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FUNGAL DISEASES OF GRAPES IN UZHHOROD AND ON SURROUNDING LANDS

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Fungal diseases of grapes in Uzhhorod and on surrounding lands.- Sharga Boris M.- *Fungal diseases of grape were studied on small private vineyards in Uzhhorod and on surrounding lands with overgrown vineyards of former state farms during 2015 growing season. The alternariosis, bunch rot (Alternaria alternata), anthracnose (Gloeosporium ampelophagum), berry rots (Aspergillus niger, Cladosporium herbarum, Penicillium spp., Rhizopus arrhizus, R. stolonifer), black rot (Guignardia bidwellii), brown spot (Septoria melanosa), cercosporose (Cercospora sessilis), downy mildew (Plasmopara viticola), powdery mildew (Uncinula necator), fusariosis (Fusarium equiseti, F. moniliforme, F. scirpi, F. solani), gray rot (Botrytis cinerea), rotbrenner (Pseudopeziza tracheiphila), trunk and arm dieback (Eutypa lata, Phomopsis viticola, Botryosphaeria sp.), white rot (Coniella diplodiella*) *were noted and their incidences and symptoms severities were estimated.*

Small non-treated plantings near houses and large neglected vineyards often act as the diseases sources. Integrated plant protection, cultivation of resistant varieties and overgrown vineyards clearance and sanitation are necessary for grape diseases control.

Key words*: grape, fungal diseases, Uzhhorod, vineyards, cultivars.*

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Грибні хвороби винограду в Ужгороді та на прилеглих землях.- Шарга Борис М.- *Досліджено хвороби винограду на малих приватних виноградниках та залишених без догляду ділянках колишніх державних радгосп-заводів у Ужгороді та на прилеглих землях протягом сезону вирощування 2015. Тут були виявлені і досліджені на поширення і агресивність симптомів альтернаріоз та гниль грона (Alternaria alternata), антракноз (Gloeosporium ampelophagum), гниль ягоди (Aspergillus niger, Cladosporium herbarum, Penicillium spp., Rhizopus arrhizus, R. stolonifer), чорна гниль (Guignardia bidwellii), коричнева плямистість (Septoria melanosa), церкоспороз (Cercospora sessilis), несправжня борошниста роса (Plasmopara viticola), борошниста роса (Uncinula necator), фузаріоз (Fusarium equiseti, F. moniliforme, F. scirpi, F. solani), сіра гниль (Botrytis cinerea), червонуха (Pseudopeziza tracheiphila), сухорукавість (Eutypa lata, Phomopsis viticola, Botryosphaeria sp.), біла гниль (Coniella diplodiella).Необроблені насадження біля будинків і великі «забуті» виноградники є джерелами цих хвороб. Інтегрований захист рослин, вирощування стійких сортів і розчистка та санація заростих виноградників необхідні для захисту винограду від хвороб.*

Ключові слова: *виноград, грибні хвороби, Ужгород, виноградники, сорти.*

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Introduction

The Transcarpathia was documented as region of grapes cultivation and wines production for centuries. Historically, our lands were involved in production of well-known “Tokaj” wine. At Soviet Union times, our region has been supplying popular wines “Aligoté”, “Riesling”, “Kadarka”, “Trojanda Zakarpattya”, “Irshavske”, “Serednyanske”, etc. Average regional grapes production in last USSR’s years (1989-91), recorded after "anti-alcohol campaign”, was 25.500 t (Глагола 1992). Today, because of specialized state and collective farms decline, local grape production does not meet demand. In this regard, as well as through increased excise taxes, most of wineries of the region are on the verge of bankruptcy.

Grapes traditionally have been grown on the hills and outskirts of Uzhhorod, and this is evidenced by vines arms pictured as elements of the town emblem. The grape plants grow almost on every courtyard. The small plantings often improperly managed or abandoned in same way as the plantations of collapsed collective or state farms. Non-treated grapes act as pathogens sources to commercial plantations. Grape fungal diseases cause significant damage to our viticulture and wine industry. However, these were scarcely explored in our region. Last survey in pathogenic mycobiota of fruit trees and grapes was conducted in our region in

the late 1980s (Глагола 1992). Since that time there were significant reduction in vineyards areas. Some of them were neglected and new varieties were planted. Global warming increased the air temperature by 2°C within last decades. This might gave rise of new diseases or change aggressiveness of existing. New studies of grape plant pathogenic fungi in Uzhhorod and surrounding lands are relevant.

Materials and methods

Small private vineyards located in a valley and on the hills of Uzhhorod and on surrounding lands, particularly, vine plantations of former state farm-vineyards "Velykolazivsky" and "Uzhhorodsky" on the outskirts of the town (totally 2000 plots) were surveyed for fungal diseases during growing season 2015. Half of these (1000 vineyards) were sprayed by fungicides and the rest left untreated after the hand pruning. The fungicides were applied at doses 0.8 L/ha for "Quadris", 2.5 kg/ha for "Ridomil Gold" and 0.15 L/ha for "Topas" during growing season since the stage of 5-7 leaves unfolded with intervals of 14 days until the stage of veraison. "Ridomil Gold" is a water dispersible granule formulation containing 4% w/w metalaxyl-M and 64% w/w mancozeb. The fungicides "Quadris" and "Topas" contained 250 g/L of azoxystrobin and propiconazol, respectively. Altogether 3 treatments have been done by each of chemicals with change of fungicide family (i.e., 1-st spray - strobilurines ("Quadris"), 2-nd spray dithiocarbamates ("Ridomyl Gold"), 3-d spray azoles ("Topas"). To eradicate wood-decay, the heavy cutting off vines top, mulching, removing debris and low new growth before application of fungicides were used (Sosnowski et al. 2012).

