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INFECTION RATE OF POMEGRANATE CULTIVARS BY ZITHIOUS FRUIT ROT IN THE CONDITIONS OF THE WESTERN PART OF AZERBAIJAN

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ABSTRACT

Currently, the study of pomegranate diseases is one of the priority areas of phytopathological research in Azerbaijan. So, as this is the most important factor in the sustainable development of pomegranate production in Azerbaijan. The article presents the results of a 2-year (2019-2020) study on the susceptibility of local cultivars of pomegranate to zithia fruit rot (*Zythia versoniana* Sacc.) in the conditions of the western part of Azerbaijan. For this purpose, to study the cultivar susceptibility of the pomegranate, surveys were carried out in the Goranboy region on 2 cultivars ('Gulosh pink' and 'Krmyzy kabuh'). *Zythia* fruit rot (*Zythia versoniana* Sacc.) in its negative economic value is one of the most harmful pomegranate diseases. As a rule, the disease begins in June and continues throughout the growing season of the plant, until harvest (late October - early November). Pomegranate fruits affected by zithiosis rot intensively during storage. Thus, *zythia* fruit rot (*Zythia versoniana* Sacc.) on pomegranate is characterized by great harmfulness both in the field and during storage of fruits. Since, the rotting of pomegranate fruits is 50-100%. In the fight against diseases, one of the leading places is the introduction of resistant cultivars into production. The identification of cultivars relatively resistant to zithiose fruit rot is of great national economic importance. As already noted, to determine the degree of infection of pomegranate cultivars with zithiosis, observations were made on two cultivars. As a result of experimental field studies, it was found that both examined pomegranate cultivars were to some extent susceptible to zithia fruit rot (*Zythia versoniana* Sacc.). The spread of the disease in 2020 on the 'Krmyzy kabukh' cultivar did not exceed 26.3%, and the development was 14.2%; respectively, on the cultivar 'Pink Gulosha', the spread is 17.4%, the development is 12.3%. Thus, both cultivars are characterized by comparative resistance.

Key words: *pomegranate bush, zithiose fruit rot, local cultivars of pomegranate, susceptibility, resistance.*

INTRODUCTION

Pomegranate is a subtropical fruit crop, growing as a tree or bush with a long dormant winter period (Huseynova, 2018). It belongs to the Punicaceae family, with a single genus, *Punica* L., which includes common pomegranate (*P. granatum* L.) and Socotra pomegranate (*P. protopunica* Belf.) (Guliev & Huseynova, 2020a). The Socotra pomegranate is endemic to Socotra Island and is rich in relict species (Guliev & Huseynova, 2020a). Common pomegranate exists as cultivars, varieties, and wild forms, typically growing up to 3–5 m with a curved trunk and branched crown (Guliev & Huseynova, 2020). The genus *Punica* is ancient, dating to the Tertiary period, with fossil remains in Azerbaijan. The birthplace of cultivated pomegranate is Azerbaijan, where the largest wild thickets in the former USSR occur in Eastern Transcaucasia (Guliyev et al., 2020).

Pomegranate is widely cultivated in the former USSR, particularly in Azerbaijan, Georgia, Dagestan, Crimea, and Turkmenistan, while in Uzbekistan and Tajikistan it is mainly grown with winter digging in foothill areas to protect plants during cold periods (Guliev & Huseynova, 2020b). This subtropical fruit crop is highly valued, and interest in its cultivation is increasing across Central Asia and Transcaucasia. Farmers and researchers are establishing new orchards and improving agricultural practices to achieve higher yields and better-quality fruits (Guliev et al., 2021).

Azerbaijan, in particular, possesses a rich diversity of local pomegranate cultivars, such as ‘Azerbaijan or Red Gulosha,’ ‘Pink Gulosha,’ ‘Bala Mursal or Kalyn Kabuh Gulosha,’ ‘Agdam Gulosha,’ ‘Shirin Nar,’ ‘Shah Nar,’ ‘Absheron,’ ‘Nasimi,’ and many others (Guliev & Huseynova, 2020b) (Figure 2 & 3). The fruits and other parts of the plant are valued for their chemical composition, which includes numerous biologically active substances. These properties make pomegranate important not only as a fruit crop but also for medicinal, technical, and decorative purposes. Its fruits are characterized by excellent taste, medicinal benefits, and long shelf life, often lasting four to six months under proper storage conditions.

