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Diseases of Peach Caused by Ascomycete Fungi in Fergana Valley

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Annotation: The distribution and development of peach diseases were studied during field observations conducted in some regions of the Fergana Valley. It was found that leaf curling was the most common disease in peach trees in orchards. Symptoms of the disease appeared in early spring, and in summer, with an increase in temperature and a decrease in air humidity, its development stopped. In peach trees, clasterosporiosis was rare, powdery mildew was very rare, and moniliosis was not recorded

Keywords: peach, disease, leaf curl, Taphrina deformans, klaasterosporiosis, powdery mildew, moniliosis.

Introduction. Horticulture is an ancient and important branch of agriculture in Uzbekistan, and the issues of its development are always in the focus of the country's leadership. The Decree of President Sh.M. Mirziyoyev dated February 7, 2017 No. PF-4947 and the Program of the Ministry of Agriculture of the Republic of Uzbekistan dated January 16, 2018 No. 03/1-3184 set the tasks of expanding the area of fruit orchards, exporting more than 2.4 million tons of high-quality fruit products abroad, in addition to the needs of the population, and they are being implemented. At the same time, harmful organisms, including diseases, found in fruit trees, prevent the successful implementation of these tasks.

Taxonomy and varieties of peach trees . The common peach belongs to the species *Prunus persica* (L.) Batsch, 1801 (not Stokes 1812 nor (L.) Siebold & Zucc. 1845), and is a member of the kingdom Plantae, clade Eudicots, order Rosales, genus *Prunus of the family Rosaceae* . The scientific name has more than 20 synonyms: *Persica vulgaris* Mill. and others. Peaches with a

hairless ("naked") peel are called "nectarines", and some scientists consider them to be an independent species *Persica nucipersica* (L.) Borkh. or a variety of the common peach *Prunus persica* var. *nucipersica* (Sukhow) CK Schneid.; however, these names have now become synonyms of the common peach (Peach, 2023).

The taxonomy of peaches is not fully resolved, and the Fergana peach (FSP) group is an example of this. FSP is also called Xinjiang peach. According to scientists, FSP is either an independent species or a landrace of the common peach [1]. Some scientists have given this group the species name *Prunus ferganensis (Kost. & Rjab.) YY Yao, synonyms Prunus persica* ssp. *ferganensis* Kost. & Rjab. , *Persica ferganensis* (Cost. & Rjab.) Koval. & Kost., *Persica vulgaris* ssp. *ferganensis* (Kost. & Rjab.) Rjab. et al. (Shoferistov, 2013; Fergana peach, 2021). Fergana peach is found growing wild in China (Kashgar and Yorkent in Xinjiang Province), the Fergana and Zarafshan valleys, Bukhara and Khorezm regions. In nature, Fergana peach easily crosses with various varieties of common peach, wild David peach (*Prunus davidiana* [Carr.] Franch.) and wild apricot (*Prunus simonii* Carr.), and many new hybrid forms have been formed in China and Central Asia. Some Chinese scientists consider some forms of Fergana peach to be the ancestors of nectarines (Shoferistov, 2013). In Uzbekistan, white-fleshed (Fergansky belyy), yellow-fleshed (Fergansky zhёltый) forms of FSH, hairy White Fig Peach (белый инжирный), New Fig Peach (Инжирный новый), and hairless (nectarine) varieties called Ak luchchak, Qara luchchak (= Ak ikhthar, Kyzil ikhthar), Ertagagi luchchak (Лучак ranniy) and Tashkent nectarine (Нектарин ташкентский) have also been created (Venyaminov et al., 1953; Abdullaev, Isroilov, 2021). FSH forms are quite resistant to fungal diseases, especially highly resistant or immune to powdery mildew. For this reason, representatives of the FSH group are used in many countries as a source of resistance in powdery mildew resistance breeding (Shishova, Zvonaryova, 2010, etc.).