The symptoms severities of diseases were determined as a damage percentage in bunch, leaf, shoot, arm or trunk. The number of plots with particular disease was counted. The disease incidences and symptoms severities on treated and untreated plots were compared.

Symptomatic tissues were incubated at 18-24°C in plastic bags on a cotton wool humidified by sterile water. The mycelia from grape tissues were studied in light microscope. Diseases were identified by symptoms, morphology of pathogen's mycelia and spores (Bisiach 1998, Ainsworth et al. 1965–1973).

Results and Discussion

The Table 1 summarizes the data on diseases distribution, incidences and symptoms severities on sprayed and non-sprayed plots. More than 1/3 of unsprayed (341) and some sprayed vineyards (17) showed *Botrytis cinerea* (Pers.: Fr.) gray rot at the bloom and at the end of the growing season 2015 (Fig.1). The spring weather was not suitable for foliar and shoot blight symptoms development. Infection of young leaves resulted in areas of brown necrotic tissue. Small shoots were killed often and older canes were broken off or wilted at the site of infection. Infection was noted mainly at the points where water remaining longer, allowing conidial germination.

The flowers at bloom showed no symptoms. However, aborted infected flowers were observed within 18.1-30.0% of bunches in different cvrs at pre-bunch closure stage on untreated and within 9.7-14.5% of bunches on treated plots. The presence of *B. cinerea* was revealed in 80 and 65% of apparently healthy calottes and stamens, respectively (Sanzani et al. 2012). *B. cinerea* was recovered from 0.2 to 0.5% of surface-disinfested berries just subsequent to fruit set, and 1.6–4.8% of surface-disinfected, over-wintered dormant buds (Dugan et al. 2002).

The berries were without symptoms of gray rot infection between bloom and veraison. After veraison the fungus produced disease symptoms in susceptible cultivars (cvrs). However, symptoms severity varies between them. Thus, the "Aligoté", "Gamay", "Chardonnay", "Chasselas doreé", "Perlă de Csaba", "Riesling", "Sauvignon Blanc", were highly susceptible to the disease. They showed from about 10.1 to 29.7% berries in clusters damaged, if not received fungicides treatment. Var. "Concord", "Crimson Seedless" "Chancellor", "Delaware", "Blauerzweigelt", "Elvira", "Emperor", "Muscat de Hamburg", "Pance D'Espagne", "Princess", "Thompson Seedless", "Traminer white", "Traminer rose" showed moderate symptoms as about 5.0-6.5% of berries in their bunches were rotted. The cvrs "Autumn Royal", "Cabernet Sauvignon", "Isabella", "Merlot", "Moldova", "Ruby Cabernet", "Ruby red", "Victoria" were slightly sensitive to it and demonstrated much less severe symptoms, as about 3.2-4.0% of bunch berries (most with mechanical damage from feeding of insects or birds) were affected. The cvrs "Cabernet Blanc", "Gamaret" and "Bronner" showed no symptoms, regardless of the *Botrytis* conidia present on these grapes. Some unknown varieties, planted near houses, were resistant also. Treated vineyards demonstrated less severe symptoms and lower incidences, compared to non-treated plots (Table 1). Gray rot was most dispersed disease in growing season 2015. The disease incidence was depending on cvrs, plantation location and treatment also. For ex., for non-sprayed "Chardonnay" it was about 44.1-50% and incidences about 10.2-11.1% was estimated on untreated "Zinfandel". About 49.6% of the number of grape bunches were affected on overgrown vineyards of state farm-factories "Velykolazivsky" and "Uzhhorodsky", planted with "Leanka" and "Riesling". The severities of symptoms varied here from 20.6 to 29.7%. They were more aggressive on close to the ground clusters, leaves or shoots and less severe in tops. This was observed in all affected varieties and vineyards.

The mycotoxins and some other metabolites of *B. cinerea*, have negative effect on table grape storage and may affect wine quality during grape processing.

The *Alternaria alternata* (Fr.:Fr.) Keissl. caused spots and necrosis in leaves, shoots and berries on weakened plants. On spring 2015 *Alternaria* mycelium and spores were detected in the buds. Grape leaves and shoots were covered with silvery spots later. Then, the spots turned brown. Disease was favored by humid weather. It was observed on plants of 132 untreated and 5 treated plots. In many vines strong development of the disease resulted in leaves blackening and withering. The disease incidences and severities were lower on treated plantings (Fig.1, Table 1).

