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Panonychus ulmi L. distribution in some apple cultivars

Saranda Musa[1], Blerta Mehmedi[2*], Ahmet Musa[3]
[1] Faculty of Agriculture and Veterinary, Plant Protection Department, University "Hasan Prishtina" Prishtina, Kosovo
[2, 3] Analytical, Agriculture and Food Laboratory, Phytosanitary Corporate "Sara & Meti", Prishtina, Kosovo

Abstract
The paper goal was to investigate distribution of *Panonychus ulmi* in four apple cultivars (Red Delicious, Golden Delicious, Idared and Granny smith) in two localities of Kosovo (Podujevë and Pristina), as well to give an appropriate indication about the measures that should be taken to keep this pest under control. The research was performed during the years of 2018 and 2019, while experiment was based on the method of randomized blocks in three replications. In each replication, leaves from 10 trees of apples were checked randomly, from which the eggs and the moving stages of *Panonychus ulmi* were collected during vegetation period. The most affected cultivar by *Panonychus ulmi* was the Red delicious with a total of 1811 ascertained individuals of this pest, while the least affected was the Granny smith with 436 individuals. Other cultivars were affected also at different levels with 1348 and 716 individuals of this pest in the Golden delicious respectively Idared.

Keywords: apple, cultivar, *Panonychus ulmi*, locality

1. Introduction
Malus spp. is important fruit tree which is cultivated a lot in Kosovo. This crop is affected by a significant number of different pests which in different forms lower the quality and the yield of the apple fruits. The pests that appear in apple crop are numerous, of which significant damage is caused by codling moth (*Carpocapsa pomonella*), apple sawfly (*Hoplocampa testudinea*), plant aphids (*Aphididae*), apple psylla (*Cacopsylla mali*), various mites (*Acarinae*), etc. *Panonychus ulmi*, is considered harmful pests for the apple worldwide [11]. This mite is an economically significant pest, occurring in almost all intensive orchards and ornamental plants [21, 7]. *Panonychus ulmi* has been reported as a polyphagous pest that causes direct or indirect damages, as vectors of viral diseases to various plant crops [18, 19]. This pest is present and spread worldwide and as main hosts are mentioned fruit trees as well the bushes from the *Rosaceae* family [20, 1, 5]. A lot of studies regarding development of the pest *Panonychus ulmi* related to apple as host were conducted in several countries in the world [10, 12]. The mites from *Tetranychidae* are very danger as well widespread pests in apple growing areas worldwide [15]. In case of high densities *Panonychus ulmi* will reduce photosynthetic activity in apple leaves [17]. The consequences of strong attacks can also be seen in next or following growing seasons, because due to the reduced accumulation of dry matter in the tree, flower buds develop less and smaller fruits are being developed [14, 3, 4]. As a consequence of being affected by this pest, the yield of apples often decreases by over 50%, but there are also losses regarding the quality of the fruits.
The paper goal was to confirm distribution of *Panonychus ulmi* in four apple cultivars (Red Delicious, Golden Delicious, Idared and Granny smith) in the two localities of Kosovo (Podujevë and Pristina), as well to give an appropriate indication about the measures that should be taken to keep this pest under control.

2. Material and method
2.1 Locality and apple cultivars
The research was conducted during the years of 2018 and 2019, while the experiment was conducted in two localities, in Podujevë and Prishtinë, in apple orchards blocks (*Malus* spp.). The experiment involved four apple cultivars (Red delicious, Golden delicious, Idared and Granny smith), while the experiment was based on the method of randomized blocks in three replications. In each replication, 10 apple trees were checked according to the random method, from which the eggs and the moving stages of the *Panonychus ulmi* were collected and registered.

2.2 Laboratory work
In total 3 samples for analysis (from 5 apple leaves for each replications) were taken once every 10 days from the apple trees, from each cultivar. In that case, all samples taken were placed in nylon bags, provided with all relevant data (date of sampling, sample number, locality, apple cultivar, etc.). Such samples, later on were taken immediately at Laboratory "Sara&Meti" Phytosanitary Corporation in Prishtina to be analyzed and identified with the help of various keys. Various acarological keys were utilized to determine *Panonychus ulmi* [9].

2.3 Statistical analysis
The obtained results were statistically processed with statistical package MSTAT-C software by the University of Michigan. ANOVA as well LSD-test were performed to confirm the differences of *Panonychus ulmi* concentrations in apple cultivars, whereas the level of significance for the differences was accepted at $p<0.05$ as well $p<0.01$. Interactions of factors also were computed from the ANOVA.

