Journal of Agricultural Sciences
Vol. 55, No. 1, 2010
Pages 103-122

DOI: 10.2298/JAS1001103S
UDC: 582.782.2:632.95
Review article

PLANT PROTECTION PRODUCTS IN ORGANIC GRAPEVINE GROWING

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Abstract: Pests and grapevine diseases in organic production are suppressed by preventive measures with a view to reducing the impact of the attack. Allowed substances acting on patogenous fungi, insects, mites and other harmful organisms are used, if appropriate. Insecticides of plant origin are used in the organic production of grapevine, as well as vegetable oils, powders and insecticidal soaps that are selective, with a narrow range of effects and of lower toxicity, as well as biological products. As a rule, such plant protection products require a more frequent application. Copper-based and sulphur-based fungicides are still leading products in suppressing grapevine diseases. Researches are directed to decrease the quantity of application and to find their replacement by also efficient fungicides. A special emphasis is put on researching the efficient fungicides for suppressing *Botrytis* bunch rot and factors causing grapevine wood diseases (Esca and *Eutypa*) in organic production. Along with copper and sulphur, different substances such as bicarbonates, plant extracts and oils, biological products being parasites, patogenous or diseases agent antagonists, and natural products such as milk and whey are applied in the organic production of grapevine.

Key words: grapevine, *Vitis vinifera* L., organic pest management, pests, diseases.

Introduction

The field of the organic production is governed by the relevant law and implementing provisions such as a production based on natural processes and use of organic and natural materials. These processes and materials are not separately listed because they are clearly defined and in the system of control. Since in certain cases the available resources are not sufficient for sustainable production, the law

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allows for exceptions and such resources of synthetic-chemical origin are listed as specially allowed substances. A great number of such exceptions refer to plant protection products because there is still no alternative for them. The list of allowed plant protection products in organic production containing 24 fungicides with five active substances, such as *Bacillus subtilis* Cohn variety ST1/III, copper (oxychloride, hydroxide, sulphate, oxide), mineral oil, *Pythium oligandrum* Dreschler and sulphur, has been published in Serbia. The list includes 8 products for insect suppression with five active substances such as *Bacillus thuringiensis* subspecies *kurstaki* Berliner, *Bacillus thuringiensis* subspecies *tenebrionis*, mineral (paraphine), mineral (white) oil and oil seed rape oil (Spisak sredstava za zaštitu bilja, 2009).

The European and Mediterranean organization for plant protection established the standard for the best practice regarding grapevine protection that includes the listed procedures and products, as well as the lists of the most significant diseases and grapevine pests (OEPP/EPPO, 2000). The lists of the allowed pesticides for organic production in the European countries are integrated in the following directives-Regulation (EEC) No. 2092/91 (1991) - ANNEX II, Regulation (EC) No. 834/2007, Article 16(3) (c) and Regulation (EC) No. 834/2007.

There are few data relating to organic production of grapevine in locally published literature and even fewer data treating the protection problems (Sivčev et al., 2003; Sivčev, 2005). The objective of this paper is to describe the products for grapevine protection that are used in different countries worldwide in organic production of grapevine.

Suppressing grapevine pests

Grapevine pests in organic production are the same as in conventional production (OEPP/EPPO, 2000). There is a difference in the manner of their suppression that is based on preventive measures aiming at reducing the impact of the attack, with a subsequent application of allowed products acting on insects, mites and other harmful organisms. Insecticides of plant origin with a wide range of action on harmful insects are used in the organic production of grapevine, as well as

vegetable oils, powders and insecticidal soaps that are selective with a narrow range of action and of lower toxicity. As a rule, such products require a more frequent application.

Cicadas suppression

A massive deterioration of vineyards infected with phytoplasmas emphasised the significance of cicadas and their vector role in phytoplasma epidemiology. It has been estimated that phytoplasma Flavescence dorée endangers over 40% of vineyards in Serbia, with a tendency to grow (Krnjajić, 2008). Three treatments are compulsory in France: T1-one month after egg hatching, T2-upon the expiry of persistence of insecticides from the previous treatment and T3-on adults (Kreiter, 2000). The problem of suppression lies in the lack of efficient insecticide for adults that easily fly over and efficiently transmit the infection by feeding on neighbouring healthy grapevine plants. This imposes the need of regular control and taking out infected grapevine plants, as well as regular suppression of larvae. In Switzerland, golden yellowness and mandatory suppression of its vector *S. titanus* are considered to be a significant problem in organic viticulture. Vineyard experiments showed that the Parexan N (pyretrine + sesame oil) was the only organic product with the efficiency of over 90% on larvae of *S. titanus*. However, this product had no effect on this vector's adults. Three applications by spraying are recommended in 10-day intervals after the first appearance of units in the third larval stage (Gusberti et al., 2008).

A green leafhopper, *Empoasca vitis* Goethe, is sometimes present in a great population (over 1 insect/leaf) during July and August, which requires the application of insecticides.

Insecticidal soaps are recommended and efficient in the organic production only if cicadas are directly sprayed. These insecticides are allowed for use in the European Union and the USA. The soaps are made of potassium salts and fatty acids resulting in water soluble potassium salts of fatty oils. Not all the soaps are insecticidal; some of them may be herbicidal. Insecticidal soaps penetrate through the cuticulum and destroy the integrity of the neighbouring cells leading to paralysis and dehydration. They have a narrow range of action, usually on smaller and soft insects such as leaf, shield and butterfly lice, pear leaf flee and thrips. The efficient suppression requires several treatments since insecticidal soap must be applied onto the body of the pest, and/or there must be a contact before a deposit gets dry.

Insecticides with the active substance based on piretrine and a plant extract of sabadilla are recommended for the suppression of cicada. Pyretrine is well-known in our market and there are lots of commercial products as well. Sabadilla alkaloids are traditionally used by the American Indians against the pests including bedbugs, cicadas and caterpillars. They are obtained by grinding dried mature lily seeds, *Schoenocaulon officinale* (Schltdl. & Cham.) A. Gray ex Benth. The active substance is alkaloid veratrine. It is used on different plants and for human head lice (Osun, 2009).

Rotenton is an insecticide of a wide range of action. It is of plant origin and it is obtained from the root of tropical and subtropical leguminous plants of the species *Lonchocarpus* or *Derris*. It is the most used pesticide in the USA in home use. It is very toxic for fish and it is used for exterminating unwanted fish species in fish pools (EPA, 2009). Rotenton acts slowly, by internal contact, it is quickly degraded in the sun and it is best applied in the evening. It may be toxic also for beneficial insects, as well as for certain mammals. In accordance with Annex II to Directive (EEC) No. 2092/91, (1991)-Rotenton is allowed for use in organic production, but it did not show to be efficient enough with respect to larvae and particularly with respect to the adult units of *S. titanus* (Anonymous, 2006).