Pomegranate bushes are susceptible to a wide range of infectious diseases, the incidence and severity of which are influenced by the ecological and geographical conditions of western Azerbaijan (Guliev et al., 2021). In the Ganja-Kazakh zone, fungal pathogens dominate, and although the species composition has remained relatively stable over the years, the intensity of disease development can vary. Among these, Zythia fruit rot (*Zythia versoni* Sacc.) is the most common and destructive. This mycotic disease affects all above-ground organs of the plant, including leaves, flowers, fruit, pedicels, branches, trunk, and root neck. The pathogen persists on plant debris and garden structures for up to two years and can be transmitted by fruits, wind (anemochory), water drops (hydrochory), insects, especially ants (myrmecochory), and human activities (anthropochory). These factors allow the fungus to infect pomegranate bushes at early stages of development, leading to significant yield losses (Guliev & Huseynova, 2020a).



Figure 1. Pomegranate cultivar 'Pink gulosha'



Figure 2. Pomegranate cultivar 'Krmyzy kabukh'

Infected flowers are covered with brown or dark brown spots and in most cases fall off. The disease of the fetus often begins with the appearance of watery spots, which, growing, passes to the rest of the fetus (Fig. 3).



Figure 3. The beginning of the zithiosis



Figure 4. Rusty-brown spot on a pomegranate fruit

Numerous rusty-brown dots are formed on the decayed tissue - pycnidia of the pathogen (Fig. 4). Then this watery and rusty-brown spot while expanding completely covers the whole of the fruit and as a result the fruit rots (Fig. 5,6). The affected pomegranate fruit softens and becomes slimy (Fig. 7). Affected young fruits fall off, while older ones become mummified and can hang on trees for a long time (Fig. 8). Brown spots appear on the peduncle, which become rusty-brown over time. From here, zytious fruit rot (*Zythia versoniana* Sacc.) passes to the branches, causing them to dry out.



Figure 5. The completely rotten fruit



Figure 6. The expanding spot

Relatively large brown spots dotted with rusty-brown dots appear on the leaves, which leads to yellowing and premature shedding (Fig. 9,10).



Figure 7. The internal view of a rotten slimy fruit



Figure 8. The mummified pomegranate fruit



Figure 9. Healthy leaves



Figure 10. Affected leaves

Affected by zythiosis (*Zythia versoniana* Sacc.), the bark and surface layers of the wood of the trunk and root neck become rusty-brown and rot. In the future, the bark cracks, peels off, but does not exfoliate. In diseased bushes, the leaves gradually turn yellow and fall off, then individual branches and even the entire tree dry out. And also, it should be noted that as a result of damage to the root collar, the transfer of water and nutrients to the aerial part of plants is disrupted, which causes their gradual withering and death.

The first appearance of the disease is expected in the first or second decade of June, reaching its maximum development in October.

Mass damage to pomegranate bushes by zytiose fruit rot is often observed in wet years. *Zythia versoniana* Sacc. causes the greatest harm during the flowering period, often causing massive fall of the ovaries. Fruits are more severely affected, which is often observed when they ripen. Zytious fruit rot on pomegranate is characterized by great harmfulness both in the field and during storage of fruits. Zytious fruit rot with its strong development leads to premature death of the leaves, resulting in reduced yield.

As already noted, it spreads with raindrops (hydrochory) and air currents (anemochory). Pycnosporos germinate in droplets of moisture at a temperature of 12.5-350C (optimum 24-250C).

