

***POLYVINYLPIROLIDON AND BISUBLIMATED IODINE
COMPLEX AS AN ALTERNATIVE IN CONTROLLING
BACTERIAL SPOT OF PEPPER
XANTHOMONAS CAMPESTRIS PV. VESICATORIA***

MLADEN ĐORĐEVIĆ*, JELENA DAMNJANOVIĆ, BOGOLJUB ZEČEVIĆ,
RADIŠA ĐORĐEVIĆ, MILAN UGRINOVIĆ

¹ Insitute for Vegetable Crops, Smederevska Palanka, Serbia

* e-mail: mladendj1981@hotmail.com

The aim of this research was to test efficiency of polyvinylpyrrolidon and bisublimated iodine complex in controlling *Xanthomonas campestris* pv. *vesicatoria*. Efficiency of this complex has been compared to efficiency of biological pesticide Serenade, antibiotic Starner and copper pesticide Bakrocid S – 50. The trial included two treatments: (i) two hours before inoculation; (ii) four hours after inoculation and control inoculated only with the pathogen.

Disease intensity (DSI) and efficiency has been observed after 14 days. The results showed that pesticide Vestal PVP-179 in treatment (i) had efficiency 77.23%, while in treatment (ii) had 72.28% which is close to the efficiency of other pesticides. The conclusion is that this pesticide could be used in controlling this pathogen.

Key words: *Xanthomonas campestris* pv. *vesicatoria*, alternative, control, copper, antibiotics, *Bacillus subtilis*, polyvinylpyrrolidon and bisublimated iodine complex

INTRODUCTION

Pepper (*Capsicum annuum* L.) is one of the most important vegetables in Serbia with long tradition of growing (Zečević *et al.*, 2009, 2011). It represents very important raw for proceeding industry and is a part of everyday nutrition in Serbia. Considering the importance of pepper in Serbia, the control of possible

pathogens it is very important since they can decrease the quality and quantity of this culture.

One of the most important pepper pathogen is *Xanthomonas campestris* pv. *vesicatoria* (Xcv) causer of pepper bacterial spots (Arsenijević, 1997; Obradović *et al.*, 1997, 1999, 2005). This bacteria is very spread and it occurs every year more or less intensively and can cause great losses (Djordjević *et al.*, 2006; Obradović *et al.*, 1997). Losses are important not only from the aspect in commercial production but in seed production, also.

The most used pesticides in controlling Xcv usually contained copper as active substance (Djordjević and Zecević, 2008; Milijasević *et al.*, 2006). Copper has been in use for quite some time and it is considered to be very efficient for this purpose. However, some researches proved resistance of some races of the pathogen to the copper. Besides the fact that some races of the pathogen have been resistant, concept of organic production implies restricted use of copper (Voloudakis *et al.*, 2005).

Pesticides based on antibiotics (McManus *et al.*, 2002) have been in use from the 1950s, in protection of highly profitable fruit and vegetable cultures from bacterial pathogens. Although these pesticides are considered very efficient, their usage is questionable due to potential consequences on human health (McManus *et al.*, 2002).

Biological pesticides with antagonistic micro organism as active matter, such as *Serenade*[®] with *Bacillus subtilis* as active matter, have been in use for controlling the pathogen (Djordjević i Zecević, 2008).

Besides these possibilities of controlling the Xcv, new solutions should be explored constantly, bearing in mind the complexity of control and a concept of sustainable agricultural production. Vestal PVP-179[®] (Vestal Chimica Italiana, Italy) with *polyvinylpyrrolidon* and *bisublimated iodine* as active substance could, potentially, be one of the solutions. This pesticide has been registered in Italy as bactericide for usage in agriculture with low influence on environment as well as in veterinary and medicine as a disinfectant.

The aim of this research was to investigate the efficiency of pesticide Vestal PVP-179[®] and compare it to efficiency of other pesticides belonging to different substances, used in control of this pathogen, such as copper, biological and antibiotic pesticides.

MATERIAL AND METHODS

The trial for examination of the efficiency of Vestal PVP-179 comparing to other pesticides mentioned above, has been set up in Smederevska Palanka at the Institute for Vegetable Crops. The trial has been set up in outdoor conditions in random block system with three replications. Each repetition included 30 plants. Pepper variety Romana has been inoculated in this research, since it is middle sensitive to this pathogen (Djordjević and Zečević, 2008).

