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ROSE DISEASES AND THEIR CONTROL IN THE CONDITIONS OF VINNYTSIA REGION

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This article highlights the problem of improved and substantiated elements of the system of protection against the main diseases of roses based on the establishment of the peculiarities of the formation of their complex in the conditions of the Vinnytsia region. According to the results of the conducted research, it was established that the highest percentage of the ratio among phytopathogens that were detected on roses: powdery mildew, which was 42%, black spot – 21,0%, diseases such as yellow rust – 15,0% also had a high percentage, botrytis bligh (gray mold) – 13,0%, less numerous were downy mildew – 5,0%, root rot – 3,0%, a lower percentage characteristic of stem cancer – slightly more than 1,0%. Poisoning of planting material with fungicides Maxim 025 FS and Kinto Duo, CS provided reliable protection of rose plants against root rot. The development of root rot on the treated plots was lower than the control variant on average – by 3,7–6,1 times. The best indicators against leaf diseases were obtained when processing Alto Super 330 ES (0.5 l/ha), Amistar Gold 250 SE (12 ml/5 l of water per 100 m^2) and Maxim 025 FS (0,75 l/ha) + Horus 75 WG (0,6 kg/ha). Technical efficiency against powdery mildew on these variants was at the level of 84,8–92,6%, black leaf spot – 74,5–82,1%.

The highest productivity and economic efficiency of rose cultivation was achieved when the fungicide Amistar Gold 250 SE 12 ml/5 l of water per 100 m^2 was used. This ensured the yield of roses per cut at the level of 26 pcs./m^2, which is 7 pcs./m^2 more than in the control variant. The highest rate of profit was obtained when using the fungicide Amistar Gold 250 SE, KS, 12 ml/5 l of water per 100 m^2 and was UAH 1160 which is UAH 560 higher than the control. The cost of growing roses per cut amounted to 350 UAH.

***Key words:** roses, main rose diseases, disease development, fungicides, effectiveness.*
Table 6. Fig. 5. Lit. 17.

Introduction. Decorative floriculture is one of the young industries for Ukraine. Its development is facilitated by the importation of a significant amount of planting material of ornamental crops from Western European countries. Among the flowers grown for sale in flower farms, a special place and spread belongs to the rose belonging to the genus *Rosa* L. from the family Rosaceae Juss, which is in great demand among the population. However, the appearance of flowers deteriorates significantly as a result of disease. Therefore, as the culture develops, the species affiliation of pathogens, their developmental properties, and the search for measures to protect plants from them are also being studied.

Analysis of recent research and publications. Having barely recovered from the coronavirus crisis, the flower business found itself on the brink again due to the start of a full-scale war: shops did not work, a huge amount of flowers purchased before March 8 spoiled, people began to save and the demand for flowers collapsed. All these factors have changed both the main players and the rules of the game in the field of flower business.

After the crisis in 2014, connected with the annexation of the Crimean Peninsula and the start of hostilities in the east of Ukraine, during the last years the market of flowers and decorative plants began to grow and show gradual development, thanks to both the growth of demand for flower and decorative products, and the growth of supply: domestic production and import. These positive changes contribute to the growing interest of suppliers from other countries in the Ukrainian market. The Kingdom of the Netherlands is the undisputed leader in the supply of flower and decorative products, especially flower bulbs and cut flowers, and also occupies a leading position in the technology of growing ornamental plants.

According to the data of the State Statistics Service, in 2021 Ukraine imported flowers in the amount of 18,7 million dollars, and the value of imports increased by 23%, the import value includes products from the Netherlands (11,9 million dollars).

In 2021, flowers accounted for 75% of the value of imports, and decorative plants accounted for 25%, respectively. In the «flowers» category, half of the import value (49%) was made up of cut flowers [1, 5].

However, in terms of domestic production, Ukraine mainly grows rose flowers for consumption within the country, export volumes are insignificant.

According to the official statistics of Ukraine, roses are mainly grown in the category of cut flowers: a total of 70.1 million pieces were grown. in 2017, and 99% of them were cultivated in the professional segment.

Ukraine is on the 75th position among the world exporters of flowers and its share in exports is 0.02% of the world exports of the category. In 2017, Ukraine exported USD 1 million. Ukraine exports cut flowers to only 2 regions and 8 countries. 63% of Ukrainian exports go to the EU, 36% of exports go to CIS countries [1].

The general growth of demand on the world market can testify to the prospects of exports from Ukraine: key importers of the category, such as the USA and the Netherlands, demonstrate an increase in the volume of imports. The European Union in general is also increasing the import volumes of the category. That is, under the conditions of stable production of products that meet all the necessary qualities and requirements of the countries to which the plants will be exported, Ukraine has every chance to increase export volumes. As of 2023, Ukrainian exports consisted mainly of floriculture products (87% of value and 74% of quantity). Ornamental plants accounted for only 13% of the total volume of exports in money terms. 98% of cut flowers are roses. Ornamental plants in the export structure consist of garden roses for 70%. The largest Ukrainian exporters of cut flowers are «Askania-Flora» LLC and «Cameliya-PR» LLC. The largest exporters in the sector of decorative plants are IP «Cornelis», PVP «Nova Khvylia», LLC «Dekoplant» [1].