The disease appeared on bunches in August. Spots on mature berries had metallic luster and dark gray sporulation later. The cvrs with tight clusters, cracking from growth pressure, fruit abscission or mechanical damage were more affected by the rot. The "Isabella", "Moldova" and some other cvrs with less compact bunches seemed less affected by the disease (the incidences 0.4-0.6%), however, cvrs "Leanka", "Pinot Noir" showed the disease incidence about 22%. About 29.3-31.2% of berries sampled at harvest from fungicide untreated grape bunches exhibited growth of *A. alternata* on PDA at 24°C. About 17.7-23.3% of berries from treated plots gave this fungus mycelium growth at these conditions. Latent *A. alternata* infections were present in vineyards during the whole growing season. Similar result was obtained earlier (Sware, Ho1z 1994). Usually, *Alternaria* bunch rot infects grapes in wormer regions (Евдокимова 2008). Recently, it was discovered in Slovakia close to our region also (Kakaliková et al. 2009).

Aspergillus niger Tiegh., *Cladosporium herbarum* (Pers.) Lk., *Penicillium* spp. contributed to the summer bunch rot also, sometime as a mixed infections with *A. alternata* and/or *B. cinerea.* The incidences and symptom severities of their infections on vineyards were lower on fungicide treated areas (Table 1). *Aspergillus* Sect. Nigri is able to cause vine cankers (Vitale et al. 2012), however these were not observed in vineyards of Uzhhorod and nearby areas.

The black bitter rot (*Rhizopus arrhizus* Fisch., *R. stolonifer* Ehrenb.), was detected on mechanically damaged bunches collected from 19 plots at the end of growing. The disease severities and incidences were estimated at higher levels on non-sprayed vineyards (Table 1). These pathogens, primary grown as saprophytes in juice on mechanically damaged berries, gradually affecting healthy cells, turned on parasitism. To decrease these infections, care must be taken to avoid the bunch mechanical damage during grape growing and harvest time.

Berry decay fungi as *A. alternata, A. niger, C. herbarum, Penicillium* spp., *R. arrhizus, R. stolonifer* may influence the must and wine quality by producing off-flavour or mycotoxins (Serra et al. 2005, Kassemeyer, Berkelmann-Löhnertz 2009).

Young berries, leaves and shoots manifested powdery mildew since April. *Uncinula necator* (Schwein.) Burrill (anamorph: *Oidium tuckeri* Berk.) development was observed on the surface of all green organs, of grapes. The treatment of vines by fungicides keeps them healthy on 749 vineyards. The disease damaged grape on the rest of the plots (2 treated and 249 untreated) with non-resistant cvrs. It was impossible to get edible grape in autumn from some varieties on untreated plantings. The symptoms severities or their spread were higher on untreated plots (Table 1). The manifestation of disease was cultivar dependant. For ex., the incidence on leaves of non-sprayed "Chardonnay" variety was 33-35% and the incidence 68-70% was estimated on untreated leaves of "Thompson Seedless". The "Aurora", "Chancellor", "Chardonnay", "Geisengeim", "Merlot", "Sauvignon blank", "Riesling", "Victoria", "Bohotin", "Fetyaska nigra", "Muscat Ottonel", "Thompson Seedless" were highly susceptible to the disease. Depending on local conditions and cvrs, they manifested from 20 to 42% of leaf area damaged and incidence of symptoms more than 30%. The cvrs "Aligote", "Bastard de Magarach", "Eona", "Pinot noir", "Princess", "Traminer rose", "Traminer white" and "Steuben" demonstrated moderate incidences (5-17%) and low symptoms severities (5-10% of leaf surface damaged by fungus). Usually, the "Isabella", "Moldova", "Regent" either sprayed or unsprayed showed no powdery mildew.

Downy mildew (*Plasmopara viticola* Berk. & M.A. Curtis) occurred on 259 untreated and 3 treated plantings on vine leaves, shoots, tendrils, blossoms and berries. The leaves were affected fist with oily, translucent spots. Affected tissue died off and turned red in colored and yellowish or brownish in white cvrs. The spots onto shoots first were dark brown, later turned black. Green shoots curved, because of growth retardation in diseased side.

The "Aligote", "Pleven", "King Rubi", "Bulgaria" and some unknown cvrs were resistant to the disease. The cvrs "Chardonnay", "Merlot", "Muscat Ottonel", "Sauvignon", "Riesling", "Blauerzweigelt" and some unknown var. showed up high symptoms severity.

The applications of fungicides prevented severe downy mildew spread (Table 1). The cvrs "Delaware", "Chancellor", "Chardonnay", "Fetyaska nigra", "Riesling Italian" or "Riesling" were most susceptible, the incidences on these genotypes were in range 24.3-30.1% with symptoms severity on berries 20.4-52.6%. Unsprayed "Aligoté", "Cascade", "Concord", "Isabella" showed about 5% of the disease incidences and less than 4% symptoms severity on berries. These cvrs had no symptoms of the disease, when sprayed. Even unsprayed, the cvrs "Moldova" and "Regent" were not affected by downy mildew.

Both mildews were discovered on the same plots and on the same plants often. They were at

higher levels on unsprayed plots (Table 1). The *V. riparia*, a principal rootstock in region, is growing in neglected vineyards or nature and serves as additional sources of these diseases.