Stolbur phytoplasma is widespread, but economically less important. It causes black wood (Bois noir, Legno nero) and its main vector is cicada *Hyalestes obsoletus* Sign. as well as recently detected vector, cicada *Reptalus panzeri* Löw (Cvrković, 2009). Grapevine is not a host to cicada *H. obsoletus* but it transmits a disease to grapevine during trial feeding on it. In nature, this cicada is present on weeds, however, it may be occasionally found on grapevine (Boudon-Padieu, 2003). Experiments in Italy showed that insecticides neither reduce cicada *H. obsoletus* population in vineyards, nor the expansion of stolbur phytoplasma (Mori et al., 2007).

The efficiency of kaolin with the registered product Surround WP is particularly emphasised in the protection of grapevine against cicada vectors of phytoplasma in the USA. The application of kaolin in organic viticulture is comparatively a new technology in the suppression of cicadas. Along with insects (cicadas, thrips, fruit moths), kaolin has a good effect on mites, fungi (oidium), bacteria, against sun burns and heat stress. It is applied by spraying every 7-14 days because a full coverage of plants is very important for its full efficiency (ATTRA, 1999).

The active substance on the basis of *Chenopodium ambrosioides* near *ambrosioides* L. has insecticide effects primarily on the suctorial insects and mites. It acts on all development stages of insects, starting from eggs to imagos. It acts well on cicadas on grapevine. There is no pre harvest interval, and the producer claims that the effect on useful organisms is neglectable. The product Requiem may be found in the market and it is registered for organic production of grapevine and other cultivated plants (Agraquest, 2009).

Suppression of grape moths

Grape moth (*Polychrosis botrana* Denis & Schiffermüller**)** and grape bud moth (*Clysia ambiguella* Hübner) can be found on the grapevine. These grapevine moths can be found in most viticulture regions of Serbia, in localities with increased humidity, in vineyards where shoots are thick, as well as in cultivars with compact bunch. The suppression of moths is a routine and regular measure of protection in conventional production and usually one treatment is sufficient to suppress the first (the second half of May) or the second generation. Grapevine moths populations are regularly monitored by feromon traps and based on such data the spraying date is determined. The spraying may be conducted simultaneously with the suppression of grapevine downy mildew and powdery mildew.

Grapevine moths in vineyards based on organic production could be suppressed by natural insecticides-pyretrines extracted from *Chrysanthemum cinerariaefolium* Vis. There are a great number of commercial products on the basis of pyretrine in the market. Pyretrine acts on a great number of harmful and useful insects and mites. It quickly degrades in the sun and its effects are better at night at lower temperatures. Insects become resistant to it, therefore the active substance with a different mechanism of action should be used.

Commercial biological product with a wasp *Trichogramma* ssp. being a parasite of grapevine, moth eggs should be used for the suppression of these pests. These wasps are released at the beginning of laying eggs. Biological products based on the bacterium *Bacillus thuringiensis* subspecies *kurstaki* have favourable effects on grapevine moths, but they should be applied at the beginning of pest egg hatching when young larvae are the most numerous. The products based on this bacterium are efficient and they are applied to the suppression of most of the other harmful caterpillars that may appear in the vineyard.

Feromone dispensers deployed in greater number in the vineyard may be used for the suppression of grape moths because they cause the confusion in males which are not able to find females to copulate with resulting in the lack of fertilized eggs and larvae which cause subsequent damage. In Germany, 50% of organic production is protected by this method, by the placement of 500 dispensers/ha (Schruft, 1995). Neem is the extract obtained from the seeds of tropical tree *Azadirachta indica* A. Jus originating in India. Neem has fungicidae, insecticidae, nematocidal and bactericidal effects (EPA, 2009). Several different pesticides are obtained from neem as follows:

- Insecticides based on azadirachtin that inhibits moulting of insects. It has repellent effects on adult insects, diverting them from feeding on and laying eggs on treated plants, reducing fecundity and prolonging development.
- Oil fraction of neem extract acts as a fungicide (against downy mildew, oidium and rust), insecticide or acaricide in a similar way as all other insecticide oils.
- Potassium soap made of neem oil (product K+Neem) is insecticidal soap acting by destroying cell membrane.

Products on the basis of neem applied foliary are not persistent and spraying must be done more often to achieve a good efficiency. There are lots of commercial products available in the market.

Vegetable oils are allowed for use in organic production. These oils act as contact insecticides as long as they are liquid. They prevent respiration, disrupt membrane functions and are partially toxic for the cells due to the penetration of oil, they interrupt feeding of suctorial insects by forming a layer of oil on the leaf.

Spraying with oil is efficient only for the exposed eggs and insects coated with a layer of oil that must be durable enough to suffocate the pest but not the plant. Lighter oils are often used for winter and summer treatment but in different concentrations.

The products based on other vegetable oils may be found in the markets worldwide. Canola oil is edible refined oil obtained from *Brassica* spp. plants. The selections that were obtained from rape seed in Canada have a low content of erucic acid (0.3-1.2%) and they are called Canola as abbreviated from "Canadian oil, low acid". The commercial product is applied either by spraying or irrigation. The repellent action of this oil is not harmful for humans (EPA, 2009).

Jojoba *Simmondsia chinensis* (Link) C.K.Schneid grows in deserts of Mexico, Arizona and California, and oil is derived from its seeds. This oil contains about 14% toxic saturated erucic acid. It is used in the protection of a great number of plants, practically without limitation. It acts as a fungicide and insecticide. Commercial products contain 97.5% of jojoba oil and have the approval for application in mixtures containing less than 1% of jojoba oil. Thus, the applied product contains around 1% of jojoba oil, and/or 0.14% of unwanted saturated erucic acid which is 10 times less than the allowed percentage (EPA, 2009).

Essential oils are oils producing a characteristic fragrance, taste or flavour to a plant, flower or fruit during evaporation. Oils are registered as pesticide active substances from 1947. Nowadays, there are more than 25 essential oils that are defined, standardised and under a characteristic name in the USA market. These oils are used as repellents, insecticides and acaricides, as well as agents interrupting feeding of pests and against micro-organisms. The action of oils is non-toxic.

A large number of investigations have been dedicated to the researches of essential oils some of which are efficient against the most significant pests. In Serbia it has been shown that the essential oils of sage *Salvia officinalis* L. have good effects on larvae of beetles and butterfly catterpillars (Kostić et al., 2007; Kostić et al., 2008).