Roses make up the vast majority (up to 70%) of flowers in the assortment of cut flowers. The most popular is the red rose (about half of all roses), followed by the white rose (25%), roses of other colors usually make up no more than 25% of the assortment [13].

A very small part of the cultivated products of ornamental plant production is exported. Exporters are nurseries such as Decoplant, Cornelis, Hardy, Natalis, Agroflora [1].

Some of the products are exported to Europe: cuttings for roses and bush seedlings from the Cornelis nursery. Dekoplant nursery exports up to 20% of grown garden roses.

Among the barriers to export, experts name: the inability of Ukrainian nurseries to provide constant supplies of the necessary volume of grown products, the inconsistency of the quality of planting material, compared to European nurseries.

Roses can be grown in open soil for up to 20 years, and in sheltered soil for up to 7 years, after the specified period of cultivation, the plantation must be renewed. The main reasons for this are, on the one hand, the intensity of plant cultivation, and on the other, myco-entomological factors. As a result of long-term growth in one place, a complex of phytopathogenic microorganisms accumulates on the territory from year to year, which are constant companions of roses, and the number of populations of which must be systematically controlled throughout the growing season, and which become more virulent every year. Practice has proven that there are no absolutely resistant varieties of roses to pathogens and pests. Some of them show greater or lesser resistance to one or another disease. In order to effectively use the potential of the assortment of the genus *Rosa* L. for the landscaping of populated areas, it is necessary to clearly know the reasons for the decrease in productivity, decorativeness and durability of plants [4, 13].

The species composition of the phytopathogenic complex of representatives of the genus *Rosa* L. has not been sufficiently studied, some observers claim that about 270 species of fungi, 6 species of bacteria, 9 species of viruses, and 19 species of nematodes were found on growing plants and their plant remains. Others, during the study of the phytosanitary state of rose gardens in botanical gardens and on roses for the greening of populated areas of russia and the CIS, discovered 28 types of pathogens of phytopathogenic organisms of fungal origin [2].

Pathologies of rose plants are manifested in the form of the formation of spores of pathogens in the middle of the tissues of leaves and shoots, plaques on leaves, shoots and other organs, rot, wilting of plants, necrosis, cancer formations, viral diseases. Powdery mildew is one of the most widespread and harmful pathologies of roses in open and closed soil in different geographical zones, which has an epiphytic character. The spread and harmfulness of powdery mildew has been known since the 3rd century AD. The causative agent of the pathology is the fungus Sphaerotheca pannosa Lev. var. rosae Woronich. synonyms Alphitomorpha pannosa Wallr. The causative agent of powdery mildew of roses belongs to the species Sphaerotheca pannosa (Wallr.) Lév., genus Sphaerotheca Lév., family Erysiphaceae Tul. & C. Tull [8].

The development of the pathogen of powdery mildew occurs according to an incomplete cycle, excluding the marsupial stage, therefore, the pathogen overwinters

in the form of mycelium on the affected shoots. The primary source of rose infection is conidia on the wintering mycelium. Pathogen of Sphaerotheca pannosa Lev. var. rosae Woronich. develops on all aerial parts of the plant, but most strongly on young shoots. The disease causes a general weakening of plants due to a decrease in the photosynthetic surface (the appearance of dense mycelial plaque on the leaf epidermis, curling of leaves, premature drying), and a decrease in the decorative qualities of varieties. Powdery mildew-resistant roses with leathery glossy leaves, the most susceptible varieties with large leaves, dark-colored varieties of roses [3, 5].
Leaf damage occurs from the bottom to the top (up to 5–6 leaves). Old leaves are not affected by powdery mildew. The initial manifestation of the disease on the leaves is noted in the form of a white powdery coating, which quickly becomes powdery. The leaves are deformed. The pathogen causes thickening and ugliness of young shoots and buds. Severely affected leaves turn brown, dry and fall prematurely. Affected plants lag behind in growth, shoots are twisted, leaves are deformed and twisted upwards, buds do not open, flowers do not develop (Fig. 1).

Fig. 1. Powdery mildew (caused by Sphaerotheca pannosa var. rosae) on rose foliage
source: formed on the basis of own research

In polyanthic roses, small red spots, arranged in a mosaic, first appear on young leaves. Gradually, a liquid cobweb mycelium coating is formed on them, which spreads over the entire surface, the leaves gradually turn brown, dry and fall [6].

Black spot is a dominant and harmful disease of roses in many regions of the world. The disease was first described in Europe in Sweden in 1815, then in Belgium in 1827 and in other European countries. Today, the disease is widespread throughout the world, even found in oceanic islands such as the Philippines and Hawaii [8].

The causative agent of Diplocarpon rosae F.A. Wolf (anamorph – Marssonina rosae (Lib.) Died.) affects a large number of species and decorative forms of the genus Rosa L. In the presence of the marsupial stage (Diplocarpon rosae Wolf.), the causative agent of black spot is quite variable, has a large number of races of the fungus, with different virulence and adaptability to different varieties of cultivated roses. Black spot affects wild plants and cultivated species of the genus Rosa L., most harmful on hybrid tea and remontant roses. The most susceptible are varieties with small leaf plates, for example, a group of miniature roses [7].