Cercospora leaf spot (*Cercospora sessilis* Sorok.) was detected on overgrown abandoned vineyards of state farm-factories "Velykolazivsky", "Uzhhorodsky" and on weakened plants near houses. Totally 22 plots (out of these 3 sprayed) manifested the disease. Only leaves were damaged. The symptoms developed as large separate round dark-gray or brown spots often together with mildew on the same leaf. Bottom foliage was damaged mainly.

Brown spot, *Septoria melanosa* Elenkin, was noted first at the end of July on 30 plots (4 sprayed and 26 unsprayed). Usually, disease appeared as numerous small (0.5-3 mm in diameter) light brown dots on both leaf sides. Then they enlarged and became angular between last veins branching and dark brown or black in color. Black picnids, releasing long septate spores, developed in spots on both sides of leaves. Bottom, close to soil leaves were infected mainly.

The severities and incidences of brown spot and cercospora leaf spot were higher on untreated plots (Table 1). The diseases had minor importance in 2015.

Anthracnose (*Gloeosporium ampelophagum* Shear) was noted on 92 plots (out of these 8 sprayed) after bloom as gray spots with dark brown or reddish-brown borders on aerial plant organs. Because of dry, hot weather during growing season the disease severity was low. The holes into leaves and deep cankers of coffee color with dark purple border on the shoot internodes formed. Merging, cankers caused shoot death. The acervuli with masses of conidia under epidermis were observed. The rachis of bunches showed up symptoms at berry touch. Spots on berries were slightly depressed, first brown with a purple tinge, later gray with dark purple rim. The disease manifestation on sprayed plots was lower than on unsprayed plantations (Table 1). Many cvrs in 2015 survay had the disease, if left unsprayed. However, some unknown muscadine cvrs showed resistance to anthracnose. Usually, the European grapes were more susceptible to disease as compared to American varieties. For ex., “Cabernet Sauvignon” and “Chardonnay” were susceptible, but cvrs “Isabella” and “Delaware” were free of the disease during 2015. This is consistent with results of grape cvrs tests with anthracnose agent culture filtrates (Myung Hwan Jang et al. 2011) and with results of anthracnose disease resistance study in *Vitis rotundifolia* (Clifford et al. 2011).

The *Colletotrichum capsici* was reported as causal agent of anthracnose in India (Sawant et al. 2012). The fungus present in our region on peppers, but it was not isolated as anthracnose agent in 2015.

First signs of black rot (*Phoma uvicola* Berk. & M.A. Curtis) were in June, 10 days after the hail. Necrotic spots of 1–12 mm in diameter were onto leaves. Longitudinal necrotic plaques were observed in young shoots as black strokes of 2–20 mm. Later they have increased in size and cracked. The disease symptoms and incidencies were lower on sprayed vineyards (Table 1). Cvrs “Aligote”, “Riesling”, “Sauvignon Green”, “Chardonnay” are susceptible to the disease and had aggressive symptoms (2–4 points). Moderate symptoms were in “Merlot” and “Isabella” (1–2 points). The “Gamaret” and “Bronner” seemed not affected by the disease. Infection was present on 99 untreated and on 7 treated plots.

Fusarium solani Mart., *F. equiseti* Sacc., *F. moniliforme* Sheld., *F. scirpi* Lamb. et Fautr. infections were on 101 sprayed and 116 unsprayed plots, untreated vineyards of state farms “Uzhhorodsky” and “Velykolazivsky” included. The first symptoms, yellowing of the tissue between the upper leaves veins, appeared about 10 days before flowering. The cottis symptoms were present. Berries were malformed, with bad quality and yield. Shoot, leaf and bunch disease symptoms severity and incidences were higher on unsprayed plots (Table 1).

The incidences and severities data were close between sprayed and unsprayed plants, evidencing that applied fungicides were not effective against the disease. Vascular necrosis indicated by pink color of wood was observed in plants with foliar and shoot symptoms.

Fusarium harmfulness increased in many areas, but effective remedy against it is not developed yet. *F. oxysporum* grape vine wilt and root rot was reported of worldwide (Ziedan El-Sayed et al. 2011). Plant pathogenic *Fusarium* spp. isolates are known as potential producers of mycotoxins trichothecenes (Serra et al. 2005). By using good cultural practice, growers must reduce the risk of grape contamination with mycotoxigenic fungi and subsequent mycotoxin presence in wines.

The first signs of black rot (*Guignardia bidwellii* Ellis) were in June, about 10 days after the hail. Necrotic spots of 1-12 mm in diameter onto leaves and black often cracked strokes of 2-20 mm in young shoots were observed. The cvrs “Aurora”, “Concord”, “Cabernet Franc”, “Cabernet Sauvignon”, “Chardonnay”, “Golden Muscat”, “Regent”, “White Riesling” were highly susceptible to black rot and they had most aggressive symptoms. Var. “Aligoté”, “Riesling”, “Sauvignon Green” also susceptible, however, they had moderate symptoms, if left untreated. Least severe symptoms were in “Sauvignon Blanc”, “Merlot”, “Delaware”, “Moldova” and “Isabella”. Infection was present in grapes on 9 treated and 65 untreated plots. Fungicides sprays prevented disease in moderately susceptible plants, while rotted berries were present in bunches of highly susceptible cvrs. The “Gamaret” and “Bronner” seemed not affected by the disease even after single treatment with Bordeaux mixture.