Entomopathogen fungi *Beauveria bassiana* Bals. is a cosmopolitan species parasiting a great number of insects pests of different plants. In the USA it has been registered for the suppression of harmful insects on grape-vine. Fungus spores must be in contact with the insect and in the conditions of high air humidity they germinate, penetrate the cuticula of the insect and invade its chemolymph and internal organs. The infected insect dies usually after 5 days. There are several commercial products available in the market (EPA, 2009; Troy biosciences Inc, 2009). There are lots of entomopathogen fungi in nature attacking different pests. They are characterized by a certain seasonal appearance and as a rule they appear when the insect host is overpopulated (Sivčev, 1992). The development of those fungi and their efficiency in field conditions depend on temperature, relative air humidity and UV rays (Sivčev and Draganić, 1994; Sivčev, and Manojlović, 1995).

Suppression of mites

Mites from the family of *Tetranychidae* (*Panonychus ulmi* Koch and *Tetranychus urticae* Koch) and the family of *Eriophyidae* (*Colomerus vitis* Pagenstecher and *Calepitrimerus vitis* Nalepa) can be found on grapevine and they can cause a serious damage.

Potassium silicate is a compound that can be found in nature and is used as acaricide, fungicide and insecticide. It is registered in the USA for the application with respect to all agriculture grown plants including grapevine. Potassium silicate is potassium salt and plant takes it if it is formulated and has effect on the mites, whitefly`s and other insects. It is applied by standard equipment for spraying (EPA, 2009).

The application of sulphur and pyretrine in the suppression of oidium or insects is also effective against mites and it is used in the production to a great extent. However, these products are toxic also for predatory mites that significantly reduce the population of harmful mites. Unlike this the maintenance of the zone cover with plants is very favourable for predatory mites and different useful insects such as golden eye or predator thrips (Dufour, 2006).

Insecticidal soaps also act on mites and mites must be directly sprayed which is made more difficult by feeding on the back of leaves. Potassium soap may have effects on the quality of grape-vine and it is applied usually before harvesting. The product “Trilogy” is registered for mites and it is based on neem (*Azadirachta indica*).

Suppression of nematodes

The protection of grown plants from phyto-parasite nematodes refers to the maintenance of the population of harmful species below the limits of harm, and/or the population is controlled and brought to as low level as possible by different measures (Krnjajić and Krnjajić, 1987).

The population of nematodes may be regulated with the selection of soil since they are the most numerous in sandy soil. The soil containing 3-5% of humus, or by growing cover plants or by using of fertilisers keeps humidity longer and reduces grapevine’s stress. Biodiversity in such soil is higher which is seen in competence and increased population of predatory and parasite species of fauna, flora, micro-organisms and their secretions (Raičević et al., 2004; Sivčev et al., 2005).

It is a well-known fact that sesame (*Sesamum indicum* L.) allelopathically acts on nematodes which was used for making a commercial product. Ground straw of sesame is intended to suppress nematodes in a great number of different grown plant species. The active substance in this product for suppressing nematodes consists of celluloses and polymers with a long chain and it is not known how it acts on nematodes. The ground sesame straw is mixed with the soil before planting or it is applied as mulch around grown plants in view of suppressing harmful nematodes (EPA, 2009).

Paecilomyces lilacinus Samson is nemato-patogenous fungus used as a biological nematocide for suppressing nematodes. This fungus is an efficient parasite of all developmental stages of nematodes and it is especially efficient against eggs and infective juveniles. It is used before or during rain, by spraying or during watering. MeloCon WG (Certis, 2009) is registered as biological nematocide product and it is applied on citrus fruits, stone fruits, peaches and grapevine.

Protection of grapevine from disease

Fungicide materials in organic production are preventive and must be applied before the onset of infection. A special attention must be paid to preventive suppression through the best practices in viticulture (canopy management, grapevine training, dormant pruning, balanced pruning and shoot thinning, shoot position, proportion of optimal leaf surface and quality of yield), list of varieties/rootstock and vineyard site selection since the allowed products are not efficient enough for all disease causing factors (Gadoury, 1995).

Suppression of downy mildew (*Plasmopara viticola* Berl. & Toni)

Downy mildew of grapevine was brought to Europe in 1878 together with the rootstocks of American grapevine. It spread fast causing damage to vineyards until the French botanic professor, Pierre Alexis Millardet and Ulysse Gayon, did not discover the effect of Bordeaux mixture (Galet, 2002). Since then, copper has been irreplaceable agent in the suppression of downy mildew of grapevine. In order to efficiently suppress downy mildew using copper, it is necessary to apply it onto a leaf before the onset of infection. Alternatives are sought for replacing copper in organic production in order to reduce its application and accumulation in vineyard soil. Its application was allowed in organic production in the European Union countries in the amount of 8 kg/ha (Comission Regulation (EEC) No. 2092/91, 1991 Annex II.), while as of 2006, up to 6 kg of copper/ha has been allowed. In Switzerland it is limited to 4 kg/ha a year and in Slovenia to 3 kg/ha a year, while Denmark and the Netherlands prohibit its use (Speiser and Schmid, 2003). The use of only 3kg/ha a year has been recently allowed in Germany. Experiments showed that a good protection of grapevine can be achieved by the application with only 2 kg/ha but in combination with other substances (mixture of copper, sulphur and stone powder) (Heibertshausen et al., 2006). Also, it has been found that a new formulation in the form of copper octanoate allows for the application of less quantity of copper.

The results of investigating the efficiency of newer active substances in suppression of downy mildew of grapevine in organic production showed that such substances existed. The active substance acibenzolar-S-methyl (benzothiadiazol (product "Bion", Syngenta, AG) is a plant activator inducing the resistance of the plant to bacteria and fungi (Dagostin et al., 2006). Also, downy mildew appeared less frequently in vineyards with mixed varieties and the extracts of fungi, plants and bacteria were efficient against downy mildew or encouraged grapevine resistance (Schweikert et al., 2006). Oil extract of perennial Mediterranean plant *Inula viscosa* (L.) Aiton. (*Compositae*) used in traditional medicine with active substances-tometosine and costic acid had good effects on downy mildew (Cohen et al., 2006). Based on such results (Köhl, 2007) it is expected that the application of copper will be decreased or prohibited and that the technology with new commercial products efficiently protecting grapevine will appear.

A biological product based on *Bacillus subtilis* (product "Serenade") (Agraquest, 2009) showed a certain efficacy against downy mildew. In the USA it is often used as a replacement or in combination with copper products. According to European researchers, the product did not show a sufficient efficiency (Dagostin et al., 2006). This bacterium is more efficient against other important fungi on grapevine such as grey mould and powdery mildew. The biological product based on *Bacillus pumilus* Meyer and Gottheil isolate QST 2808 (Rhapsody), (Agraquest, 2009), along with being intended for powder mildew of grapevine, is also registered for suppressing downy mildew of grapevine. Saprophytic bacterium *Bacillus pumilus* is good for the application in conventional production in a view of managing the resistance of phytopatogenous fungi due to completely different and new way of action on fungi.

