

**THE OCCURRENCE OF OLIVE KNOT DISEASE CAUSED BY *Pseudomonas savastanoi* IN THE NORTHWEST REGION OF ISTRIAN PENINSULA**

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**ABSTRACT**

Olive knot, a disease caused by pathogen bacteria *Pseudomonas savastanoi* is known from the ancient Roman times. Nowadays it is spread in almost all olive production areas and represents the main disease in olive groves. The bacteria stimulates tissue proliferation and abnormal cell division from which tumour formations are formed. With disease development, tumours grow and their number increase which can lead to branch and shoots decline and lower yields. The oil from olives on contaminated olive trees has lower quality. The bacteria penetrates the olive through open wounds from cutting or harvesting as well as through wound caused by hail and strong winds. Considering the incidence of disease occurrence in surroundings of Poreč (northwest Istria, Croatia) during the 2008 our aim was to quantify the presence of olive knot appearance and set possible reasons which have influenced its presence and spreading. The researched area had 140 ha of olive trees in which there were 5 separate research locations with similar ecological and microclimatic circumstances planted with Leccino and Picholine varieties. Frequency and degree of contamination were defined by visual examination of olive's upper parts, and results were shown numerically (on scale). Intensity infestation of olive knot was different on various locations. Variety Leccino showed less susceptibility to infection of bacteria compared to Picholine. Gained results can be used in strategies for decreasing damages caused by this disease.

**Key words:** Croatia, monitoring, olive knot, olive tree, *Pseudomonas savastanoi*.

**IZVLEČEK**

**POJAV BAKTERIJSKEGA OLJČNEGA RAKA (*Pseudomonas savastanoi*) V SEVEROZAHODNEM DELU ISTRSKEGA POLOTOKA**

Oljčni rak, ki ga povzroča patogen bakterija *Pseudomonas savastanoi* je znan že iz časov starega Rima. Danes je razširjen praktično v vseh območjih, kjer raste oljka in predstavlja najpomembnejšo bolezen na tej rastlini. Bakterija pospešuje rast rastlinskega tkiva in nekontrolirano delitev celic iz katerih se razvijejo novotvorbe, njihovo množenje in rast povzroča propad vej in korenin, kar ima za posledico nižji pridelek. Olje z okuženih rastlin pa ima slabšo kvaliteto. Bakterija prodre v rastlinsko tkivo skozi odprte rane, ki ostanejo od obrezovanja ali od spravljjanja pridelka in skozi rane, ki jih naredi toča ali močan veter. V naši raziskavi, ki smo jo opravili v letu 2008, smo želeli ugotoviti vzroke, ki vplivajo na pojav in razširjanje te bolezni v okolici Poreča (severozahodna Istra, Hrvaška). Območje raziskovanja je skupaj obsegalo 140 ha oljčnih nasadov, ki so bili postavljeni na petih med seboj ločenih

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lokacijah s podobnimi ekološkimi in mikroklimatskimi pogoji. V poskus sta bili vključeni 2 sorti: Leccino in Picholine. Okužbe na oljkah, ki smo jih ugotavljali vizualno s pregledovanjem zgornjih delov dreves, smo prikazali v številčni skali. Intenzivnost okužbe z oljčnim rakom se je med lokacijami razlikovala. Sorta Leccino se je pokazala kot bolj občutljiva v primerjavi s sorto Picholine. Dobljeni rezultati bodo uporabljeni v strategiji zatiranja proti tej bolezni.