Black spotting is a widespread pathology of plants of the genus Rosa L., both in open and closed soil, but according to some data, the development of pathology was

not detected in closed soil conditions. Black spotting is characterized by a high distribution index that exceeds the 50% threshold. According to a number of researchers, the first symptoms of pathology appear in the second half of the plant's growing season, namely the second to third decade of July, when plant resistance decreases, with significant damage in August, leaf fall is observed. According to other researchers, the first signs appear at the end of June, in the second-third decade of May, at the end of August. The development of the disease is observed before frost [12].The causative agent of the disease develops in a wide temperature range the best formation of conidia is observed at a temperature of +23–25 ºC 24 hours after infection. The incubation period lasts from 8 to 21 days. The temperature maximum for the development of the fungus is +30 ºC, at a temperature of +35 ºC the conidia die completely, and at 0 ºC they do not develop. Black spotting develops intensively in rainy weather and at a moderate air temperature of +12–20 ºC, +21 °C is optimal for the development of mycelium. The fungus in vitro is stored at temperatures from -20 to -80 °C on leaves or pure culture, while conidia do not lose their vitality. The period from the onset of the disease to complete leaf fall is from 14 to 29 days [2, 7]. The pathology is manifested on the leaves in the form of black spots of a rounded shape. Conidia of the fungus develop on the spots, which are visible as swellings of an irregular shape. With severe damage, the leaves turn yellow, fall off, and the plants lose their ability to develop normally (the assimilation surface decreases, productivity decreases). First of all, young and middle-aged leaves are affected, old ones are not affected (Fig. 2).

Fig. 2. Black spot (caused by Diplocarpon rosae) of rose

source: formed on the basis of own research

With severe damage, rose bushes are completely exposed. Black spot damage does not affect flowering in this growing season, but has a negative effect on the amount of nutrients with which plants leave for the winter, on the formation and number of flower buds, on the maturation of shoots. In the next growing season, the growth of shoots and flowering productivity decrease sharply. Affected plants are less resistant to adverse factors. The harmfulness of the disease consists in premature death of leaves, leaf fall (defoliation), general weakening of plants, death of susceptible plants, reduction of decorativeness and resistance to adverse conditions. By the third decade of August or the beginning of September, the affected rose bushes become bare and the plants resume growth due to axillary buds. In winter, such bushes freeze strongly, weaken, which contributes to their secondary damage

by semi-parasitic and parasitic fungi. Also, the development of black spots contributes to the appearance of an infectious «burn» of the stem. Therefore, black spotting is the most harmful infectious pathology of roses [17].

Leaf lesions were observed throughout the growing season of members of the genus Rosa L. At the beginning of the disease, on the upper side of the leaf, less often on the green bark of one-year shoots, sometimes purple-white, and then rounded dark brown or black spots with a radiant structure are formed on the sepals.

The first symptoms appear on the lower layers of the leaves. The spread of pathology occurs from the lower leaves and gradually spreads to the top, covering the entire plant. The spots in the first stages of the lesion are small up to 0,8 cm in diameter, but gradually increase to 1,5–2,5 cm, merge, the leaves turn yellow, turn brown, twist upwards, defoliation occurs, the bushes become bare, only the leaf rosettes at the tops remain shoots [5].

Yellow rust is a common disease of wild and garden roses. Agents of rose rust are monoecious, that is, the entire cycle of their development takes place on rose plants. Pathology causes significant damage to rose plants, causing the twisting and drying of shoots, drying of leaves and bushes, delayed growth and development, and also significantly reduces the decorative qualities of varieties (Fig. 3).

Fig. 3. Rust (caused by *Phragmidium mucronatum*) on rose foliage. The erumpent pustules form on the lower surface of leaves, and these produce the orange rust spores

source: formed on the basis of own research

In the conditions of Ukraine, the mass development of rusty plaque on the leaves of roses was manifested only in certain years, which are favorable for the development of pathogens. A careful examination described various stages of the development of the fungus during the entire growing season: in late April–early May, bright yellow clusters of ecidial sporulation were noted on the stem, from July to October, orange-colored uredospores were detected on the leaves, from the third decade of August to October on the lower surface leaves – the formation of dark brown wintering spores of the teleitostage. Dry weather during the growing season of plants restrains the development of rose rust, the first signs are revealed in the second half of September after abundant morning dew. Under favorable conditions, from the third decade of September to the second decade of October, the development of the disease was noted, which manifested itself in abundant and simultaneous uredo- and

teleytosporogenesis on the lower surfaces of the leaves. Signs of damage are found on all organs of rose plants. The first symptoms appear on young shoots, petioles and buds in the form of orange-red spots. At the end of flowering until autumn, numerous pads of uredospores are formed on the underside of the leaves. The underside of the leaves is covered with chlorotic yellow spots. Such damage causes massive leaf fall, with the gradual growth of new ones. Affected by rust leads to an extension of the growing season of plants, their exhaustion, and a decrease in resistance to adverse abiotic factors, primarily to low temperatures. With a strong development of the pathology, the stems dry up [7].