Hydrogen peroxide (H_2O_2) is the product known for a long time as a fungicide and bactericide of wide range of action. It was shown to be effective against downy mildew and powdery mildew of grapevine. Hydrogen peroxide acts by contact on the spores of those fungi, and it gets degraded quickly and it is not phyto-toxic. In the USA it was allowed for use in organic production and this approval was withdrawn until its production was reconciled with regulations and the product was newly formulated (EPA, 2009). Potassium bicarbonate was registered in 1998 for suppressing powdery mildew and it has an indirect effect on downy mildew and other fungi (EPA, 2009). Products based on oil fraction of neem (*Azadirachta indica*) are registered for suppressing downy mildew, and it also acts as fungicide on downy mildews of other plants, powdery mildew, rusts (product Trilogy, Certis-USA).

Compost tea proved to be an efficient product in suppressing downy mildew and powdery mildew of grapevine and other different diseases. This product can be made on a farm in accordance with the recipe of (Diver, 2002). Compost tea contains useful micro-organisms which when sprayed onto a plant use plant escudates for themselves instead of patogenous micro-organisms for their development, while other micro-organisms in the compost have antagonistic effects on phytopatogenous micro-organisms. Compost tea contains a great number of different useful micro-organisms that patogens on a plant cannot compete with.

Suppression of powdery mildew (*Uncinula necator* Burril)

Powdery mildew was brought into Europe from the North America in 1845 causing great damage to vineyards until sulphur was detected to be efficient in its suppression. In vineyards with organic production, sulphur is the main agent for powdery mildew suppression. Its application is the same as in conventional production, but it is applied more carefully not to allow over populating of parasites and then its suppression becomes more difficult. Sulphur inhibits germination of spores and the increase of oidium micelium. The quantity of sulphur is not limited, but potential replacements have been intensively investigated (Kauer et al., 2000).

In organic vineyards in Australia, sulphur is used with canola oil, bicarbonates and biological plant protection products. The application of milk or whey (pure or in mixture with canola oil) decreased the strength of oidium attack. Eight spraying treatments with solution of milk 1:10 or 45 gr/l of whey powder or combination of alternating spraying every 10-14 days with potassium bicarbonate with oil and whey were efficient as much as sulphur (Crisp et al., 2006).

In California, sprayings with sulphur every 7-14 days are recommended as of bursting of buds until inflorescence, and then the application of sulphur powder. If disease is successfully stopped, further protection is provided by means of other products based on Stylet oil, potassium bicarbonate (Armicarb, Kaligrin) and biological fungicides based on *Bacillus subtilis* (Serenade) and *Bacillus pumilus* (Sonata) that are efficient in the conditions of weak to medium attack of oidium (McGourty, 2008).

Researches conducted in Germany showed rape seed oil decreased the events of powdery mildew by 99% but it has negative effects on predator spiders (Trimborn et al., 2000). In the USA, a good alternative to sulphur is used and that is a refined vegetable oil for suppression of powdery mildew (product "JMS Stylet oil") which is also efficient against *Botrytis cinerea* and mites. It is used as of the beginning of the vegetation period (bud burst) until inflorescence every 10-14 days. After inflorescence, the treatments may be continued or sulphur can be used. The treated plant should be well covered (JMS Flower Farms Inc, 2009). A danger of resistance developing is low and these products are good for the application in the conventional production in view of resistance management.

Fungus *Ampelomyces quisqualis* Ces. ex Schlecht. is known as hyper parasite of oidiums in nature. It infects hiphae of powdery mildew and then forms its reproductive organs. Myco-parasite *A. quisqualis* is specific for powdery mildew (genus *Erysiphales*), and as of 1994 it has been commercialized. Water is necessary for a development of the infection, and the infections are stronger at temperatures between 20-30^{o}C. A commercial product is used to suppress oidium during the period of high humidity and rainy weather (Falk et al., 1995).

Bacillus pumilus is the bacterium found in nature, soil and water. Metabolites of these bacteria have fungicide action, they inhibit the germination of spores and increase of hiphae (Bottone and Peluso, 2003). When applied on plants, it forms a physical barrier between the leaf of the plant and spores and then it colonises the spores. The products of these bacteria destroy the cell wall (EPA, 2009). It is registered for suppression of powdery mildew on grapevine (Sonata, AgraQuest, Inc.). Its action lasts for 14 days and it is applied before inflorescence in the intervals of 7-14 days. This bacterium also acts on downy mildew of grapevine. Due to completely different mechanism of action on fungi, *Bacillus pumilus* is good for the application also in conventional production in view of resistance management.

A biological product based on *Streptomyces lydicus* De Boer et al. (product "Actinovate® SP") has been registered in the USA for the suppression of bunch rot and powdery mildew in organic production. In favourable conditions of humidity and temperature, spores of bacteria produce more antibiotics and antifungal secondary metabolites that are destructive for disease causing agents. The bacterium creates hytinase destroying the cell wall of some fungi (Sims, 1998). Potassium bicarbonate is registered in 1998 for suppression of powdery mildew with good efficiency. It has a good action on *Phomopsis* cane and leaf spot, as well as indirect action on bunch rot, downy mildew and other fungi, and it is generally efficient on grapevine (EPA, 2009). Potassium bicarbonate destroys the cell wall of a fungus by disrupting the balance of potassium ions in the cell. Commercial products contain 82% of active substance of potassium bicarbonate in micro capsules and formulated with wetting agents and other inert substances so that the product applied onto a plant has pH=7. In combination with oils, a better efficiency is achieved (Kuepper et al., 2001).

Suppression of *Botrytis* bunch rot [*Botryotinia fuckeliana* (de Bary) Whetzel]

Botrytis bunch rot caused by fungus *Botryotinia fuckeliana* may be very harmful during humid seasons or in high humidity locations. Botrytis bunch rot is a greater problem for grapevine cultivars with tight clustered, white varieties such as Chardonnay, Riesling, Sauvignon Blanc, Semillon, and red varieties such as Pinot Noir and Baco Noir. A good viticulture practice is the most important for the suppression of *Botrytis* bunch rot in vineyards for organic production, particularly in relation to varieties with a small berry and thin skin, e.g., Pinot Blanc, Pinot Gris or Gewürztraminer.