More than 30 peach varieties have been regionalized in our country. Of these, 10 are varieties of the State Institute of Plant Genetic Resources and 7 are varieties of the Institute of Plant Genetic Resources, and the rest were introduced from foreign countries (Register, 2020; Abdullaev, Isroilov, 2021).

Research on the topic. More than 220 fungi and oomycetes, including 132 ascomycetes, have been reported in the literature to infect peach trees and/or their fruits. The most dangerous diseases caused by ascomycetes include peach leaf curl (PLL) (Zapromyotov, 1925, 1926; Akhmedova, 1960), klasterosporiosis in all pome fruit trees (Panfilova, 1950; Niyazov, 1977), moniliosis (Panfilova, 1950; Doshimov, 1958; Boyzhigitov, 2011), and powdery mildew (Golovin, 1949, 1960; Panfilova, 1950; Niyazov, 1977; Gaponenko et al., 1983; Khamroev et al., 1995). They are reported to be widespread in all countries of Central Asia, including Uzbekistan.

peach diseases are most common in the Fergana Valley (Niyazov, 1977; Gulyamova et al., 1990). However, there is no data on the distribution of these diseases in individual regions of our country, confirmed by accurate figures. Taking into account that such data will be the basis for planning and properly implementing disease control measures, we studied the distribution of peach diseases in the Fergana Valley.

Research methods . Observations were made in the peach orchards of some districts of the Fergana Valley, and the types, distribution and development levels of the diseases encountered in the trees were determined. For this purpose, 3 trees of each peach cultivar were sampled in each orchard, 25 leaves on 4 sides of each tree, for a total of 100 leaves per tree (and, if present, other members) were counted using the following generally accepted methods.

The prevalence of the disease was calculated according to the following formula (Chumakov, Zakharova, 1990):

[1] Landrace (English landrace , Russian landrace or old-fashioned variety) is a crop variety that has been cultivated by the local population in a country or region for a long time.

$T = n \bullet 100/N$

where : T is the disease prevalence (%), n is the number of diseased plants or organs, N is the total number of plants or organs counted.

Peach leaf curling and leaf spotting (claysterosporiosis) or powdery mildew (fluffing) are scored using the following modified 6-point scale (Smolyakova et al., 1999):

0 - no disease;

1 – up to 5% of leaf surface affected (very slight damage);

2 - 6-10% of damaged leaf surface (less damage);

3 - damaged leaf surface 11-25% (damage is moderate);

4 - 26-50% of the damaged leaf surface (damage is severe);

5 - more than 50% of the affected leaf surface (the damage is too strong).

Disease progression (in points or percentages) was calculated using the following formula (Chumakov, Zakharova, 1990):

$R = \square (a \bullet b)/N$

where : R is the level of disease development (points or %), $\square (a \bullet b)$ is the sum of the number of infected plant organs multiplied by the degree of infection, N is the total number of considered (healthy and infected) plant organs.

When necessary, we used the following formula to convert values from point scale to percentage scale (Chumakov, Zakharova, 1990):

$R_p = \square (a \bullet b) \bullet 100/K \bullet N$

where : R_p – disease development (%), $\square (a \bullet b)$ – the sum of the number of infected plant organs multiplied by the proportional level of infection, N – the total number of counted (healthy and infected) plant organs, K – the highest score on the scale.

Research results . In order to determine the spread and development of diseases in peach trees, directional and/or stationary observations were conducted in some farms and horticultural farms and other orchards in Andijan, Fergana and Namangan regions in 2021-2023 . These observations took into account the occurrence and development of leaf curl, clasterosporiosis powdery mildew and moniliosis diseases in peach trees. These diseases (with the exception of moniliosis) form characteristic signs on peach leaves and were identified based on these morphological signs. To identify diseases of peach blossoms and twig rot, mycological analysis of the affected organs was performed. Preparations prepared from the sporulating organs of the causative fungi were studied using microscopy.

Leaf curl . This disease of peach trees is caused by the ascomycete fungus *Taphrina deformans* Tul. Its main and typical host plant is peach, and nectarine varieties are often less resistant to the disease than hairy peach (Tskhvedadze et al., 2011). In Uzbekistan, only peaches are affected by leaf curl.