Extremely dry weather, which is characteristic of southeastern Ukraine in the spring and summer months, restrains the development of rust. The first signs appear in the second decade of September, after abundant morning dew. From the third decade of September to the second decade of October, a massive development of the pathology is observed, which was manifested in abundant and simultaneous uredo- and teleytosporogenesis on the underside of the leaves.

Botrytis blight roses (gray mold). Pathology caused by the pathogen *Botrytis cinerea* was detected on buds and flowers and very rarely on stems and leaves. Brown spots develop on the affected tissues. In humid weather, the spots are covered with a dense gray coating of the fungus and rot (soft rot), in low humidity conditions, they dry out. The buds do not open or they form deformed flowers. There are small brown spots or sores on the petals. With a high degree of damage, the flowers dry up, deform, lose their color and rebloom within a day, while the petals often do not fall but hang down, which significantly reduces the decorativeness of roses (Fig. 4).

Fig. 4. Botrytis blight (caused by Botrytis cinerea) on a rose flower. The fungus will produce gray-brown fungal growth with spores on the petals

source: formed on the basis of own research

Due to damage to the stem, the damaged green shoots are covered with a gray coating, gradually dry up, the leaves turn yellow and fall off without other visible symptoms. The disease is very dangerous for rooting by cuttings and grafting roses [11].

In addition, there are root diseases in rose plantations. Fusarium root rot of roses. Young plants of the genus Rosa L are affected. Pathology is caused by pathogens from the genus Fusarium Link, which can be diagnosed by the following signs: darkening of root hairs, formation of deep brown ulcers on the roots and stems near the root neck, covering more than half of the entire surface. The root system and the base of the stem gradually die. The lower leaves on the plant begin to wither, and the

edges of the leaves above become watery, may be covered with spots of light yellow or light green color. Due to the weakening of the vessels of the leaf petioles, the leaves hang along the stem. Withering of plants occurs as a result of damage to the vascular bundles of the upper part of the root and the base of the stem. A cross-section of these organs shows browning of blood vessels in the form of rings, semi-rings or brown dots arranged in a ring. In wet weather, a white fluffy coating and pale pink, whitish or yellowish mucous pads appear at the base of the stems of the affected plants – sporodochia, which are a dense tangle of short, often branched conidiophores with conidia. Affected plants show general wilting, lack of bud formation, and flowering. Plants lag behind in growth and die [9].

Thus, as a result of phytopathological monitoring of agrobiocenoses of roses in the Vinnitsa region, pathogens of mycological diseases cause pathological changes in plants in the form of root rot, wilting and various types of spots. Therefore, clarifying the main causative agents of rose diseases, factors regulating their development through the use of plant protection products in modern conditions is relevant.

Materials and methods of research. Phytopathological monitoring of biocenoses of roses was carried out by a route survey according to generally accepted methods in phytopathology. Identification of pathogens was carried out by microscopic analysis of affected organs and establishment of diseases by determinants. Identification of pathogens was carried out in the research laboratory of phytopathology, where the collected herbarium material of affected rose organs is stored. The modern name of mushroom species, as well as their synonyms, was agreed with the international mycological global database Index Fungorum [10, 14].

The area of experimental plots is 2 m^2, the placement of plots is randomized. The hybrid tea rose variety Black Magik was used in the experiments.

For the treatment of planting material, the fungicides Maxim 025 FS, TN (active substance – fludioxonil, 25 g/l) and Kinto Duo, KS (triticonazole, 20 g/l + prochloraz, 60 g/l) Table 1.

Table 1

Scheme of an experiment on the use of anti-poisoning fungicides to protect rose planting material from diseases, 2022–2023

№ p/p	Variant	Consumption rate, kg (l)/t
1.	Control	-
2.	Maxim 025 FS	1,5 l/t
3.	Kinto Duo, CS	2,5 l/t

source: formed on the basis of own research

Treatment of experimental plots with fungicides was carried out with the help of a knapsack motor sprayer with a rate of consumption of the working liquid at the rate of 200 l/ha. In order to control diseases, the effect of the following fungicides was studied: Impact T, CS (flutriafol, 75 g/l + tebuconazole, 225 g/l), Bumper Super, CE

(propiconazole, 90 g/l + prochloraz, 400 g/l), Amistar Extra 280 SC (azoxystrobin, 200 g/l + cyproconazole, 80 g/l), Amistar Gold 280 SE, (azoxystrobin, 125 g/l + difenoconazole, 125 g/l), Alto Super 300 ES, (cyproconazole, 80 g/l + propiconazole, 250 g/l), Maxim 025 FS (fludioxonil, 25 g/l), Horus 75 WG, (cyprodinil, 750 g/l) and their mixtures. These drugs belong to various chemical groups, including derivatives of triazoles, strobilurins, imidazoles, phenylpyrroles, cyprodinils [15, 17].

The first spraying of crops with fungicides was carried out with the development of diseases in control of 3–5%, the second – after 30 days. Records of diseases were carried out before processing and 15 and 30 days after it Table 2.