The suppression of this disease both in conventional and organic production includes removal of leaves around the clusters providing a better aeration and lighting with the effects on disease causing agents of *Botrytis* bunch rot and on increasing the quality of grapes and wine. The process of grapevine pruning leaving an optimal number of shoots and their good positioning on the grapevine plant in order to obtain an optimal lighting and aeration may reduce the infection. Bordeaux mixture and the products based on sulphur are not efficient for *Botrytis*. Since the problem of suppression has not been solved yet, intensive investigations have been conducted in order to find new solutions meeting the requirements of the organic production with good results (Schoene, 2002). Among new fungicides used in organic production only two biological products based on *Bacillus subtilis*, (product "Serenade") acting on grey mould can be used if applied during inflorescence and *Trichoderma harzianum* Rifai (product "Trichodex").

Saprophyte bacterium *Bacillus subtilis* is widely spread in nature. It may be used for suppressing plant diseases caused by bacteria and fungi. This bacterium (product "Serenade-Agraquest") suppresses harmful micro-organisms through the competition for food and directly populating them. It is not toxic for humans and environment (EPA, 2009). In the USA it is registered for the application on grapevine for the suppression of powder mildew and *Botrytis* bunch rot. Since the mechanism of action is completely different than the mechanisms applied in the grapevine protection to date, it may be used in the program for resistance management. It may be efficiently used until the harvest since there are no harmful residues. It is used for the suppression of grey mould and other causing agents of bunch mould.

Fungus *Trichoderma harzianum* is a cosmopolitan species that may be found in the ground. As an antagonist, this fungus suppresses grey mould on the grapevine when applied at the beginning of vegetation. This fungus is not harmful for humans, different mammals and birds. Apart from grapevine, this active substance is applied also for suppressing *Botrytis cinerea* on vegetables and greenhouses (Elad, 2000). Commercial biological products based on *T. harzianum* (Trihodex) are available.

Suppression of *Phomopsis* cane and leaf spot (*Phomopsis viticola* Sacc.)

Phomopsis affects young shoots and grapevine leaves. When the infections are severe, flowers and young clusters are also damaged. The disease overwinters in picnides and spreads by rain drops. The suppression of *Phomopsis* should start with pruning as a sanitation measure when infected white shoots are removed, and with bud burst when the first shoot is sprayed with sulphur in higher doses or with liquid formulations of copper fungicides. If the disease was intensive during a previous year, the plants are sprayed with limesulphur mixture during the resting period ("Eau Grison"-calcium polisulphide) (McGourty, 2008; Dufour, 2006). A biological product “Mycostop™” is available at the market, based on *Streptomyces griseoviridis*, registered for the suppression of *Phomopsis* (EPA, 2009).

Suppression of black rot (*Guignardia bidwellii* Viala and Ravaz)

The suppression of agents causing this disease is based on the indirect action of copper products during their application against the downy mildew. Newer microbiological products based on *Bacillus subtilis* are also applied with the efficiency of 50-70% (Dufour, 2006).

Suppression of grapevine wood disease *Eutypa* and Esca

Grapevine wood disease that appears very frequently is caused by fungus *Eutypa lata* [Pers.Fr.] Tul. & C.Tul. The wood infection with this fungus reduces the production life of grapevine and significantly influences the loss of yields through worse quality and less quantity. It expands by wind carried ascospores to great distances. Due to these reasons and because of great number of potential hosts, the application of sanitation measures is of limited significance. The fungus penetrates through fresh pruning wounds. If appropriate measures are not timelily taken, the infected grapevine eventually dries out. The suppression measures include late pruning to healthy wood so that the spots could dry as fast as possible. The pruned shoots should be removed from the vineyard and burned, as well as the infected wood from neighbouring vineyards and orchards in order to reduce the infectious inoculums and pathogen expansion. In case of raining during pruning, new pruning of the biggest wounds is recommended. Recent results show that these measures did not affect the disease in France, while burning of the remains of pruning reduced the number of disease events and drying of grapevine plants. According to the results of this analysis, in France 3.5% of grapevines are infected with *Eutypa*, while list of varieties and grapevine growing region had the greatest impact on the onset of disease (Bertrand et al., 2007).

A good method of protection is to treat pruning wounds by fungicides or by wound coating products. Pruning wounds are sensitive to the infection by *Eutypa lata* during the 4 weeks (Munkvold and Marois, 1994). Thus treatments with chemical fungicides that are usually less persistent may be inefficient. Sodium arsenite has been applied for a long time in France for suppressing the agents causing grapevine wood disease, but as of 2001 its use has been prohibited (Fussler et al., 2008). Its prohibition was believed to increase the problem, but recent researches deny this (Bertrand et al., 2007).

A standard product for suppressing *Eutypa lata* in the USA was a synthetic fungicide based on the active substance benomil but it was withdrawn from use. Biological agents that usually act as antagonists populate these pruning wounds and may survive there for a long time and provide a longer protection from disease. Schmidt et al. (2001) found out that the efficiency resulting from antagonism against *Eutypa lata* shown by bacteria *Bacillus subtilis*, *Erwinia herbicola*, *Serratia* is achieved by 100% during the period of 4 weeks. Good results were also achieved with *Fusarium lateritium* Nees and *Cladosporium herbarum* (Pers.: Fr.) Link, being the typical representatives of epiphyte mycoflora populating the grapevine wounds (Munkvold and Marois, 1993). In field experiments (Ferreira et al., 1991), excellent efficiency was achieved with *Bacillus subtilis* when spraying *Eutypa lata* wounds by the suspension of bacteria. Commercial biological products based on these antagonists may be found in markets worldwide. The commercial formulation of *Bacillus subtilis* (product Serenade-Agraquest) can be applied for suppressing *Eutypa lata*. Bacterium suppresses the fungus by competing for food and space for development, and also by populating fungus colony.

Boron's acid is also an efficient product for suppressing this disease that is applied by spraying on fresh pruning wounds (Rolshausen and Gubler, 2005). Boron's acid has been registered in some countries in organic production but only as a fertiliser not as a pesticide.

Fungus C. *herbarum* was shown to be efficient in combination with boron's acid. Fungus *Fusarium lateritium* Nees ex Link is a cosmopolite and it often populates wood. It parasites a great number of plants and it is known as a causing agent of wood rot and wood cancer (USDA, 2009). It is also a parasite of other fungi some of which are plant pathogens such as *E. lata* and *B. cinerea* (Vajna, 2008). *Fusarium lateritium* is often isolated from the wounds caused by pruning grapevine and it has a useful role there. *Fusarium lateritium* has good results if applied directly onto pruning wounds (Ho et al., 2005). In Australia, the only product registered for suppressing *E. lata* is based on *Trichoderma* spp. (product "Vinevax, Trichoseal") and it is efficiently used for coating wounds.

