya" and "Anadolu"). The intensity of damage caused to cherry leaves by scab was assessed on the following scale:

0 point - no infection;

1 point - from 1 to 10% of the leaf surface is affected;

2 points - from 11 to 25% of the leaf surface is affected;

3 points - from 25 to 50% of the leaf surface is affected;

4 points - more than 50% of the leaf surface is affected.

The field experiments were laid in 4-fold repetition. The treatment of the cherry orchards with fungicides was carried out during the growing season: firstly, when the first signs of the disease appeared, followed by an interval of 7-10 days (Beloshapkina, 2017).

The prevalence (P, %) was determined after counting the affected and healthy plants in the sample using the formula:

$$P=100n/N,$$

where n is the number of affected plants in the sample; N is the total number of examined plants.

The development of the disease (R, %) was determined by the following formula:

$$R=(100\sum(ab))/Nk$$

where *a* is the number of affected plants; *b* - the corresponding score of their defeat; *N* is the total number of registered plants (sick and healthy); *k* is the highest score in the accounting scale.

The dynamics of development was determined by the weather characteristics of the growing season. After rainfall, the prevalence of the cherry scab had increased.

Biological efficiency (BE), expressed as a percentage, was calculated using the formula [7,8]:

$$BE=(Mk-Mo)/Mkx100,$$

where Mk is an indicator of the development of the disease in control (protective measures were not taken); Mo is an indicator of the development of the disease in the experiment (with protective measures).

These cultivars have also been used to determine the effectiveness of fungicides in laboratory and field trials. The infection of plants in the field took place naturally. The 2-hectare plot of the industrial plantations, where the chemical protection against scab (*Fusicladium cerasi* (Rabenh.) Sacc.) was tested, is represented by a group of resistant and moderately resistant cherry cultivars. The determination of the optimal timing of chemical treatments of cherry orchards was carried out on the basis of observations of the manifestation of scab on highly susceptible indicator cultivars ("Shedraya" and "Anadolu"). For this purpose, the following preparations were tested in the struggle against scab of cherries: Abiga Peak, BC (400 g/l copper oxychloride), Score, EC (250 g/l difenoconazole) - spraying - in the

phases of budding and after harvesting with an interval 20 days; spraying - in the "green cone" phase, the second - after flowering; waiting period (frequency of treatments) - 21 (2), Hom, SP (861 g/kg copper oxychloride) - spraying during the growing season with an interval of 20 days, Chorus, VDG (750 g/kg cyprodinil) - spraying during the growing season: the first - when the first signs of the disease appear, the next - with an interval of 7-10 days and control without chemical treatment. For the statistical analysis of the research results, we used the methods developed by A.E. Chumakov and others (1974), B.A. Dospekhov (1985) (Chumakov et al., 1974; Dospekhov, 1985). Weather conditions in 2021-2022 were favorable for the development of cherry scab.

RESULTS AND DISCUSSION

The main experimental material was obtained through phytosanitary monitoring of the industrial cherry orchards in the Ganja-Kazakh geographical zone in 2021-2022 on a natural infectious background. As already noted, the research material was the cultivars of cherries "Shedraya" and "Anadolu". Used standard methods for identifying and counting cherry scab (Dyakov,2012; Kirai et al., 1974; Müller, 1995) (Table 1).

Table 1. Distribution of the cherry scab (*Fusicladium cerasi* (Rabenh.) Sacc.) in various western regions of Azerbaijan (2021-2022)

Western regions of Azerbaijan	2021 year			2022 year		
	Date of illness	P, %	R, %	Date of illness	P, %	R, %
Shamkir	5.XI	39,9	21,8	5.XI	44,5	22,2
Samukh	7.XI	36,8	19,6	5.XI	42,6	20,7
Tovuz	10.XI	35,2	18,9	10.XI	39,7	20,9
Kazakh	10.XI	27,8	13,2	10.XI	33,2	15,9
On average	-	35,0	18,4	-	40,0	20,0

Note: P - disease prevalence, %; **R** - intensity of development, %

The table shows that over the years, the spread and development of the disease is gradually increasing. In 2021, the spread of the disease in the regions ranged from 27.8 to 39.9%; development intensity from 13.2 to 21.8%. In 2022, these figures ranged from 33.2% to 44.5%; and the intensity was from 15.9 to 22.2%. The incidence of cherry scab in various western regions of the republic turned out to be different.

As the analysis of the meteorological data shows, during a period of intensive spread of the disease, there is an increase in the relative humidity, precipitation, and the temperature is kept within the optimal range for the development of the pathogen fungus. These two factors, the optimal temperature and the high relative humidity of the air, apparently, determine the intensive development of the disease.

As a result of the laboratory studies carried out by us, it was found that the causative agent of the cherry scab is the fungus *Fusicladium cerasi* (Rabenh.) Sacc. (class - *Deuteromycetes*; order - *Hyphomycetales*). The conidiophores are brownish-olive, solitary, collected in small bunches or in the form of continuous turf, simple or occasionally branched, unicellular or with one, rarely 2-3 septa, 20-45.5x3.0-4.0 microns. Conidia in chains, pale olive, fusiform, ellipsoidal or almost cylindrical, unicellular, later with one septum 13-23x3.0-6.0 microns (Müller, 1995).

The biology of the fungus *Fusicladium cerasi* (Rabenh.) Sacc. is similar to the biology of the apple scab pathogen (*Venturia inaequalis* (Cooke) G.Winter.). It also overwinters on affected leaves. In the spring, during bud break,

ascospores are ejected from ripe bags, which produce a primary infection of young leaves. During the summer, the pathogen reproduces with conidia, infecting the leaves and fruits of the cherries. Spore dispersal occurs only in rainy weather. Therefore, the conditions favorable for the development of the disease are the rainy spring and the summer with moderate temperatures. The most resistant to scab is the steppe cherry (*Prunus fruticosa* Pall.).