Table 2

Scheme of the experiment on the use of fungicides to protect roses from diseases, 2022–2023

№p/p	Variant	Consumption rate, l/ha + kg/ha
1.	Control	-
2.	Impact T, CS	1,0 l/ha
3.	Bumper Super, CE	0,8 l/ha
4.	Amistar Extra 280 SC	0,75 l/ha
5.	Alto Super 300 EC	0,5 l/ha
6.	Amistar Gold 250 SC	12 ml/5 l of water per 100 m^2
7.	Maxim 025 FS	0,75 l/ha
8.	Horus 75 WG	0,6 kg/ha
9.	Maxim 025 FS + Horus 75 WG	0,75 l/ha + 0,6 kg/ha

source: formed on the basis of own research

Pathological lesions were recorded with the calculation of phytopathological indicators: disease prevalence (P, %), average weighted lesion score (Bx), degree of disease development (C, %). The prevalence (P) of pathology in the biocenosis of roses was determined by the number of diseased plants for each sample as a percentage of the total number according to the formula:

$$P = n \times 100 / N, \qquad (1)$$

where N is the total number of accounting plants;

n is the number of affected plants [10].

In the field experiment, records of damage to rose plants were carried out at stationary recording sites on 25 consecutively taken plants on all leaves separately for damage caused by powdery mildew and black spot. The calculation was carried out before spraying and after the first spraying on the 7th day and after the second spraying in the phase of the beginning of flowering and at the end of flowering. Records of damage to plants by diseases (powdery mildew, black spot) were carried out according to the appropriate scales given in the Table 3. The number of pests on each variant was counted before treatment and 3, 7 and 14 days after it. The technical efficiency of fungicides and poisons was determined by the percentage of pest death according to the formula:

$$Te = \frac{A - B}{A} \cdot 100, \qquad (2)$$

where Te is technical efficiency, %;

A – indicator of disease development in the control;

B is an indicator of the development of the disease in the experimental version [14].

The economic effectiveness of protection measures was determined on the basis of income from the sale of crops and the amount of actual costs for processing crops, purchase prices for drugs and additional costs. Experimental data were processed on a computer by the method of dispersion analysis, calculations were performed on a computer using the *Excel* spreadsheet program.

Table 3

Scale of defeat of roses by *powdery mildew* and *black spot*

Bal	The degree of the lesion	Characteristic signs	The area of the affected plant surface, %
0	Absent	Healthy plants	0
0,1	Insignificant	Single on individual leaves mushroom mycelium pads	<1
1	Weak	Many cushions of the mycelium of the mushroom	1-10
2	Average	Affected up to ¼ of the surface of the leaves, conidial sporulation of the fungus. Individual pads of mycelium of the mushroom on leaves	11-25
3	Strong	Up to ½ of the leaf surface is affected, strong conidial sporulation of the fungus, death begins leaf blade, affected stems, bud	26-50
4	Very strong	Affected leaves die. Buds fall off	>50

source: formed on the basis of own research

Research results. In order to select an assortment of effective fungicides for their inclusion in the system of protection of roses against plant damage by pathogens, they were studied in the conditions of LLC «Dekoplant» of the Vinnitsa region.

The study of the species composition of diseases on rose plants is important for the selection of effective fungicidal drugs and the justification of their use in protection systems in order to preserve the potential yield.

According to the results of the research, the percentage ratio of the main types of diseases, the causative agents of which we detected on plants in rose plantations in 2022–2023, was established.

During observations of rose plants, such diseases as powdery mildew, black spot, yellow rust, botrytis blight, downy mildew, stem cancer, and root rot were found. According to the results of our calculations on the control variant of the experiment, the highest percentage of the ratio among the phytopathogens that we detected fell on such a disease of roses, powdery mildew, which was 42%, black spot – 21,0%, a high percentage also had such diseases as yellow rust – 15,0%, botrytis blight – 13,0%, downy mildew – 5,0%, root rot – 3,0%, the lower percentage is typical for stem cancer – slightly more than 1,0% (Fig. 5).

Thus, at present, the main fungal diseases of rose plants in the Vinnitsia region are powdery mildew, black spot, yellow rust, botrytis blight, downy mildew and root rot.

Therefore, to develop the protection of rose plantations against diseases, it is necessary to select fungicides with a spectrum of action against these phytopathogens.

Powdery mildew (the causative agent of *Sphaerotheca pannosa* var. *rosae* Woron.) affected plants annually, both in the spring-summer and in the autumn growing season.