Suppressing weeds in vineyards

There are no allowed herbicides in the organic production, producers use agro-technical suppression measures. Lots of conventional producers suppress the weeds by this method. These measures are also efficient as synthetic herbicides and encourage microbiological activity of soil in a vineyard (Raičević et al., 2001a, b). Maintaining soil of a vineyard is one of the most important agro-technical measures with the impact also on quality and yield of grapes (Sivčev, 1988). Shallow tillage in a vineyard several times during a season and cutting weeds are the measures applied in Serbia. It is important to point out that most vineyards in Serbia are grown on slopes in order to prevent erosion. It is recommended that the soil in a vineyard should be maintained under a green cover on a temporary or permanent basis. The amount and schedule of precipitations directly influence the application of this measure. The spontaneous population of weed species as a green cover is the most unfavourable option, since some species may be hosts to pests and diseases of grapevine . Sowing the mixture of grass species in combination with some leguminous plants gave excellent results in brown soils (Lović and Sivčev, 1986; Sivčev, 1989).

Protection of grapes during storage

Raisins may be attacked by copper moth *Plodia interpunctela* Hbn. during storage. A biological product based on entomopathogen granulosis virus (GV) (EPA, 2009) may be used for suppression of larvae. The commercial product acts by spraying onto the stored products and larvae digest them through feeding. Water suspension is sprayed onto connections of floor tiles and along the walls where these insects may be found.

A traditional method of keeping grapes is its drying in the sun or in drying facilities. Grapes of seedless grapevine cultivars are usually soaked in the water solution of potassium carbonate and olive oil and then spread in the sun or in a drying facility to dry out.

Glycerol monoesters and propylene glycol monoesters are used for protecting grapevine in fields or stored raisins. There are several registered commercial products. These active substances are used prior to or after storage, and/or in a vineyard before harvesting or on raisins for the purpose of ensuring protection against mites and micro-organisms. These esters are considered to act by destroying the membranes of micro-organisms. Esters of glycerol fatty acid are found in all living organisms including plants and humans, while propylene glycol esters are produced. These chemical substances and their degradation products are used for nutrition and are not toxic for humans (EPA, 2009).

Candida oleophila Montrocher, is yeast found in different plant tissues in nature. Commercially used isolate is applied in the suppression of *Botrytis* bunch rot and other agents causing rot to fruit, grapes, etc. (Droby et al., 1998). *Candida oleophila* inhibits the growth of harmful fungi by colonisation on fruits and plants and through the competition for food and particularly in the damaged plant tissue. This fungus is applied after harvesting by spraying or soaking (EPA, 2009).

The length of keeping table grapes in markets depends on the appearance of *Botrytis* bunch rot. Romanazzi et al. (2007) found out that chitosan, a natural polymer with antifungal action and ethanol, a food additive with antifungal action, are efficient in reducing grape degradation.

Conclusion

The markets worldwide offer various registered products for plant protection that may be used in organic production of grapes. Producers in Serbia dispose of less available products. Investigations of new protection products are very dynamic and they result in discovering new active substances with new mechanism of action, therefore they are used in conventional production for harmful organism resistance management. Some new products are efficient as synthetic products and they are used in the conventional production. New products have been developed for suppressing grapevine pests but they may not be called insecticides because some of them cause repellence, irritation to insects, or are produced or used as biological plant protection products. Investigations of grapevine protection from disease causing agents have advanced in terms of developing a tendency to reduce the quantity of copper and sulphur ultimately being replaced with new products. Different natural materials or biological products with a different mechanism of action are used such as antagonism or competition. New products have been developed for suppressing *Botrytis* bunch rot and grapevine wood disease and they may be used in conventional production as well.

Acknowledgements

This review paper is a part of research on Project No. 20093 financed by Ministry of Science and Technological Development in Republic of Serbia: Organic grape and wine production and full production of grapevine.

References

Agraquest (2009): Agrochemical. http://www.agraquest.com/.

Anonymous (2006): Jaunisses á phytoplasmes de la vigne. Flavescence dorée & Bois noir. Groupe de travail national Flavescence dorée, INRA, 24 pp.

ATTRA (1999): Kaolin clay for management of glassy-winged sharpshooter in grapes. University of California Division of Agriculture and Natural Resources. http://attra.ncat.org/attra-pub/PDF/kaolin-clay-grapes.pdf.

Bertrand, F., Maumy, M., Fussler, L., Kobes, N., Savary, S., Grosman, J. (2007): Using factor analyses to explore data generated by the national grapevine wood diseases survey. http://hal.archives-ouvertes.fr/docs/00/16/69/70/PDF/Case study Phyto Bertrand-Maumy.pdf.

Bottone, J.E., Peluso, R.W. (2003): Production by *Bacillus pumilus* (MSH) of an antifungal compound that is active against *Mucoraceae* and *Aspergillus* species: preliminary report. J. Med. Microbiol. 52:69-74.

Boudon-Padieu, E. (2003): The situation of grapevine yellows and current research directions: distribution, diversity, vectors, diffusion and control. 14th ICVG Conference, Locorotondo, 12-17 September, pp. 47-53.

Certis (2009): MeloCon WG. http://www.certisusa.com/index.htm.

Cohen, Y., Wang, W., Ben-Daniel, B., Ben-Daniel, Y. (2006): Extracts of *Inula viscosa* control downy mildew of grapes caused by *Plasmopara viticola*. Phytopathology 96:417-424.

Crisp, P., Wicks, T.J. Bruer, D., Scott, E.S. (2006): An evaluation of biological and abiotic controls for grapevine powdery mildew. 2. Vineyard trials. Australian Journal of Grape and Wine Research 12:203-211.

Cvrković, T. (2009): Diverzitet cikada u vinogradima Srbije i njihova uloga u prenošenju Bois noir fitoplazme. Doktorska disertacija. Univerzitet u Beogradu.

Dagostin, S., Ferrari, A., Pertot, I. (2006): Integration of different control measures to maximise disease control of *Plasmopara viticola* in Italian organic viticulture. Proceedings from European Joint Organic Congress, 30-31 May, Odense, Denmark, pp. 338-339.

Diver, S. (2002): Notes on compost teas: A supplement to the ATTRA publication. Compost teas for plant disease control. www.attra.ncat.org.

Droby, S., Cohen, L., Daus, A.,Weiss, B., Horev, B., Chalutz, E., Katz, H., Keren-Tzur, M., Shachnai, A. (1998): Commercial testing of aspire: A yeast preparation for the biological control of postharvest decay of *Citrus*. Biological Control 12(2):97-101.

Dufour, P. (2006): Grapes: Organic production. ATTRA. www.attra.ncat.org.