The disease incidences and disease severities on untreated shoots, leaves or bunches were higher than on sprayed aerial plant parts (Table 1). The most severe symptoms were on bunches. The flesh turned brown, berry filled by mycelium mummify and crumple at dry weather and remained hanging. Mass shedding of berries was noted at veraison. Berries incubated in a humid bag were wet rotted on 3rd day with a large number of picnids. As primary inoculum load plays crucial role in the disease development on bunches and secondary infections are less important (Jermini, Gessler 1966), it was suggested, that in traditional vine growing, using cutting by hands black rot can be avoided by method of Sosnowski (Sosnowski et al. 2012).

Grapevine dieback, caused by *Eutypa lata*, with symptoms of necrosis in the xylem of a grapevine cordon and trunk was noted on 71 treated and 67 untreated plots. The diseased plants were detected by leaf discoloration. The perithecia developed on the cankers of dead xylem tissue of older plants. Perithecial cavities were seen after knife scraping of the surface of the stromata. Fresh perithecia were hollow, shiny and black inside, when dry. Curved ascospores discharge was observed from them in laboratory. All vineyards over 15 years old were affected stronger, than young plantations (less than 10 years old) (Table 1). The plants of cvrs "Chasselas", "Grenache" and "Thompson Seedless" were most often damaged. The grape var. "Aligote", "Cabernet Franc", "Cabernet Sauvignon", "Chardonnay", "Merlot", "Riesling", "Semillon" were free of disease. The "Thompson Seedless", particularly, is more susceptible to the disease, than "Isabella" or "Dalawar". *Eutypa* dieback affects grapevines in major grape-producing areas, including Europe (Carter et al. 1983, Živkovič et al. 2012). Particularly, it is present in Hungary (Rábai et al. 2008) and Romania (Oprea et al. 2008) the countries, bordering the Transcarpathia.

The *Phomopsis viticola* Berl. et Toni infections were found in all above-ground parts of grape on 97 untreated and 89 treated plots. Overwintered mycelium was observed in wood and bark in spring 2015. Spots on lower leaves and rounded black or brown points on the nodes of annual shoots appeared in spring. Necrotic spots surrounding the stomata of young shoots were clearly visible beneath the bark. They fused in stripes, cracked. Small dark brown spots with greenish-yellow border were in the leaves, the latter deformed, developed necrosis, cracked and drop. Dark brown elongated, depressed spots were on the tendrills, inflorescences, green bunches. Infected mature berries turn dark purple. Vague discolored spots developed around the first nodes of woody shoots, as a rule. The affected areas of the cortex and berries formed numerous black picnids with picnospores, at spring and fall. The cvrs "Aligote", "Cabernet Sauvignon", "Caraburnu", "Cardinal", "Golubok", "Muscat White", "Zinfandel" were more often infected by *P. viticola*, than "Barbera", "Chardonnay", "Merlot", "Thompson Seedless". The var. "Cabernet", "Sauvignon", "Traminer white", "Traminer rose", "Riesling" were healthy. The data on cvrs susceptibility are in compliance with those, described in (Úrbez-Torres 2013). Most of varieties in Uzhgorod area are susceptible to the disease. Non-sprayed plots showed higher disease incidences and symptoms severities, than sprayed plantations. The sprayed "Chardonnay", "Merlot", "Isabella" and "Moldova" showed moderate symptoms (severity less than 4.0%) or no symptoms on leaves and shoots.

The disease incidence of cane and leaf spot was estimated 50 and 42%, respectively, in commercial vineyards in Ohio (Nita et al. 2008). The incidences of symptoms on canes were higher, than this study. The infection in form of trunk and arms dieback was observed. The incidences and symptoms severities not differed significantly between treated and untreated plots, proving the pruning and fungicide sprays were not effective enough.

The *Ph. viticola* was often (in 10.6% of samples) isolated from wood dieback with either of *Botryosphaeria sp.* or *E. lata*. *Ph. viticola*, *Botryosphaeria sp.* and *E. lata* were discovered as single fungus infections in 59.6, 29.4 and 11% of declining arms or trunks, respectively.

The *Botryosphaeria* sp. caused symptoms as elongated black lesions on the internodes, swelling at the shoot base with darkened cortex rupturing, shoot breakage and dieback, dark brown bud mortality, wood discoloration, mild leaf chlorosis, water-soaked rots of berries. These were found on 67 unsprayed and 63 sprayed plots. The disease incidences and symptoms severities on shoots, leaves/buds, bunch, arms/trunks had little difference between treated and untreated plots, indicating low effectiveness of sprays on established infection (Table 1). The *Botryosphaeria* as a grape pathogen has been noted in main grape growing areas, particularly, in some European countries, close to the Transcarpathia (EPPO 2014, Van Niekerk et al. 2006).