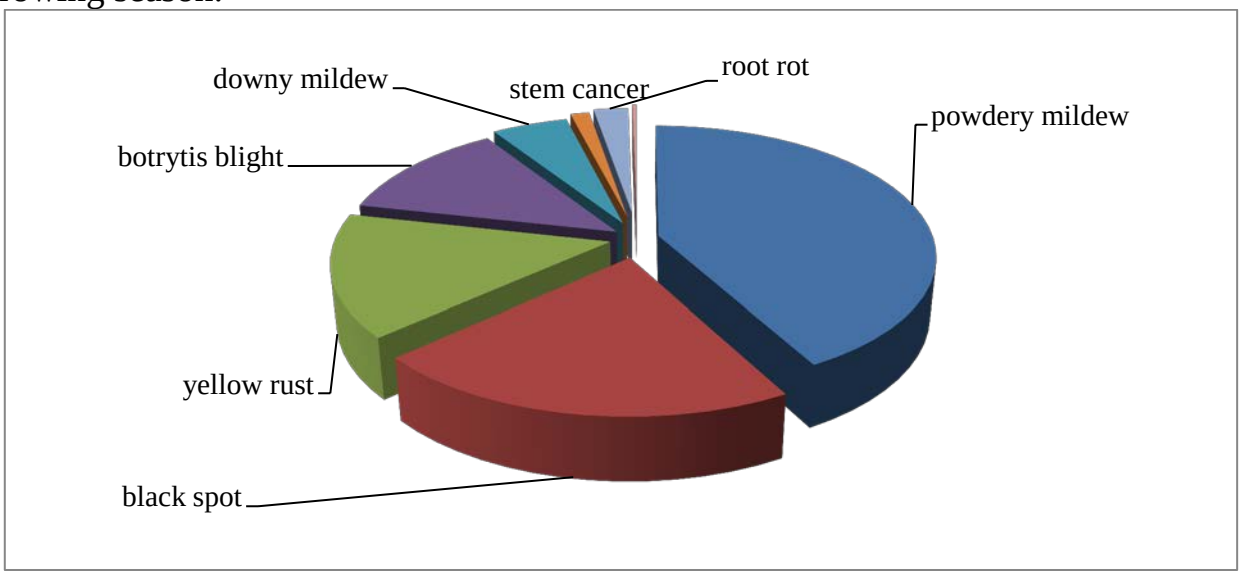

Fig. 5. The species ratio of the main diseases of roses in the conditions of the Vinnitsia region, 2022–2023.

source: formed on the basis of own research

The mycelium of the mushroom had the appearance of a white weblike layering, later it was compacted and became floury. Later, the cotton pads acquired a dirty yellow-gray shade and small black cleistothecia formed on them.

Both the spread and the development of the disease were noted at a high level during the research period. The highest rate of prevalence and development of powdery mildew was recorded in 2022 – it reached 15,2–25,3%. The disease affected rose plants the least intensively in 2023, when its prevalence was 22,6%, and development was 10,5%, respectively (Table 4).

Table 4

Spreading and development of diseases on roses, 2022–2023

Name of the disease and its pathogen	Disease spread, %		Disease development, %	
	2022	2023	2022	2023
Yellow rust (*Phragmidium mucronatum* Pers.)	10,9	6,4	4,1	1,5
Botrytis blight roses (*Botrytis cinerea*)	8,4	6,1	1,8	0,6
Powdery mildew *(Erysiphe graminis* DC.*)*	25,3	22,6	15,2	10,5
Black spotting of leaves *(Diplocarpon rosa*e Wolf.)	13,4	8,5	3,9	3,5

source: formed on the basis of own research

A significant spread and development on rose plants was observed in rose leaves affected by black spot, in 2022 it was 3,9–13,4% and in 2023 it was 3,5–8,5%, respectively. Yellow rust and gray rot were less common and developed. These diseases were 4,1–10,9% and 1,8–8,6% in 2022, and 6,4–1,5 and 6,1–0,6% in 2023 respectively. So, over the years of research, it was established that roses were significantly affected by diseases during the growing season, so it became necessary to limit the development and spread of these diseases by applying fungicidal protection of roses. Effectiveness of treatment of planting material and basal aerial part against diseases of roses. Treatment of planting material of roses is an important element in growing technology, which makes it possible to protect young sprouts in the early stages of ontogenesis from root and soil infections, to significantly reduce the damage to vegetative organs. In addition, such a measure as the treatment of planting material and the basal aerial part also contributes to the improvement of the wintering conditions of plants during the long and unfavorable autumn-winter period.

The research was carried out during 2022–2023 for the treatment of planting material, fungicides Maksym 025 FS (active substance – fludioxonil, 25 g/l) and Kinto duo, CS triticonazole, 20 g/l + prochloraz, 60 g/l) were used with consumption rates of 1,5 and 2,5 l/t, respectively. Fludioxonil belongs to the chemical group of phenylamides and has a contact-penetrating effect, acting on pathogen cells regardless of the stage of their development. As a poison, it is used on many cultures. Fludioxonil prevents the development of mold, is effective against root rot.

Triticonazole and prochloraz, components of Kinto Duo antidote, belong to triazoles and imidazoles, respectively. These active substances are characterized by different mechanisms of action on pathogens. Thus, thanks to its systemic action, triticonazole destroys surface and internal infection, penetrates into the seedling, providing protection of plants against diseases in the early stages of their development. Prochloraz has a local and systemic effect. It penetrates inside the planting material, having a disinfecting effect. In addition, it can travel down the roots, protecting and maintaining a healthy root system from the very beginning. Kinto Duo poison is effective against mould, root rot and seedling diseases [10, 16].

Records of root rots were carried out after the restoration of plant vegetation. As evidenced by the results of the phytopathological analysis, Fusarium root rot was dominant (Table 5).