Elad, Y. (2000): *Trichoderma harzianum* T39 preparation for biocontrol of plant diseases: Control of *Botrytis cinerea*, *Sclerotinia sclerotiorum* and *Cladosporium fulvum*. Biocontrol Science and Technology 10:499-507.

EPA (2009): Pesticides. http://www.epa.gov/pesticides/a-z/index.htm.

Falk, S.P., Gadoury, D.M., Cortesi, P., Pearson, R.C., Seem, R.C. (1995): Parasitism of *Uncinula necator* cleistothecia by the mycoparasite *Ampelomyces quisqualis*. Phytopathology 85:794-800.

Ferreira, J.H.S., Matthee, F.N., Thomas, A.C. (1991): Biological control of E*utypa lata* on grapevine by antagonistic strain of *Bacillus subtilis*. Phytopathology 81:283-287.

Fussler, L., Kobes, N., Bertrand, F., Maumy, M., Grosman, J., Savary, S. (2008): A characterization of grapevine trunk diseases in France from the national grapevine wood diseases survey. Phytopathology 98:571-579.

Gadoury, D.M. (1995): Controlling fungal diseases of grapevine under organic management practices. Organic grape and wine production symposium. Experiment Station Geneva. http://www.nysaes.cornell.edu/hort/faculty/pool/organicvitwkshp/newgadoury.pdf.

Galet, P. (2002): Grape varieties. Hachette Wine Library. London, E144JP, pp. 159.

Gusberti, M, Jermini, M., Wyss, E., Linder, C. (2008): Efficacité d`insecticides contre *Scaphoideus titanus* en vignoble biologiques et effets secondaires. Revue Suisse Viticulture Arboriculture Horticulture 40(3):173-177.

Heibertshausen, D., Baus-Reichel, O., Hofmann, U., Berkelmann-Loehnertz, B. (2006): Copper reduction, a successful approach to control downy mildew in organic viticulture. Proceedings 5th International workshop on grapevine and powdery mildew. San Michele all'Adige, 18-23 June, pp. 193.

Ho, M.A., Squire, L.M., Sabeh, N.C., Giles, D.K., Vander Gheynst, J.S. (2005): Design and evaluation of a grapevine pruner for biofungicide application. Bioresource Technology 96(8):963-968.

JMS Flower Farms, Inc (2009): Organic JMS stylet-oil. www.stylet-oil.com.

Kauer, R., Gaubatz, B., Wohrle, M., Kornitzer, U., Schultz, H.R., Kirchner, B. (2000): Organic viticulture without sulfur? 3 years of experience with sodium and potassiumbicarbonate. In: Willer, H., Meier, U. (Eds.), "Proceedings 6th International Congress on Organic Viticulture", 25-26 August, Basel, pp. 180-182.

Köhl, J. (2007): Replacement of copper fungicides in organic production of grapevine and apple in Europe. Publishable Final Activity Report. REPCO 501452. http://www.rep-co.nl.

Kostić, M., Drazić, S., Popović, Z., Stanković, S., Sivčev, I., Zivanović, T. (2007): Developmental and feeding alternations in *Leptinotarsa decemlineata* Say. (*Coleoptera*:*Chrysomelidae*) caused by *Salvia officinalis* L. (*Lamiaceae*) essential oil. Biotechnology and Biotechnological Equipment 21(4):426-430.

Kostić, M., Popović, Z., Brkić, D., Milanović, S., Sivčev, I., Stanković, S. (2008): Larvicidal and antifeedant activity of some plant-derived compounds to *Lymantria dispar* L. (*Lepidoptera*:*Limantriidae*). Bioresource Technology 99(16):7897-7901.

Kreiter, C. (2000): Management of major arthropod pests in organic viticulture. In: Willer, H., Meier, U. (Eds.), "Proceedings 6th International Congress on Organic Viticulture", 25-26 August, Basel, pp. 149-159.

Krnjajić, S. (2008): Uloga cikade *Scaphoideus titanus* Ball u prenošenju fitoplazme zlatastog žutila vinove loze "Flavescence dorée". Doktorska disertacija. Univerzitet u Novom Sadu.

Krnjajić, Đ., Krnjajić, S. (1987): Fitonematologija: štetne nematode u biljnoj proizvodnji i njihovo suzbijanje. Nolit, Beograd.

Kuepper, G., Thomas, R., Earles, R. (2001): Use of baking soda as a fungicide. Appropriate Technology Transfer to Rural Areas (ATTRA). http://attra.ncat.org/attra-pub/bakingsoda.html.

Lović, R., Sivčev, B. (1986): Einfluss der egrünung beim weinrebenanbau an terrassen auf ertrag und die qualität der trauben sorten Negotinski rubin. VI Internationales Kolloquim, Bergunung in Weinbau, Maribor, pp. 132-149.

McGourty, G.T. (2008): Fighting disease organically wines &vines. winegrapes.wsu.edu/organic.html.

Mori, N., Pavan, F., Bondavalli, R., Reggiani, N., Paltrinieri, S., Bertaccini, A. (2007): Factors affecting the spread of Bois Noir disease in grapevine cv. Lambrusco in Northern Italy. Bulletin of Insectology 60(2):295-296.

Munkvold, G.P., Marois, J.J. (1993): Efficacy of natural epiphytes and colonizers of grapevine pruning wounds for biological control of *Eutypa* dieback. Phytopathology 83:624-629.

Munkvold, G.P., Marois, J.J. (1994): Factors associated with variation in susceptibility of grapevine pruning wounds to infection with *Eutypa lata*. Phytopathology 85:249-256.

OEPP/EPPO (2000): EPPO Standards: Good plant protection practice. Grapevine PP 2/23(1). Bulletin OEPP/EPPO Bulletin 32:367–369.

Osun (2009): Sabadilla. http://www.osun.org/sabadilla-pdf.html.

Raičević, V., Sivčev, B., Mojašević, M., Dakić, P. (2001a): Mikrobiološka aktivnost zemljišta u vinogradu tretiranom herbicidima Casoron G i Gallant Super. V Jugoslovensko savetovanje o zaštiti bilja. Zbornik rezimea, Zlatibor, pp. 104.

Raičević, V., Sivčev, B., Mojašević, M., Dakić, P. (2001b): Herbicides and microbiological activity in vineyard soils. 1st Internatinal Symposium “Food in the 21st century”, Subotica. Abstract, pp. 169.

Raičević, V., Sivčev, B., Jakovljević, M., Antić, S., Lalević, B. (2004): The environmental impact of viticulrure: “The influence of biofertilizer type on wine quality and soil microbiological activity”. Acta Horticulturae 652:309-313.