Field observations revealed that leaf curl is a dominant disease of peach trees in the Fergana Valley and was recorded in almost all orchards surveyed. However, the extent and development of this disease varied depending on the location of the observation, seasonal weather, and peach varieties (Tables 1 and 2).

As can be seen from the tables, the first signs of BW disease became apparent in the first decade of April, and in orchards not protected by fungicides, the disease reached its peak in the third decade of May.

In the third decade of May and early June, the affected leaves began to fall off. As a result, by

mid-late July or early August, the disease symptoms had almost completely disappeared from the trees in many orchards. Then the trees began to produce new leaves, but they did not develop any disease symptoms. It is known from the literature that in mid-summer, an accidental secondary development of the disease on young peach shoots and leaves can be observed only when the weather is unusually cool and humid (Shane, undated). However, in Uzbekistan, due to the high temperature and very low humidity in the summer months (except in mountainous regions), secondary development of the disease is usually not observed at all.

These observations did not reveal any significant differences in susceptibility to BW between hairy and hairless peach varieties, but in some areas nectarine varieties appeared to be more susceptible to the disease.

In the conditions of the Fergana Valley, gardeners in many orchards protect peach (and other fruit trees) orchards from harmful organisms by spraying insecticides, acaricides and fungicides. In this case, fungicides are often sprayed in peach orchards with a T.E. of difenoconazole (for example, Skor 25% em.k., 0.2 l/ha, etc.) before flowering. In orchards where the chemical method was used correctly and consistently, for example, in 2021 in the orchards of the Navigul joint venture in the Andijan region and the Ravshanbek Ota farm in the Fergana region, the incidence of B.E. was very low or not observed at all (Tables 1 and 2).

Table 1. Distribution and development of peach leaf curl disease in some regions of Andijan region

Date	Type	Disease prevalence, %	Disease progression, score
Izboskan District, "Kadirjan Orchard" horticulture f/x; area 0.6 ha (~ 120 trees)			
02.05.2021	White luchchak, Krasnaya Moskva, Nectarine	46.7	3.50
27.05.2021		18.0	2.5 0
02.06.2021		8.0	1.2 0
21.04.2022		28.7	3.60
06.05.2022		28.7	3.60
21.05.2022		17.0	3.67
14.06.2022		12.3	2.50
04.07.2022		6.0	1.87
18.07.2022		<1.0	<1.0
Acad. M. BUVITI Andijan experimental station named after Mirzaev (BUVITI ATS) (Izboskan district); area is 1.46 ha			
14.07.2021	White luchchak, Black luchchak, Champion, Golden Jubilee	6.3	0.5
12.08.2021		0	0
15.09.2021		0	0
21.04.2022		24.5	3.33
06.05.2022		23.0	3.67
22.05.2022		15.7	2.17
15.06.2022		17.3	3.87
04.07.2022		<1.0	<1.0
18.07.2022		<1.0	<1.0
18.04.2023		23.3	3.60
06.05.2023		25.3	3.57
22.05.2023		26.0	3.73

15.06. 2023		<1.0	<1.0
Khojaabad district, Uzbek-German joint venture "Navigul" (Uzvinsanoatholding LLC); area 54 hectares			
30.04.2021	Richlady, Jerseyland, Royal Glory, Redhaven, Venus	0	0

Clasterosporiosis. Clasterosporiosis in pome fruit trees is caused by the ascomycete fungus *Stigmina carpophila* (Lèv.) Ellis (synonyms *Clasterosporium carpophilum Aderh. et al.). This disease was very rare in the Fergana Valley in 2021-2023; the disease was recorded in only two of the locations listed in Tables 1 and 2. Of these, the disease was detected in trace amounts (prevalence* <1%) on 21.05.2021 in the "Ibrohimov Ikromjon" agricultural park in the Uchkurgan district of the Namangan region .