The rotbrenner (*Pseudopeziza tracheiphila*) was found on 9 sprayed and 98 non-sprayed plots, the areas of state-farms "Uzhhorodsky" and "Velykolazivsky" included. Young leaves were most susceptible. Typical V-shaped leaf spots were noted. In white grapes ("Chardonnay", etc.) the affected leaves developed bright spots surrounded by a narrow yellowish rim, the spot with time turned brown. The spots were ruby with greenish-yellow border in red grapes ("Merlot", etc.). Berries shed from highly infected bushes. As latent infection the disease in some cases, possibly, was not counted. Mainly European cvrs of *V. vinifera* were affected. The "Domina", "Elbling" and "Müller-Thurgau" were most damaged. Particularly, the red "Domina" variety manifested most severe symptoms as about 25-50% of untreated leaf tissue was damaged, causing early

defoliation. Unsprayed plots demonstrated higher disease incidences and more severe symptoms, than sprayed (Table 1).

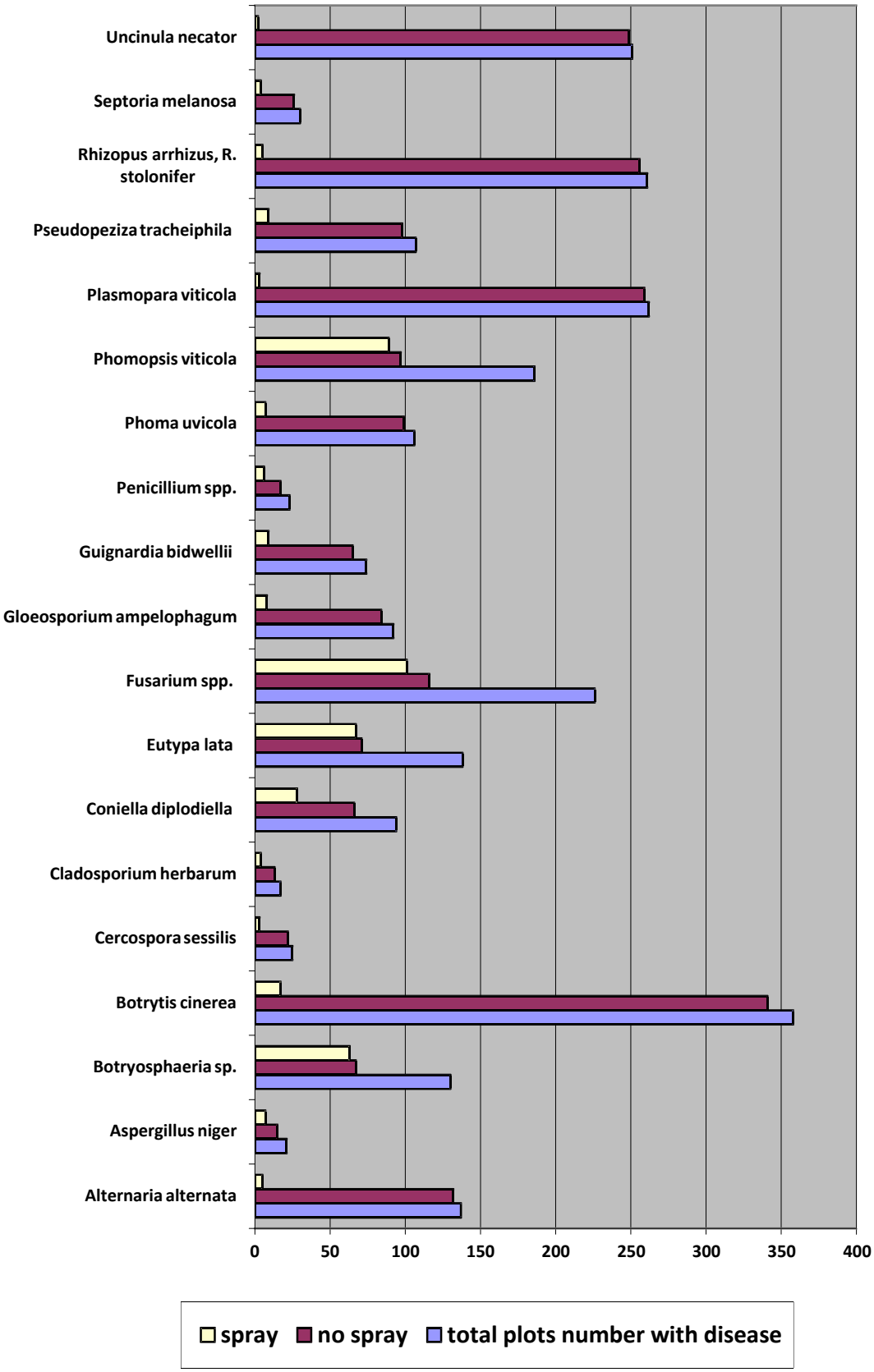

Fig. 1. Fungal infections distribution on vineyards of Uzhhorod and surrounding lands, 2015

Table 1.Grape diseases distribution, incidences and symptoms severity in Uzhhorod and surrounding lands, 2015