Regulation (EEC) No. 2092/91 (1991): On organic production of agricultural products. http://eur-lex.europa.eu/LexUriServ LexUriServ.do?uri=/: OJ:L 2008:250:0001:0084:EN:PDF.

Rolshausen, P. E., Gubler, W.D. (2005): Use of boron for the control of *Eutypa* dieback of grapevines. Plant Disease 89(7):734-738.

Romanazzi, G., Ozgur, A. Karabulut, J., Smilanick, L. (2007): Combination of chitosan and ethanol to control postharvest gray mold of table grapes. Postharvest Biology and Technology 45(1):134-140.

Schmidt, C.S., Lorenz, D., Wolf, G.A. (2001): Biological control of the grapevine dieback fungus *Eutypa lata* I: Screening of bacterial antagonists. J. Phytopathology 149:427-435.

Schoene, P. (2002): *Ulocladium atrum* as an antagonist of grey mould (*Botrytis cin*erea) in grapevine. Dissertation. Hohen Landwirtschaftlichen Fakultät, Universität Bonn.

Schruft, G. (1995): Organic grape and wine production: grower experiences in Germany. Organic grape and wine production symposium. New York State Agricultural Experiment Station Geneva. http://www.nysaes.cornell.edu/hort/faculty/pool/organicvitwkshp/18schruft.pdf.

Schweikert, C., Mildner, M., Vollrath, C., Kassemeyer, H.H. (2006): Systems for testing the efficacy of biofungicides and resistance inducers against grapevine downy mildew. Proceedings from European Joint Organic Congress, 30-31 May, Odense, Denmark, pp. 350-351.

Sims, F. (1998): Actinovate SP biological fungicide. Natural Industries, Inc. TX. www.actinovate.com.
Sivčev, B. (1988): The ways of maintain soils and ecological condition of growing vine in the vineyards of Venčac. Soil and Plant 37(3):241-260.
Sivčev, B. (1989): Uticaj zatravljivanja pri gajenju vinove loze na terasama na prinos i kvalitet grožđa sorte Negotinski rubin. Jugoslovensko vinogradarstvo i vinarstvo 6-7:30-36.
Sivčev, I. (1992): Sezonska pojava i značaj entomopatogenih gljiva kupusove vaši (*Brevicoryne brassicae* L.). Zaštita bilja 43(3):181-195.
Sivčev, B. (2005): Organska proizvodnja grožđa. In: Kovačević, D., Oljača, S. (Eds.), Organska poljoprivredna proizvodnja. Poljoprivredni fakultet, Zemun, pp. 149-174.
Sivčev, I., Draganić, M. (1994): UV zraci i konidije *Pandora neoaphidis*. Zaštita bilja 45(3):203-207.
Sivčev, I., Manojlović, B. (1995): Uticaj temperature i relativne vlažnosti na klijanje konidija afidopatogene gljive *Pandora neoaphidis*. Zaštita bilja 46(1):51-56.
Sivčev, B., Todić, S., Petrović, N. (2003): Organska proizvodnja grožđa i vina. Proizvodnja i sertifikacija organskih proizvoda. Zbornik rezimea, Mataruška Banja, pp. 24.
Sivčev, B., Jović, S., Raičević, V., Petrović, A., Lalević, B. (2005): Application of microbiological fertilizers in viticulture: Grape yield and quality of wine cv. Reisling. Journal of Agricultural Sciences 50(1):19-26.
Speiser, B., Schmid, O. (2003): Current evaluation procedures for plant protection products used in organic agriculture. Proceedings of a workshop held, 25–26 September, Frick, Switzerland, pp. 8-13.
Spisak sredstava za zaštitu bilja (2009): http://www.minpolj.gov.rs/download/Spisak sredstava 2.pdf.
Trimborn, B.F., Weltzien, H.C., Schruft, G. (2000): Contributions to environmentally safe plant protection systems in grapevine culivation. Proceedings of the 6th International Congress on Organic Viticulture, pp. 166.
Troy biosciences Inc (2009): Naturalis L-*Beauveria bassiana*. www.troybiosciences.com/.
USDA (2009): Fungal databases. http://nt.ars-grin.gov/fungaldatabases/.
Vajna, L. (2008): *Fusarium lateritium* Nees ex Link as a parasite and host in interfungal hyphal interactions. J. Phytopathology 118(2):157-164.

Received: January 25, 2010
Accepted: June 14, 2010

SREDSTVA ZA ZAŠTITU BILJA U ORGANSKOJ PROIZVODNJI GROŽĐA

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R e z i m e

Oblast organske proizvodnje je regulisana odgovarajućim zakonom i podzakonskim aktima kao proizvodnja koja se zasniva na prirodnim procesima i upotrebi prirodnih materija. U pojedinim slučajevima sredstva koja su na raspolaganju nisu dovoljna za održivu proizvodnju. Zakonom se dozvoljavaju izuzeci i ta sredstva sintetičko-hemijskog porekla su na posebnim listama dozvoljenih sredstava. Veliki broj takvih izuzetaka se odnosi na sredstva za zaštitu bilja jer još uvek nemaju alternativu. Štetočine i bolesti vinove loze u organskoj proizvodnji suzbijaju se preventivnim merama koje imaju zadatak da umanje jačinu napada, a ako postoji potreba onda se primenjuju dozvoljene supstance sa delovanjem na patogene gljive, insekte, grinje i ostale štetne organizme. U organskoj proizvodnji vinove loze se koriste insekticidi biljnog porekla koji imaju široki spektar delovanja na štetne insekte, zatim biljna ulja, prašiva, insekticidni sapuni koji su selektivni, uskog spektra delovanja i niže toksičnosti, kao i biološki preparati. Ovakvi preparati po pravilu zahtevaju češću primenu. U suzbijanju bolesti vinove loze još uvek su vodeći fungicidi na bazi bakra i sumpora. Istraživanja idu u pravcu smanjivanja količina primene i iznalaženja njihove zamene isto toliko efikasnim sredstvima. Poseban naglasak je na istraživanjima efikasnih sredstava za suzbijanje sive truleži (*Botryotinia fuckeliana)* i prouzrokovača bolesti drveta (Esca i *Eutypa*) vinove loze u organskoj proizvodnji. Osim bakra i sumpora kod vinove loze se primenjuju i različite supstance kao što su bikarbonati, biljni ekstrakti i ulja, biološki preparati, zatim prirodni proizvodi (mleko i surutka) i druge.

Ključne reči: vinova loza, *Vitis vinifera* L., organsko upravljanje štetočinama, štetočine, bolesti.

Primljeno: 25. januara 2010.
Odobreno: 14. juna 2010.

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