**Ključne besede:** Hrvaška, monitoring, oljčni rak, oljka, *Pseudomonas savastanoi*, simptomi.

## 1 INTRODUCTION

*Pseudomonas savastanoi* is a motile, gram-negative bacterium with 1-4 polar flagella with dimensions of 0,4-0,8  $\mu\text{m}$  x 1,2-2,3  $\mu\text{m}$  (Civanos López-Villalta, 1999). The bacterium lives as an epiphyte on healthy leaves and when weather conditions are optimal (22-25°C and over 80% relative humidity) it may become a source of infection (Škarica *et al.*, 1996, Civanos López-Villalta, 1999, Lavermicocca *et al.*, 2002). It is the causal agent of olive knot disease, a bacterial disease that affects olive trees mainly in Mediterranean countries, where climatic conditions often favour spread of the disease (Penyalver *et al.*, 2006). The minimal temperatures of 18-22°C are essential for the onset of the disease (Iannotta *et al.*, 2007). Tissues can be infected through leaf scars (after the leaves fall), wounds and fissures on stem and twigs caused by meteorological phenomena (hail and frost) and insect miners, as well as by harvest and pruning practices. Symptoms are characterized by tumorous outgrowths on different parts of infected plants, mainly shoots and branches. The galls are initially small protuberances or swellings. They are growing quickly and turn into smooth, soft, spherical “knots” (3-5 mm in diameter) that are soft and covered with greenish bark (Fig. 1.).



Figure 1: Knots on branches of olive (young greenish galls - left and bigger knots - on the right side of the figure) (Photo: I. Dminić).

The development of these galls is dependent on bacterial production of the phytohormone indole-3-acetic (IAA) acid and cytokinins (Penyalver *et al.*, 2006). Olive knot disease is considered as an important problem for olive crops because of its effect on vegetative growth, olive yield and even possibly on olive oil quality like inferior organoleptic characteristics (Civanos López-Villalta, 1999).

Some studies have found that different olive genotypes have different degrees of susceptibility to bacterium *P. savastanoi*. Žužić *et al.*, (1987) mention that the variety Leccino is resistant to olive knot. Iannotta *et al.* (2007) conducted a research on numerous Italian and non-Italian varieties and they showed different sensitivity to infection. In this way, cultivar Leccino showed 30%, unlike cultivar Picholine, which gained 70,83% of infection. The use of tolerant or resistant varieties is considered one of the most appropriate methods of control at this moment, because the peak of the disease depends on variety susceptibility (Civantos López-Villalta, 1999).

## 2 MATERIALS AND METHODS

Our aim was to quantify the presence of olive knot symptoms and set possible reasons which have influenced its presence and spreading.

The investigation was carried out on November 2008 in surroundings of Poreč (northwest Istria, Croatia), in the olive grove on the location Červar. The researched area had 140 ha of olive trees in which we chose 5 separate research locations, of about 900 m<sup>2</sup> each, where 10 trees per site (50 trees or 4500 m<sup>2</sup> in total) were examined. The research locations were planted by two olive varieties: Italian variety Leccino and French variety Picholine. The pruning was manual, while the harvest was performed both, manually and mechanically. The climatic factors were measured during 2007 and 2008 at the meteorological station Poreč. The medium annual temperature in 2007 was 14,5°C and the total annual precipitations were 813,5 mm, while the medium annual temperature in 2008 was 14,4°C and the total annual precipitations were 840 mm. Details (varieties, age, etc.) about different research locations are presented in the Table 1.

Table 1. Data about the researched localities.

Research location	Distance in and between the rows (m)	Variety	Irrigation	Plant age (years)
1	6x6	Leccino	-	20-30
2	6x6	Leccino	-	20-30
3	5x5	Leccino	-	20-30
4	4x5	Picholine	+	10-15
5	4x5	Leccino	+	20-30

The presence of the disease was estimated on the basis of the quantity of tubercles present on branches. Frequency and degree of contamination were defined by visual examination of upper parts of the olive trees, using the scale that was based on four categories according to Iannotta *et al.* (2007). If knots were present on less than 20% of branches, frequency of the disease incidence was marked as 1. Consequently, if knots were present on 21-50 % of branches it was marked as 2; 51-70% branches as 3 and 71-100% as 4.

## 3 RESULTS AND DISCUSSION

Based on the research that was conducted in November 2008, we found olive knot symptoms, presumably caused by bacterium *Pseudomonas savastanoi*, on olive trees at all 5 locations (Fig. 1).

Our results showed a different situation among two various cultivar (Leccino and Picholine). The frequency of olive knot symptoms based on visual evaluation of the upper parts of olives was from 5 to 90%. According to the scale of Iannotta *et al.*, 2007, all of four categories were found. The Picholine variety had higher percentage of infection than Leccino variety. The

percentage of infection of Picholine was on average 73% (category of infection 4). The percentage of infected plant parts of Leccino on the research location 1 was on average 42,5% (category of infection 2).