3. Results and discussion
During these researches, regarding the appearance of the pest *Panonychus ulmi*, in the two researched localities we

have ascertained that this pest appears during the whole vegetation period causing significant damage to the apple crop. *Panonychus ulmi* as a pest belongs to order *Acarina* and family *Tetranychidae*, which is characterized by incomplete development (metamorphosis) and within a year develops many generations.

This pest causes direct damage to apples but also to other agricultural crops, where with the oral apparatus of the piercing-sucking type they pierce the soft plant tissues (leaves, flowers, shoots, etc.), and from them they extract nutrients. As a result, the leaves and plant parts affected turn yellow, deform, and cannot perform the photosynthesis to the proper or normal degree [6]. From the results that were obtained (Table 1), clearly can be seen that the time and level of the appearance of this pest has been quite variable

Table 1: *Panonychus ulmi*, the mite frequency during vegetation season

Locality	Cultivar	Samplings									
		1	2	3	4	5	6	7	8	9	10
Podujevë	Red delicious	7	12	28	15	97	54	132	149	201	165
	Golden delicious	23	41	29	65	78	139	55	213	98	184
	Idared	5	2	14	37	29	18	46	35	143	67
	Granny Smith	-	-	6	10	13	61	12	24	18	58
Prishtinë	Red delicious	75	93	47	68	102	95	114	216	87	54
	Golden delicious	6	34	29	15	37	16	52	91	139	43
	Idared	9	23	17	56	21	12	19	34	70	59
	Granny Smith	-	2	11	7	24	16	43	19	38	74
Total		125	207	181	273	401	411	473	781	794	704

The frequency (number) of occurrence has also been different throughout the vegetation season, so the maximum number of individuals of these pests was different, depending to cultivar and the environmental factors (Figure 1).

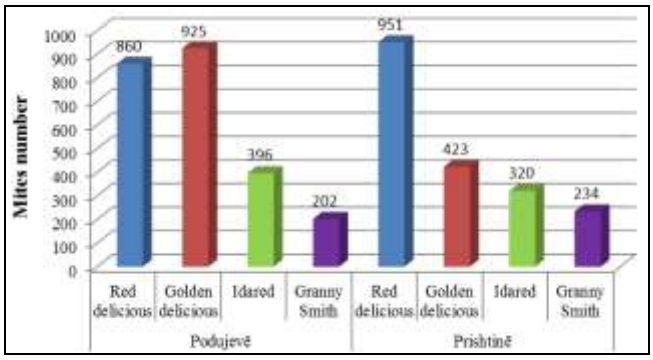

Fig 1: The mite number collected in all localities

It is also worth to be mentioned that from the beginning to the end of vegetation season during these researches the mite number exceeded the critical threshold, which for many countries is different and ranges from 2.5-5 spiders/leaves imposing the need for pest control [19].

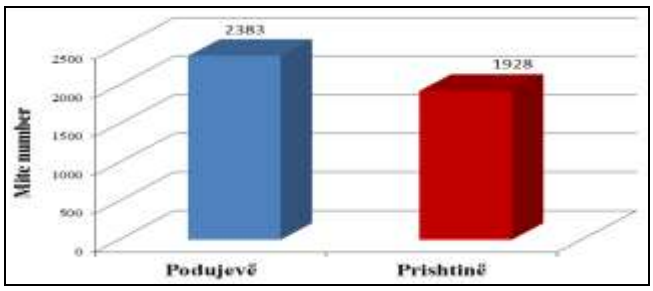

Fig 2: *Panonychus ulmi*, the mite number by localities

The spread of *Panonychus ulmi* has been approximately the same in the two researched localities, so the number of this pest as a total of all apple cultivars planted in Podujevë was 2383 and 1928 in Prishtinë respectively (Figure 2).

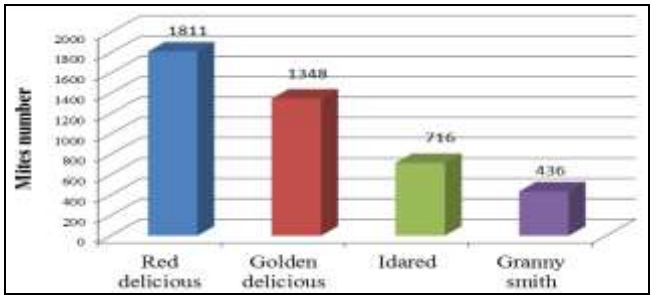

Fig 3: *Panonychus ulmi*, the mite number by cultivars

The most affected cultivar by *Panonychus ulmi* was the Red delicious with a total of 1811 ascertained individuals of this pest, while the least affected was the Granny smith with a total of 436 individuals. Other cultivars have were affected at different levels with the number of 1348 and 716 individuals of this pest in the Golden delicious respectively Idared (Figure 3). Opposite to our findings some authors reported that *Panonychus ulmi* prefers a certain assortment of apples cultivars like Golden delicious [2].