Pesticides compared to PVP-179[®] were Serenade[®] (*Bacillus subtilis*), antibiotic pesticide Starner (*oxalic acid*) and copper pesticide Bakrocid S – 50 (*copper – ox chloride*). Concentration of applied pesticides has been presented in Table 1.

Efficiency of the pesticide has been researched in two treatments: (i) treated with pesticides 2h before inoculation; (ii) treated with pesticides 4h after inoculation. Plants treated with water, before inoculation have been the control (Djordjevic *et al.*, 2006).

Plants have been inoculated artificially by using isolate KFB4 of pathogen *Xanthomonas campestris* pv. *vesicatoria* from collection of phytopathogenic bacteria of Institute for Vegetable crops, Smederevska Palanka. Suspension has been prepared out of bacteria culture 48h old in concentration 10⁻⁸ cfu/ml. Pepper plants have been inoculated by spraying with hand sprayer in phenophase of 5 leaves. During inoculation and 48h after it, maximal day temperature has been 26°C, and minimal was not lower than 23°C.

Disease intensity has been measured by examining 100 random chosen leaves, 14 days after inoculation. Characteristically spots on the leaves have been observed and the percentage of the infected leaf surface has been determinate. Based on this percentage, the observed leaves have been divided in 6 categories on scale, in order to measure the intensity of disease. The scale contained the following categories: 0: 0%; 1: 1-10%; 2: 11-25%; 3: 26-45%; 4: 46-60% and 5: >60% (Djordjević and Zečević, 2008).

Intensity of disease has been calculated by Townsend – Heuberg formula, while the efficiency of the pesticide has been calculated by Abbott. The results have been preceded by applying the variance analysis using mathematical programme MATLAB Version 7.0., while the significance of the individual tests has been tested by applying the Duncan test.

RESULTS AND DISCUSSION

The researched pesticides showed high effectiveness in controlling pepper spots, caused by *Xanthomonas campestris* pv. *vesicatoria*.

The efficiency of Vestal PVP-179® has been from 74.92% in treatment (ii) to 77.23% in treatment (i). Comparison of the observed pesticides in controlling this pathogen in treatment (i) (Table 1) showed no statistical differences among these pesticides. In treatment (ii) between efficiency of this and individual pesticides there are statistically significant differences (Table 2).

Table 1 – Mean values of disease severity index (DSI) and efficacy of tested bactericides in treatment I

Tabela 1 – Srednje vrednosti indeksa oboljenja (IO) i efikasnosti preparata primenjenih u tretmanu I

Bactericides (Baktericidi)	Concentration (%) (Koncentracije) (%)	(DSI)* (IO)*	Efficacy (Efikasnost)
Serenade	0,4	9,73 a	75,91
Starner	0,4	7,87 a	80,53
Bakrocid S-50	0,5	8,00 a	80,21
Vestal PVP-179	0,05	9,20 a	77,23
Control / <i>Kontrola</i>	/	40,40 b	0

* Values followed by same letters are not, statistically, significantly different (P=0.05) based on Duncan's multiple range test,

* vrednosti obeležene istim slovima statistički se značajno ne razlikuju (P=0,05) po Duncan-ovom testu

Considering the significance of this vegetable crop and the quality and the quantity of production it is very important to pay attention to control pathogen such as bacterium *Xanthomonas campestris* pv. *vesicatoria*. The most used pesticides for control of this pathogen have copper compounds as an active substance (Milijasevic *et al.*, 2006). Determinate efficiency of copper pesticide, Bakrocid S-50, in both treatments, is lightly higher than efficiency found by Milijasevic *et al.* (2006) in two-year trial, set in 2005 and 2006, with pesticide with the same active substance, but lower concentrated (350g/kg) Cuprozin 35 WP. The difference could be explained by fact that Bakrocid S- 50 has active substance 500g/kg. The difference in efficiency of Bakrocid S-50 in treatments (i) and (ii) has been low, while the efficiency of this pesticide according to Djordjevic *et al.* (2006), in control of the observed pathogen was significantly higher in treatment after inoculation (90,5%) than before it (73,5%). The difference in these data could be explained by different conditions for infection and difference in plant sensitivity

used in experiments (pepper Palanacka kapija , which is more sensitive to this pathogene than Romana (Djordjević i Zečević, 2008).