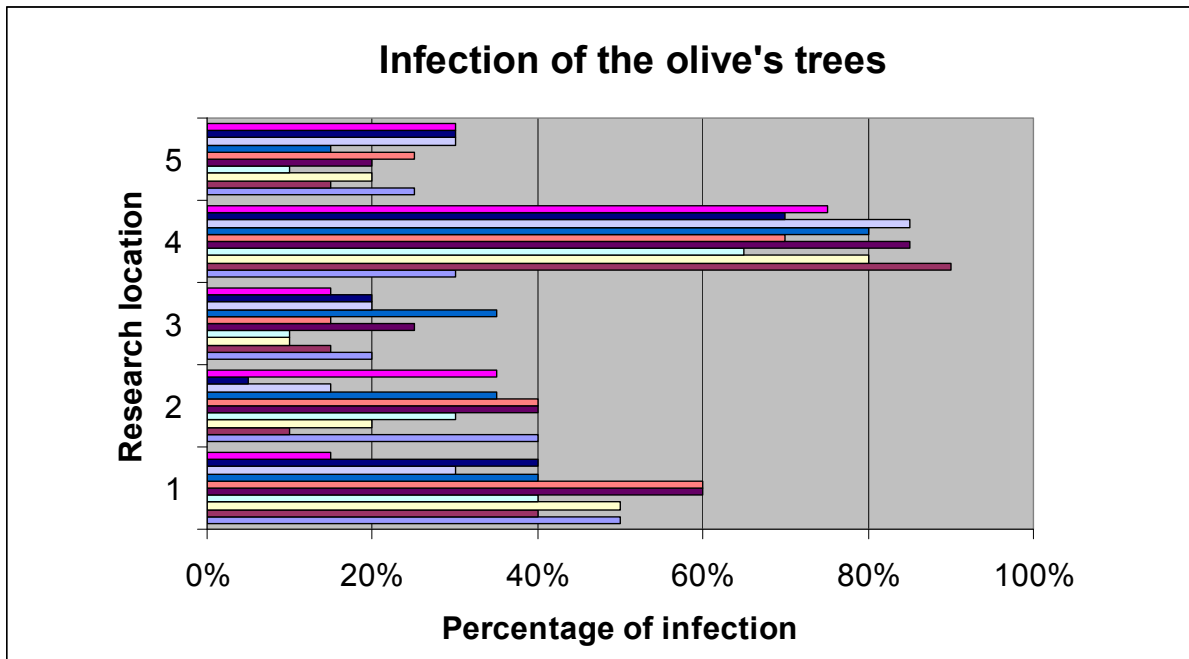


Figure 1. Presence of olive knots in different research locations in 2008.



Figure 2. Olive twigs covered by knots, presumably caused by bacterium *Pseudomonas savastanoi* (Photo: I. Dminić).



Figure 3. Olive trunk with knot symptoms (Photo: I. Dminić).

On the locations 2 and 5 the percentage was on average 27% and 22% (category of infection 2), while on the third location the frequency of the knot symptom was on average only 18,5% (category of infection 1). Based on climatic conditions and agrotechnical measures that have

prevailed in 2007 and 2008, especially the way how the pruning and the harvest were implemented, one can speculate that spread of olive knot disease were severely impacted.

#### 4 CONCLUSIONS

Based on results of our survey we can conclude that a rather high frequency of olive knot symptoms was determined at all five investigated locations in 2008. The intensity of infection rate based on visual evaluation of the upper parts of olives was from 5 up to 90%.

The higher frequency of knot symptoms was found on variety Picholine. Determined level of infection was on average 73% (category of infection 4). Determined average frequency of knot symptom on variety Leccino varied from 18,5% (category of infection 1) to 42,5% (category of infection 2). In the climatic conditions of Poreč location, olive knot symptoms arise rapidly. The selection of varieties and locations, as well as agrotechnical measures and climate conditions, can affect the abundance of olive knot symptom.

This survey was first effort in monitoring of the present status of the olive knot disease in the northwest region of Istrian peninsula. Next steps should be determining the causative agent of the knot symptom, presumably *Pseudomonas savastanoi*. In the field, in order to reduce the damage, it is necessary to regularly monitor the emergence and intensity of the disease and to implement all available control measures.

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