Table 2: *Panonychus ulmi*, Statistical Analysis (ANOVA)

Locality (A)	Cultivar (B)				Average (A)
	Red delicious	Golden delicious	Idared	Granny smith	
Podujevë	86.00	92.50	39.60	20.20	59.58
Prishtinë	95.10	46.20	32.00	23.40	49.18
Average (B)	90.55	69.35	35.80	21.80	Average (AB)
Factor		A	B		AB
LSD	1%	26.3166	28.7791		44.6453
	5%	18.3164	21.8632		32.7821

From the ANOVA and LSD testing, we can see that statistical differences of different levels of significance have been confirmed, in terms of the attack of the apple cultivars by the pest *Panonychus ulmi* (Table 2). Thus, regarding to localities, no statistical differences were found and the cultivars planted in the two researched localities were almost similar affected, with very small differences, by *Panonychus ulmi*. Statistically significant differences were found in terms of cultivars, so the most affected cultivar was

the Red delish with 90.55 individuals as a mean from total, while the least Granny smith with 21.80 individuals as an average from the total mites registered throughout the vegetation period (Table 2). Regarding factor interaction (locality and cultivar), statistical differences of different significance level have been ascertained which can be clearly seen in Table 2.

Table 3: *Panonychus ulmi*, dimensions in mm

Number of measurements	Min. (mm)	Max. (mm)	Average (mm)	Variance	Standard deviation	Standard error
Imago female						
100	0.32	0.61	0.45	0.037	0.154	0.014
Imago male						
100	0.17	0.29	0.24	0.023	0.12	0.010
Larvae						
100	0.15	0.23	0.22	0.015	0.138	0.025
Egg						
100	0.10	0.15	0.13	0.008	0.107	0.012

During the vegetation season, 100 individuals of each female, male, larvae and eggs, were carefully taken to measure body size. Their dimensions were within the limits of normal values which were reported by other authors from around the world (Table 3 and 4).

Table 4: *Panonychus ulmi*, dimensions in mm

Locality	Dimensions (mm)			
	Imago		Larvae	Egg
	Female	Male		
World	0.37 - 0.40	0.26 – 0.28	0.20 – 0.24	0.13 - 0.15
Kosovo	0.45	0.24	0.22	0.13

Given that the pest is present in apple plantations causing significant damage in both yield and quality we recommend that the control of this pest should be done within an IPM program, which means using all the measures and tools and means that are in hand to keep this pest under control. This can be for sure achieved through the implementation of agrotechnical measures like balanced fertilization with mineral fertilizers, avoiding utilization of excessive rate of nitrogen, mechanical measures through the elimination of infested shoots during the apple pruning which affects the reduction of the mite populations, biological measures where in many European countries predatory mites *Typhlodromus pyri* is being used in biocontrol and finally chemical measures using adequate chemical preparations (Acaricides) during dormant period (winter) and during vegetation season [13, 8]. During winter chemical preparations should be used against the eggs with purpose to reduce the pest populations. During vegetation season, selective chemical preparations (acaricides) should be used to fight against mites present in apple trees [16]. From acaricides one can use Vertimec, Envidor, or other chemicals that might be available in real time.

4. Conclusions

From the two-year research regarding the spread of the *Panonychus ulmi* in some apple cultivars cultivated in two localities of Kosovo, we can conclude that:

- *Panonychus ulmi* as a pest from the order *Acarina* and family *Tetranychidae* is quite widespread in apple in our country.
- The time, level and occurrence of this pest were quite variable throughout these researches.
- This pest has been quite widespread in both surveyed localities while their number has been approximately similar in both localities, Podujevë and Prishtinë.
- The cultivars have had different susceptibility to *Panonychus ulmi*, so cultivar Red delicious has been more affected by a total of 1811 individuals or 42.01%, while cultivar Granny smith has been least affected by 436 individuals or 10.11%.
- Through ANOVA as well LSD testing, statistical differences of different levels of significance were confirmed in terms of the pest collected by localities and cultivars.
- The highest level of mites was registered in the summer (June-August), when measures should be conducted to manage the pest.
- Protective measures should be undertaken in the frame of Integrated Pest Protection where priority must be oriented to other means such as: planting of immune cultivars and varieties, healthy seedlings, regular agrotechnical measures, etc. and as a last alternative the use of chemical preparations, acaricides.

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