Disease agent	Diseased plots %		Affected organs	Incidence, %		Symptoms severity, %	
	spray	no spray		spray	no spray	spray	no spray
Alternaria alternata Alternariosis, bunch rot	0.5	13.2	Shoot Leaf Bunch	1.5-5.0 1.0-5.1 2,1-3,5	8.9-16.2 9.2-16.7 2.2-22.4	1.2-4.0 0,7-3.9 0.4-2.2	11.6-29.8 36.3-52.5 6.5-29.4
Aspergillus niger, Berry rot	0.7	1.5	Bunch	0.3-0.6	1.7-2.9	0.9-1.4	5.4-7.8
Botryosphaeria sp., bud death, shoot dieback, berry rot, leaf chlorosis, trunk and arm dieback	6.3	6.7	Shoot Leaf/bud Bunch Arm/trunk	3.6-4.4 1.5-2.6 2.9-3.7 4.3-5.1	4.0-5.7 2.1-3.4 3.6-4.4 4.9-5.9	6.8-7.5 4.0-5.3 5.7–7.1 8.5-10.1	8.4-9.0 4.7-5.9 6.9-7.8 9.4-11.6
Botrytis cinerea, gray rot	1.7	34.1	Shoot Leaf Bunch	1.1-2.5 0.5-0.8 7.2-9.1	3.2-4.3 1.4-2.0 10.5-49.6	7.1-20.1 4.7-9.2 1.2-4.1	16.3-30.0 11.6-25.8 3.2-29.7
Cercospora sessilis , cercosporose	0.3	2.2	Leaf	1.4-3.3	9.6-12.1	3.4-5.1	16.2-22.3
Cladosporium herbarum, berry rot	1.3	4	Bunch	0.4-0.7	2.2-4.3	0.4-0.7	5.0-6.4
Coniella diplodiella, white rot	2.8	6.6	Shoot, Leaf Bunch	1.5-3.2 0.6-0.9 11.2-16.3	4.3-6.1 1.9-2.4 35.7- 50.0	8.4-19.6 5.1-16.2 5.4-10.3	20.1-38.6 13.7-49.7 14.0-29.8
Eutypa lata, trunk and arm dieback	6.7	7.1	Arm/trunk[1] Arm/trunk[2]	5.8-6.5 2.1-4.3	6.3-7.0 2.5-4.6	15.4-28.6 4.9-13.9	15.4-29.7 5.2-13.4
Fusarium equiseti, *F. moniliforme*, *F. scirpi*, *F. solani* fusariosis	10.1	11.6	Shoot Leaf Bunch	3.5-4.9 2.6-3.5 10.5-19.1	4.1-5.2 3.2-4.0 12.3-18.6	30.6-39.5 12.2-39.3 12.6-38,9	31.1-39.7 13.4-40.0 11.4- 39.9
Gloeosporium ampelophagum, anthracnose	0.8	8.4	Shoot Leaf Bunch	7.3-36.0 5.1-30.8 2.7- 14.8	13.5-47.4 10.1-44.4 20.1-24.5	4.0-12.9 3.2-11.0 3.9-6.7	13.4-30.0 12.2-28.7 14.0-29.6
Guignardia bidwellii, black rot	0.9	6.5	Shoot Leaf Bunch	4.0-5.3 3.5-4.1 11.4-27.5	8.5-13.9 7.1-12.3 30.4-84.2	6.2-8.5 4.0-7.6 3.9-13.8	16.1-25.8 15.2-31.0 42.3-79.4
Penicillium spp. berry rot	0.6	1.7	Bunch	0.6-0.9	4.1-4.9	1.5-3.7	8.3-13.7
Phoma uvicola, black rot	0.7	9.9	Leaf Shoot	1.2-2.5 0,9-2.0	4.9-6.7 4.0-5.9	1.1-4.9 1.4-5.7	5.1-49.5 5.6-47.4
Phomopsis viticola black spot, trunk arms dieback	8.9	9.7	Shoot Leaf Arm/trunk	4.7-12.6 5.3-8.7 3.1-3.8	5.2-13.2 5.6-8.9 3.2 -4.0	20.3-23.4 12.8-30.9 13.5-38.9	23.5-26.8 13.5-31.0 13.9-40.0
Plasmopara viticola, downy mildew	0.3	25.6	Shoot Leaf Bunch	1.7-2.5 2.1-3.0 1.5-2.1	19.3-29.5 29.1- 41.4 5.1-30.1	0.5-2.9 0.2-4.6 2.6-7.3	14.2-30.0 15.3-60.1 3.3-52.6
Pseudopeziza tracheiphila, rotbrenner	0.9	9.8	Leaf	1.3-3.2	4.6 -8.3	0.8-6.6	10.4-51.7
Rhizopus arrhizus, *R. stolonifer*, berry rot	0.5	1.4	Bunch	0.2-0.3	4.2-6.1	0.9-2.4	3.9-29.6
Septoria melanosa, brown spot	0.4	2.6	Leaf	1.8-4.4	11.3-14.1	8.7-11.5	18.9-27.9
Uncinula necator, powdery mildew	0.2	24.9	Shoot Leaf Bunch	2.1-3.3 1.3-2.2 5.6-7.2	24.3-30.1 5.4-74.6 33.3-40.1	1.8-3.1 1.1-3.2 1.3-4.0	30.2-41.2 5.5-89.1 24.9-41.4

Note: [1]vineyards over 15 years old; [2]vineyards less than 10 years old.