Table 2. Distribution and development of peach leaf curl disease in some regions of Namangan and Fergana regions

Date	Type	Disease prevalence, %	Disease progression, score
Fergana region, Toshloq district, "Ravshanbek ota fayz zynati" horticulture f/x; area is 2.5 ha			
18.06.2021	White luchchak (110 bushes), Red Moskva (60), Nectarine (110)	5.7	0.8
12.07.2021		2.7	0.7
14.08.2021		<1.0	<1.0
20.04.2022		20.3	3.33
23.05.2022		13.0	2.63
23.06.2022		<1.0	<1.0
Fergana region, Kuva district, Mingchinor massif, sample MFY, "Ahmedov Abdulatif sara bogi" horticulture f/x; area ~0.4 ha (80 trees)			
18.06.2021	Black-footed ferret	<1.0	<1.0
Namangan region, Uchkurgan district, Shahrikhan check MFY, "Ibrohimov Ikromjon" f/x; area is 1.46 ha			
21.05.2021	Nectarine and other, hairy varieties	12.3	1.87
22.06.2021		<1.0	<1.0

In the orchards of the BUVITI ATS, clasterosporiosis was recorded only at the end of the season, and its incidence was 12.3% and 23.7% on August 12 and September 15, 2021, respectively, with a development of 2.6 and 3.55 points, while in 2022, a low incidence (7.7%) and development (1.33 points) were recorded on July 4. In other monitored areas of the Fergana Valley, clasterosporiosis was not found on peaches.

Powdery mildew . Powdery mildew in peaches is caused by the ascomycete fungus *Podosphaera pannosa* (Wallr.: Fr.) de Bary (synonyms *Sphaerotheca pannosa* (Wall.: Fr.) Lèv. and others). This disease was not observed in most of the observed locations in the Fergana Valley and was only recorded in a small number of leaves (1.0-13.3%) in the Andijan region in the "Kadirjan fruit orchard" (02.06.2021 and 18.07.2022) and the BUVITI ATS orchard (14.07. and 12.08.2021). Powdery mildew was found only on shoots originating from the lower (rootstock) part of the trees, and was not found on shoots and leaves located higher up. This situation, i.e., the occurrence of powdery mildew mainly on the branches of peach grown from grafts, was also determined earlier in the observations conducted in the Kashkadarya region (Niyazov, 1977).

At the same time, at the end of the 2023 season (late August - early September) in the BUVITI

ATS orchard, powdery mildew was observed on the upper tiers of the Kara Luchchak peach trees and on their leaves. The results of the survey showed that the disease was observed on 27 out of 100 examined branches and on 20% of 500 leaves. The average degree of damage to the leaves (damaged surface area) was $\bar{x}$ = 19.6%. Powdery mildew was not observed on the branches of the Tukli Champion variety, it was very rare on the leaves, the prevalence was less than 0.1%, and the degree of development was found to be trace.

Moniliosis . Moniliosis in pome fruit trees is caused by the ascomycete fungi *Monilia laxa* Sacc. (synonym *Monilia cinerea* Bonord.), rarely *Monilia fructigena* (Aderhold & Ruhland) Honey ex Whetzel. Moniliosis was not observed during observations in the Fergana Valley. In peach trees, rotting and drying of the tips of the shoots was observed in very rare cases, but mycological analyses did not reveal the growth of pathogens of moniliosis and/or clasterosporiosis from samples of these shoots.

The agrotechnical, selective and chemical control measures used against the diseases of peach analyzed above are described in detail in the literature (Hamroev et al., 1995; Boyjigitov, 2011; Hasanov et al., 2023a,b).

Conclusions

1. Observations conducted in 2021-2023 revealed that leaf curl is the main and dominant disease of peach trees in the Fergana Valley.
2. Peach leaf curl appears early in the season, in April, and develops its intensity throughout June and sometimes July, after which the affected leaves fall off and the disease symptoms decrease sharply or disappear completely.
3. In 2021-2023, it was found that the diseases clasterosporiosis and powdery mildew were very rare and weak in peach orchards in the Fergana Valley, and moniliosis was not recorded.

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