Table 5

Effectiveness of application of treatment of planting material of roses with fungicides against root rot, 2022–2023

Variant	Consumption norms of the drug, l/t	Disease development, %		Technical efficiency, %	
		2022	2023	2022	2023
Control	-	8,8	5,9	0	0
Maxim 025 FS	1,5	2,4	1,6	72,9	75,5
Kinto Duo, CS	2,5	1,6	1,2	79,7	83,7
LSD_{05}	-	1,1	1,2	-	-

source: formed on the basis of own research

The development of the disease in the control during the research period was in the range of 5,9–8,8%. The lowest level of damage was recorded in 2023, and the highest (8,8%) – in 2023. During the processing of the planting material, there was a significant reduction in the development of the disease. Thus, in the version where Maxim 025 FS was used, this indicator was within 1,6–2,4% over the years of research. Technical efficiency was 72,9–75,5%. As for Kinto Duo, CS, a slightly stronger reduction in damage to rose plants by root rot was recorded, the development of which was in the range of 1,2–1,6%, but the difference between this drug and Maxim 025 FS was not statistically significant. The technical efficiency of Kinto Duo, CS against root rot was 82,0% on average.

Application of fungicides by spraying to protect roses from diseases. During the growing seasons of 2022–2023, under the conditions of the Vinnitsia region, the effectiveness of spraying the leaf surface of rose plants against the main diseases was investigated. The first spraying of crops with fungicides was carried out at the development of diseases of 3–5%, the second – after 30 days.

During the period of research on roses, among leaf diseases, powdery mildew was the most common, the manifestations of which were recorded on plants from the very beginning of the growing season. Also, in the spring-summer period, the symptoms of black spotting of the leaves appeared en masse, but the disease acquired a slightly smaller development.

Research records conducted 30 days after the second treatment showed that the two-time use of fungicides had a positive effect on the condition of the roses. Thus, the development of powdery mildew decreased from 23% in the control to 1,8–8,9% in the experimental variants. The most effective was the use of Alto Super 330 ES, at the consumption rate of 0,5 l/ha, Amistar Extra 280 SC at the rate of 0,75 l/ha, Amistar Gold 250 SE (12 ml/5 l of water per 100 m^2) and tank mixture Maksym 025 FS (0,75 l/ha) with Horus 75 WG (0,6 and 0,75 kg/ha). In these variants of the experiment, the technical efficiency against powdery mildew reached 82,2–92,2% (Table 6). This indicator was somewhat lower for the treatment of Bumper Super, CE (0,8 l/ha) and Maxim 025 FS, because (0,75 l/ha) – 77% and 73,5%, respectively. Impact T, CS (1,0 l/ha) and Horus 75 WG, 0,6 kg/ha had the least influence on the development of powdery mildew.

The development of black leaf spot was generally lower compared to powdery mildew and averaged 10,6% of the control. The use of fungicides contributed to its reduction to 2,1–5,1%. At the same time, the technical efficiency varied from 54,7% on the variant with Impact T, CS (1.0 l/ha) to 80–82% when processing Alto Super 330 ES (0,5 l/ha) and Amistar, respectively Gold 250 SE, (12 ml/5 l of water per 100 m^2), which showed the highest efficiency among the tested drugs and their combinations. A significant reduction in the development of the disease was achieved with the treatment of sowing Bumper Super, KE (0,8 l/ha) and tank mixture Maxim 025 FS (0,75 l/ha) with Horus 75 WG (0,6 kg/ha) – 75,5% and 74,5%, respectively.

Thus, the use of fungicides helps to reduce the development of rose diseases. The

best indicators against powdery mildew and black spotting of leaves were obtained when processing Alto Super 330 ES (0,5 l/ha), Amistar Gold 250 SE (12 ml / 5 l of water per 100 m^2) and Maxim 025 tank mixture FS (0,75 l/ha) + Horus 75 WG (0,6 kg/ha). To prevent the formation of resistance to these fungicides, it is advisable to alternate them during treatments. So, it was established that the poisoning of the planting material with the fungicides Maksym 025 FS and Kinto Duo, CS provided a reduction in the development of root rots in the treated areas, which was less than the control variant by an average of 3,7–6,1 times.

The best indicators against diseases of rose leaves were obtained when processing Alto Super 330 ES (0,5 l/ha), Amistar Gold 250 SE (12 ml/5 l of water per 100 m^2) and Maxim 025 FS tank mixture (0,75 l/ha) + Horus 75 WG (0,6 kg/ha). Technical efficiency against powdery mildew on these variants was at the level of 84,8–92,6%, black spot – 74,5–82,1%, respectively (Table 6).