Harmfulness of zytious fruit rot (*Zythia versoniana* Sacc.) is expressed in yellowing, drying and falling of leaves, premature death of bushes with early damage to the basal part of the stem. The harmfulness of the disease is expressed not only in a decrease in the yield, but also in the deterioration of its quality. Fruits rot and often fall off when infected early. As a result of severe leaf damage, assimilation is reduced and transpiration is increased, which can lead to premature leaf fall. This, in turn, affects both the yield and the general condition of the bush.

The high development of the disease on pomegranate leads to a crop shortage of up to 80-100% on highly susceptible cultivars and up to 50-60% on weakly affected ones.

The source of infection is mummified fruits, fallen leaves and ovaries, as well as affected bushes.

Before talking about the resistance of pomegranate cultivars to diseases, let's take a quick look at the local native cultivars of Azerbaijan. Currently, more than 500 cultivars of pomegranate are known worldwide. One of the most common and of great economic and economic importance in our republic is 'Azerbaijan or red gulosha', 'Pink gulosha', 'Kara Bala Mursal', 'Bala Mursal or kalynkabukh gulosha', 'Azerbaijan', 'Nyuvyadi gulosha', 'Zangilan shirin nar', 'Agdam Shirin nar', 'Krmyzy kabukh', 'Nazik kabukh', 'Shah Nar', 'Shirin nar', etc. The main indicators of local pomegranate cultivars of Azerbaijan are given in the following table.

Table 1. Comparative analysis of some local pomegranate cultivars of Azerbaijan (L.A. Huseynova, 2019-2020)

Local cultivars of pomegranate	Fruit weight, gr	The chemical composition of the fruit		Juice percentage	Productivity from one bush, kg	Ripening time	The degree of disease infestation of cultivars
		Sugar content, %	Acidity, %				
'Krmyzy kabukh'	400	12,5	2,00	60,0	45	Mid October	3 point
'Pink gulosha'	550	15,6	1,84	58,0	35	Mid October	3 point
'Azerbaijani or red gulosha'	400	14,5	1,81	50,0	45	Early October	4 point
'Agdam gulosha'	500	10,0	3,18	54,45	35	Mid October	4 point
'Bala Mursal or kalynkabukh gulosha'	350	15,97	1,28	59,0	50	Early October	1 point

Note: 4 point - strongly affected; 3 point - moderately affected; 1 point- weakly affected

The table shows pomegranate cultivars belonging to the Gulosha group. As can be seen from Table 1, based on our observations and research, it was found that the pomegranate cultivars 'Pink Gulosha' and 'Krmyzy Kabukh' are more susceptible to disease. The fruits of the 'Bala Mursal' cultivar are relatively resistant to diseases due to the thick skin. (Huseynova, 2019–2020)

MATERIAL AND METHODS

The main goal of our research in 2019-2020 was to study the ability of local pomegranate cultivars to become infected with zythia fruit rot (*Zythia versoniana* Sacc.).

To achieve this goal, it was supposed to solve the following tasks:

- To study zithiose fruit rot (*Zythia versoniana* Sacc.) of pomegranate bushes in the conditions of the western part of Azerbaijan;
- To identify the main environmental factors contributing to the wide spread of zithium fruit rot;
- To study the biological features of zithiosis;
- To study the cultivar resistance of some cultivars of pomegranate ('Krmzyz kabuh' and 'Pink gulosha') to zithiosis in the conditions of the western part of Azerbaijan.

The experiments were laid against the background of pomegranate cultivation recommended for this zone. Field experiments were laid in 5 variants of 3-fold repetition. Observations and records of the prevalence and development of pomegranate zithia fruit rot (*Zythia versoniana* Sacc.) were carried out systematically throughout the entire growing season of plants, according to methods generally accepted in phytopathology (Dospekhov, 1985; Bilay, 1982; Dyakov, 2012).

After identifying the causative agent of the disease and the prevalence of the disease, studies were carried out to study the susceptibility of pomegranate cultivars ('Pink gulosha' and 'Krmzyz kabuh') to zithious fruit rot (*Zythia versoniana* Sacc.). In order to identify the resistance of pomegranate cultivars to zythia fruit rot (*Zythia versoniana* Sacc.), we conducted surveys on commercial fruit-bearing pomegranate orchards in the western part of Azerbaijan. Experimental field experiments have established that in the 2020 research year, the 'Krmzyz kabuh' cultivars was more affected by zithiosis than the 'Pink gulosha' cultivar. As can be seen from the data, both against the background of artificial infection and in nature, both cultivars of pomegranate show susceptibility to zithia fruit rot (*Zythia versoniana* Sacc.).