It should be noted that for the first time in the Republic of Azerbaijan we have studied the prevalence, intensity of development and harmfulness of the cherry scab in the western part of the country. And also, for the first time, a system for protecting cherry orchards from scab was developed and proposed for production.

Due to the significant economic losses that can result from a severe infection with scab, much attention is paid to the development of optimal integrated methods of protection [10,11]. Various methods are used:

- Agronomic – pruning, fertilization, autumn plowing and spring harrowing;
- Biological - the use of antagonistic bacteria, fungi and biopreparations of contact action;
- Chemical - application of pesticides and fertilizers.

The most effective, fastest, and most often the only method of preventing and protecting cherries from scab is the chemical protection (Zakharychev, 2019). It should be noted that in the fight against the causative agent of the cherry scab, the correct choice of spraying time plays an important role.

As part of the 2021-2022 research, we have developed agrotechnical and chemical control measures against the cherry scab.

The agrotechnical method of plant protection is aimed at creating unfavorable conditions for the existence, reproduction and resettlement of harmful organisms, as well as at increasing the resistance of plants to damage. The agrotechnical method in its implementation does not require special costs, since it is based on the usual methods of agricultural technology. In this regard, the agrotechnical measures are the most economical and profitable.

To prevent the appearance of the cherry scab, the following preventive measures are recommended:

1. Creation and zoning of cherry cultivars highly resistant to scab. Preference is given to highly productive cultivars with group resistance to the most dangerous diseases in a certain ecological and geographical zone;
2. Systematic pest control;
3. Compliance with the correct alternation of cherries with other crops in crop rotation;
4. Carrying out a set of measures that improve the general condition of cherry trees (tillage, fertilizers, irrigation, drainage, etc.). Pruning of affected shoots and branches with the capture of healthy tissue (before leaf fall). Collection and destruction of fallen leaves, rotten and mummified fruits. Destruction of a wintering infection by spraying trees on dormant buds with 0.5% DNOC or 1% Bordeaux mixture;
5. Uprooting and destruction of heavily affected trees that have lost economic importance;
6. Treatment of planting material by immersion for 5 minutes in a 1% solution of copper sulfate or other fungicides;
7. Carrying out sanitary - preventive and agrotechnical measures that reduce the stock of infection: removal from the garden and destruction of affected leaves and fruits; timely application of macro- and micro fertilizers in accordance with soil analyses; proper soil content between rows; irrigation of plantations in irrigated areas, etc. Destruction of a wintering infection by collecting fallen leaves or keeping aisles under black fallow;
8. The introduction of a complete mineral fertilizer, mainly phosphorus-potassium, helps to increase the resistance of cherry trees to scab; One-sided application of nitrogen fertilizers should be avoided, which, by enhancing plant

growth, increase the susceptibility of cherries to disease;

9. Autumn and early spring whitewashing of trunks and skeletal branches with 20-30% milk of lime with the addition of 3% copper sulfate or other fungicides to protect them from sunburn and infection with pathogens of various diseases;

10. Systematic weed control in cherry orchards.

An effective complex of treatments against scab can be developed taking into account the biological cycle of the pathogen, the climatic conditions of the region and the degree of resistance of cherry varieties. It should include the timely implementation of agrotechnical measures, the use of a minimum of chemical means of protection. The selection of preparations must be carried out taking into account their environmental safety both for fruit products and the environment (Slovtsov et al., 2008).

As already noted, the successful protection of cherries from scab can be provided by a set of sanitary - preventive, agrotechnical and chemical measures.

Below are the results of our work on the chemical protection in the cherry orchard.

Table 2. Influence of fungicides on the distribution and intensity of development of cherry scab (2021-2022)

Fungicides, their preparative forms and consumption rate	After the third spray		
	Spread of the disease, %	The intensity of the development of the disease,%	Biological efficiency of fungicide, %
Abiga Peak, VS (8,0 l/ha)	25,5	10,8	73,0
Score, KE (0,2 l/ha)	25,9	11,3	72,0
Hom, SP (0,4 kg/ha)	26,8	12,6	68,4
Chorus, VDG (0,35 kg/ha)	27,0	13,0	67,4
Control (without chemical treatment)	66,9	39,9	-

The results of studies conducted in 2021-2022 showed that scab is more affected by the "Shedraya" cherry cultivar, and to a lesser extent by the "Anadolu" cultivar.

Field studies have established that the best results against the disease with chemical spraying are shown by the preparations Abiga Peak and Score. Thus, the biological effectiveness of these drugs was 73.0-72.0%, respectively.

CONCLUSION

The low yields of cherry are due to the loss of production from diseases, the most harmful of which is scab.

The article presents the results of research carried out on the cherry scab. A comparative assessment of the applied fungicides is given. It was found that the biological effectiveness of the fungicides, Abiga Peak and Score, was 73.0-72.0%, respectively.

The meteorological conditions in the years of research (2021-2022) differed significantly from the long-term average values, both in terms of the temperature regime and the amount of precipitation. This context had a certain effect on the development of scab in cherry orchards, as well as on the level of its yield.

It should be noted that the spread of the disease is facilitated not only by the warm and humid climate, the location of the garden, but also by the poor care taken of the cherry trees. The observations have shown that in overgrown with weeds and neglected gardens, the disease develops most intensively. Thus, the development of scab is directly dependent on

environmental conditions, as well as on the resistance of the cultivars.

The system for protecting cherry trees from diseases should be based on a set of measures, among which phytosanitary monitoring and selection of resistant cultivars. The use of effective and low-hazard means of protection are of great importance.

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