Table 2 - Mean values of disease severity index (DSI) and efficacy of tested bactericides in treatment II

Tabela 2 - Srednje vrednosti indeksa oboljenja (IO) i efikasnosti preparata primenjenih u tretmanu II

Bactericides (Baktericidi)	Concentration (%) (Koncentracije) (%)	(DSI)* (IO)*	Efficacy (Efikasnost)
Serenade	0,4	6,03 bc	86,49
Starner	0,4	5,93 bc	86,72
Bakrocid S-50	0,5	8,83 ab	84,22
Vestal PVP-179	0,05	11,2 a	74,92
Control/ <i>Kontrola</i>	/	44,65 d	0

* Values followed by different letters are, statistically, significantly different (P=0,05) based on Duncan's multiple range test,

* vrednosti obeležene različitim slovima statistički se značajno razlikuju (P=0,05) po Duncan-ovom testu.

Pesticide Starner has been registered for usage only in Israel for control of *Erwinia amylovora*, especially in regions where this pathogen developed resistance to streptomycin (McManus *et al.*, 2002). Adaskaveg *et al.*, (2001), conducted a research where pesticide Starner®, applied as preventive, concentrated 0,2% did not show satisfactory efficiency, on the contrary DSI was 62%. These authors conducted a research in controlled conditions (phyto chamber) and by applying different method. Different results could be explained by the facts mentioned above and concentration of pesticide used in this trial was doubled i.e. 0.4%. Also, use of this pesticide in Serbia has been forbidden so the resistance to this substance could not be developed.

Efficiency of pesticide Serenade, found in this trial, is in accordance with results of Djordjević *et al.* (2006).

Current plant protection tendency is to include biological pesticides as a part of sustainable agricultural production, as much as possible. This concept implicit certain replacement in the plant protection filed and does not belong to far future, but is a part of agricultural production of presence. Being aware of this, scientists work on finding adequate change for conventional methods and means of protection from this pathogen.

In accordance with previously said, and according to obtained results, we can conclude that pesticide Vestal PVP-179®, with active substance consisted of

complex *polyvinylpyrrolidon and bisublimated iodine*, in recommended concentration 0,05%, can successfully be applied as preventive solution for control of bacterial spots of pepper, caused by *Xanthomonas campestris* pv. *vesicatoria*.

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**KOMPLEKS POLIVINILPIROLIDONA I BISUMLIRANOG JODA
KAO ALTERNATIVA U SUZBIJANJU BAKTERIOZNE PEGAVOSTI
PAPRIKE *XANTHOMONAS CAMPESTRIS* PV. *VESICATORIA***

MLADEN ĐORĐEVIĆ*, JELENA DAMNJANOVIĆ, BOGOLJUB ZEČEVIĆ,
RADIŠA ĐORĐEVIĆ, MILAN UGRINOVIĆ

¹ Institut za Povrtarstvo, Smederevska Palanka

* e-mail: mladendj1981@hotmail.com

REZIME

Cilj ovog oglada je bio da se testira efikasnost kompleksa polivinilpirolidona i bisublimiranog joda u suzbijanju *Xanthomonas campestris* pv. *vesicatoria*. Efikasnost ovog kompleksa poredila se sa efikasnošću biološkog preparata Serenade, antibiotika Starner i copperskog preparata Bakrocid S – 50. U ogledu su bila dva tretmana: (i) dva sata pre inokulacije; (ii) četiri sata posle inokulacije, i kontrolu koja je samo inokulisana patogenom. Nakon 14 dana vršena je ocena inteziteta oboljenja (DSI) i efikasnosti. Utvrđeno je da je preparat Vestal PVP-179 u tretmanu (i) imao efikasnost 77,23%, dok je u tretmanu (ii) imao 72,28% što je u granicama efikasnosti koje su imali drugi preparati. Možemo zaključiti da se ovaj preparat može koristiti u cilju suzbijanja ovog patogena.

Ključne reči: *Xanthomonas campestris* pv. *vesicatoria*, alternativa, suzbijanje, bakar, antibiotik, *Bacillus subtilis*, kompleks *polivinilpirolidona* i *bisumliranog joda*

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