Accounting for the development of zithia fruit rot (*Zythia versoniana* Sacc.) on pomegranate fruits (*Punica* L.) was carried out using the following scale (Guliyev & Huseynova, 2021b):

0 point - no lesion;

1 point - a spot on the upper, open serrated part of the calyx;

2 point - the spot covers 25% of the surface of the fruit;

3 point - the spot covers more than 25% of the surface of the fruit;

4 point - the spot covers 50% of the surface of the fruit;

5 point - the spot covers more than 50% of the surface of the fruit.

RESULTS AND DISCUSSION

Diseases are one of the main factors limiting the realization of the genetic potential of a consistently high yield of modern pomegranate cultivars. Diseases of fungal etiology are widespread in pomegranate gardens in the republic. Among diseases of pomegranate bushes (*Punica* L.) of fungal etiology, zythiosis fruit rot (*Zythia versoniana* Sacc.). The disease usually begins with darkening of the skin at the sites of infection, which can gradually cover the entire fetus. The affected areas become watery or oily (Fig.).

In the fight against diseases, one of the leading places is the introduction of resistant cultivars into production. The identification of cultivars that are relatively resistant to zythiosis fruit rot (*Zythia versoniana* Sacc.) is of great national economic importance.

To establish the degree of damage to pomegranate cultivars by zithia fruit rot (*Zythia versoniana* Sacc.), observations were made on 2 cultivars (Table 2).

Table 2. The degree of infestation of pomegranate cultivars with zitiosis fruit rot (*Zythia versoniana* Sacc.) in the conditions of the western part of Azerbaijan (2019-2020)

Cultivar name	Number of fruits examined	2019 year		2020 year	
		Spreading, %	Development intensity,%	Spreading, %	Development intensity,%
'Krmzyz kabukh'	60	25,4	12,2	26,3	14,2
'Pink gulosha'	60	18,3	10,3	17,4	12,3

It follows from the table that the examined cultivars were to some extent susceptible to positivity fruit rot. The cultivar 'Pink gulosha' turned out to be relatively stable. Distribution in 2019 on the cultivar 'Krmzyz kabukh' did not exceed 25.4%, the intensity of development was 12.2%; on cultivar 'Pink gulosha' spread 18.3%, development 10.3%. In 2020, the distribution and intensity on the cultivar 'Krmzyz kabukh' and 'Pink gulosha' are 26.3-14.2% and 17.4-12.3%, respectively.

CONCLUSIONS

Studies have shown that zythia fruit rot (*Zythia versoniana* Sacc.) pomegranate is a widespread and harmful disease. The causative agent of the disease is the fungus *Zythia versoniana* Sacc. penetrates into the plant through mechanically damaged places, intensively develops at high humidity and optimal temperature (20-25°C). As already noted, the disease manifests itself on leaves, flowers, fruits, stalks, branches, trunks and root collars. The most characteristic and specific signs of zythiosis (*Zythia versoniana* Sacc.) appear on pomegranate fruits. Infection of fruits in most cases

occurs during their ripening. The disease of the fetus often begins with the appearance of brown spots, which, growing, pass to the rest of the fetus. Numerous rusty-brown dots-pycnidia of the pathogen are formed on the decayed tissue. Affected young fall off, while older ones become mummified and can hang on trees for a long time. The degree of damage to zitious fruit rot depends both on the amount of primary infection and on conditions favorable for the further development of the disease (high humidity, precipitation, etc.). There are no completely resistant cultivars to this disease. All cultivars of pomegranate are susceptible to the harmful effects of this disease. The pomegranate cultivars 'Krmzy kabukh' and 'Pink gulosha' are relatively resistant to this disease.

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