The main harm this disease is causing when vine infected before or at flowering. Later infection usually does not cause serious damage. Thus, fungicide spray should be done before bloom. Disease is important in Europe, particularly, in Hungary (Pearson et al. 1991), Romania, Moldova and present in Ukraine (EPPO 2014), therefore should be studied. The ascospore release monitoring by spore traps use enables disease forecast and timed fungicide application (Pearson et al. 1991). But, this is not practiced in our region.

White rot *Coniella diplodiella* Petr., showed symptoms on berries and grapes crests. Leaves were affected and green shoots necrosis developed on 14 treated and 66 untreated plots. They become dark green, withered, but do not drop. These symptoms severities and incidences were lower on vineyards treated by fungicides (Table 1). Typical white rot symptoms of crests drying, evolved on grape berries a few days after heavy rain with hail.

They were less severe on vineyards treated by Bordeaux mixture and systemic fungicides. Berries turned yellow, then pink-blue, loosed turgor, dried. Some of them remained juicy. Picnids that ripening under the cuticle, raised it surface above the epidermis of berries, resulting in a cavity, providing white color for fruits. Infected bunches dropped at fall 2015.

Non-typical white rot symptoms consisted in damage of upper part of the main axis of flowering shoots and quick withering of the part of the bunch, located below. Berries at this bunch bottom became flabby and pale, later brown. They dried before fungus invaded them, thus fungus from them was not isolated. White rot with bunch symptoms was on 14 untreated plots. Most severe white-rot symptoms in our area of study were observed in var. "Aligoté", "Claret", "Chasselas", "Rhine Riesling", "Sylvaner". Grape cvrs "Cabernet Sauvignon", "Chasselas white" were much less damaged. The var. "Isabella" and "Moldova" were free of the disease. However, it should be studied further if some cvrs showed no symptoms because of resistance to the disease or due to local weather conditions (i.e., no hail). The high humidity and hot weather in June 2015 favored the white rot development.

The disease is present in Africa, Asia, Australasia, Oceania, North and South Americas and in Europe, particularly, Bulgaria, Hungary, Moldova, Romania, Russia, Ukraine (EPPO 2014). Usually, it causes damage in some years on southern regions of Ukraine. Our vineyards are less affected by the disease, because of cool Transcarpathian climate. But, pycnidia of *C. diplodiella* can still release viable conidia after >15 years of infection. Losses of 20-80% have been recorded (Bisiach 1998). White rot can be a problem in Transcarpathia at certain weather. Good cultural practice with keeping of shoots high above the ground to avoid contaminated soil rain-splash could decrease the disease incidence.

Infections on some treated plots were found for all observed diseases. Possibly, new resistant strains developed or grape plants were not sprayed properly, allowing the fungi to survive and cause the diseases. The spread of many diseases, their incidences and severities on aerial plant parts were restricted by unusually hot and dry weather during May-September period of growing season 2015. The most common disease was gray rot (*Botrytis cinerea*), which took place at the biggest number of unsprayed plots and some sprayed plantations. Downy and powdery mildews were the next diseases by spread on untreated plantings. All three infections were well suppressed on sprayed plots. Berry rots caused by *Aspergillus niger*, *Penicillium* spp. *Rhizopus* spp. were least common in our vineyards. They appeared on mechanically damaged bunches at harvest time. These infections are known to be important at storage. The other infections by distribution can be placed in next row: *Alternaria alternata*>*Fusarium* spp.> *Phoma uvicola*> *Pseudopeziza tracheiphila*>*Phomopsis viticola*> *Gloeosporium ampelophagum* >*Eutypa lata* > *Botryosphaeria* sp.>*Coniella diplodiella*> *Guignardia bidwellii*>*Cladosporium herbarum*> *Septoria melanosa*> *Cercospora sessilis* (Fig.1).

The diseases caused by *Fusarium* spp., *Phomopsis viticola*, *Eutypa lata*, *Botryosphaeria* sp. had almost no suppression by our sprays, and because of their abilities to cause trunk and arm dieback could be regarded as most dangerous in our region.

Several diseases found in 2015, such as mildews (*Pl. viticola*, *U. necator*), gray mould (*B. cinerea*), black rot (*L. bidwellii*), white rot (*C. diplodiella*), blue rot (*A. glaucus*), cercosporiosis (*C. vitis*), septoriosis (*S. melanosa*), rotbrenner (*P. tracheiphila*), anthracnose (*G. ampelophagum* were noted previously (Глагола 1992). Other, as bunch rot (*A. alternata*) black spot, trunk and arms dieback (*Ph. viticola*), wood rots (*Botryosphaeria* sp., *E. lata*, *Ph. viticola*) were observed in present survey. The grape wilt and dieback are problems for some areas in Ukraine (Козар та ін.1990) and they should be studied further in our region as well as *Alternaria* bunch rot, which is also present in some southern regions of the country (Евдокимова 2008).

The presence of neglected vineyards in Uzhhorod and on surrounding areas is important for pathogenic fungi propagules development. These plots left without clearing and sprays allowed the fungi uncontrolled multiplication and high disease pressure buildup. Integrated grape protection, resistant varieties use and clearance of diseased plantings are necessary.

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