Table 6

Effectiveness of fungicide application against diseases of rose leaves and flowers, 2022–2023

Variant	Consumption norms of the drug, l/ha, kg/ha	Disease development, %		Technical efficiency, %	
		Powdery mildew	Black spotting of leaves	Powdery mildew	Black spotting of leaves
Control	-	23,2	10,4	0	0
Impact T, CS	1,0	7,6	4,8	67,0	54,7
Bumper Super, CE	0,8	5,3	2,6	77,0	75,5
Amistar Extra 280 SC	0,75	4,1	3,6	82,2	66,0
Alto Super 300 EC	0,5	1,8	2,1	92,2	80,2
Amistar Gold 250 SC	12 ml/5 l of water per 100 m^2	1,7	1,9	92,6	82,1
Maxim 025 FS	0,75	6,1	4,2	73,5	60,4
Horus 75 WG	0,6	8,9	5,2	61,3	50,9
Maxim 025 FS + Horus 75 WG	0,75+0,6	3,5	2,7	84,8	74,5
LSD_{05}		3,0	1,6		

source: formed on the basis of own research

It should also be noted that the application of fungicidal protection against the main diseases of roses, where the fungicide Amistar Gold 250 SE, 12 ml/5 l of water per 100 m^2 was used, made it possible to obtain the yield of roses per cut at the level of 26 pcs./m^2, which is more than 7 pcs./m^2 than on the control version, and the profit indicators were UAH 1160, which is higher by UAH 560 than on the control. The cost of growing roses per cut was UAH 350.

Conclusion. According to the results of the conducted research, an important scientific task of substantiating protective measures against the main diseases of roses was theoretically summarized and solved based on the establishment of the peculiarities of the formation of their complex conditions in Vinnitsia region.

It was established that the highest percentage of the ratio among phytopathogens that were detected on roses is powdery mildew, which was 42%, black spot – 21,0%, diseases such as yellow rust – 15,0%, botrytis blight – also had a high percentage 13,0%, less numerous were downy mildew – 5,0%, root rot – 3,0%, the lower percentage is typical for stem cancer – slightly more than 1,0% Poisoning of planting material with fungicides Maxim 025 FS and Kinto Duo, CS provided reliable protection of rose plants against root rot. The development of root rot on the treated plots was lower than the control variant on average – by 3,7–6,1 times.

The best indicators against leaf diseases were obtained when processing Alto Super 330 ES (0,5 l/ha), Amistar Gold 250 SE (12 ml/5 l of water per 100 m^2) and Maxim 025 FS tank mixture (0,75 l/ha) + Horus 75 WG (0,6 kg/ha). Technical efficiency against powdery mildew on these variants was at the level of 84,8–92,6%, black spotting of leaves – 74,5–82,1%. The highest productivity and economic efficiency of rose cultivation was achieved when the fungicide Amistar Gold 250 SE, 12 ml/5 l of water per 100 m^2 was used. This ensured the yield of roses per cut at the level of 26 pcs./m^2, which is 7 pcs./m^2 more than in the control variant. The highest profit indicators were obtained when using the fungicide Amistar Gold 250 SE, 12 ml/5 l of water per 100 m^2 and amounted to UAH 1,160, which is UAH 560 higher than the control. The cost of growing roses per cut was UAH 350.

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АНОТАЦІЯ
ХВОРОБИ ТРОЯНД ТА БОРОТЬБА З НИМИ В УМОВАХ ВІННИЦЬКОЇ ОБЛАСТІ

В даній статті висвітлено проблематику що полягає в удосконалені і обґрунтовані елементів системи захисту від основних хвороб троянд на основі встановлення особливостей формування їх комплексу в умовах Вінницького району. За результатами проведених нами досліджень встановлено, найвищий відсоток співвідношення серед фітопатогенів, які були виявлені на трояндах були, борошниста роса, що склала 42%, чорна плямистість – 21,0%, високий відсоток також мали такі хвороби, як жовта іржа – 15,0%, сіра гниль – 13,0%, менш численними були переноспороз – 5,0%, кореневі гнилі –3,0%, нижчий відсоток характерний для стеблового раку – трохи більше 1,0%. Протруєння садильного матеріалу фунгіцидними протруйниками Максим 025 FS, ТН і Кінто Дуо, КС забезпечувало надійний захист рослин троянд від кореневих гнилей. Розвиток кореневої гнилі на оброблених ділянках був меншим від контрольного варіанту в середньому – у 3,7–6,1 рази.

Найкращі показники проти хвороб листя отримано за проведення обробок Альто Супер 330 ЕС, КЕ (0,5 л/га), Амістар Голд 250 SE, КС (12 мл/5 л води на 100 м^2) та баковою сумішшю Максим 025 FS, т.к.с. (0,75 л/га) + Хорус 75 WG, ВГ (0,6 кг/га). Технічна ефективність проти борошнистої роси на цих варіантах була на рівні 84,8–92,6%, чорної плямистості листя – 74,5–82,1%.

Найбільша продуктивність та економічна ефективність вирощування троянди була при вирощуванні, де використовувався фунгіцид Амістар Голд 250 SE, КС, 12 мл/5 л води на 100 м^2. Це забезпечило одержання врожайності троянд на зріз на рівні 26 шт./м^2, що більше 7 шт./м^2 ніж на контрольному варіанті. Найвищий показник прибутку був отриманий при застосуванні фунгіциду Амістар Голд 250 SE, КС, 12 мл/5 л води на 100 м^2 і становив 1160 грн., що вище на 560 грн, ніж на контролі. Собівартість вирощування троянд на зріз при цьому становила 350 грн.

***Ключові слова**: троянди, основні хвороби троянд, розвиток хвороб, фунгіциди, ефективність*

Табл. 6. Рис. 5. Літ. 17.

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