

## Plant aphids in apple during the spring period in some localities of Kosovo

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### Abstract

In order to investigate the presence of aphid species in apple research was conducted during the years of 2018 and 2019 on apple plantations in two locations in Kosovo (Prishtinë and Klinë). The experimental pattern was according to randomized blocks method in three repetitions. At each repetition 100 shoots from apple cultivars were monitored all the time with ten day intervals, starting from the beginning of April, from where the aphids were taken. Insects collected were brought to the laboratory of the phytosanitary corporation "Sara & Meti" in Prishtina to identify and describe the aphid species. During of these researches we have identified these aphid species: *Aphis pomi*, *Dysaphis plantaginea*, *Aphis sipraecola* *Eriosoma lanigerum*. Referring to the ANOVA and the LSD test, statistically significant differences by localities, cultivars and pests were found. Measures concerning plant protection should be incorporated in IPM programs where priority must be addressed to other measures like planting tolerant cultivars, healthy seedlings, regular agrotechnical and pomotechnical measures, etc. and as a last alternative the use of insecticides.

**Keywords:** Aphids, *Aphis pomi*, localities, cultivar

### 1. Introduction

The apple (*Malus domestica* Borkh) is a plant tree that belongs to the *Rosaceae* family, the subfamily *Pomoideae* and the genus *Malus* [29]. Throughout the vegetation season and during the storage as well the apple is affected and attacked by pests and various diseases reducing the quality and the yield of the fruits. Aphids as a very large group of the pests are harmful on apple trees, but since they are very often oligophagous they might occur also in other fruit trees like pear, medlar, quince, etc. [13]. Aphids are major pests in apple orchards, debilitating the crop and spreading disease. Moreover, several other aphid species attack the apple trees, such as *Aphis spiraeicola*, *Rhopalosiphum insertum*, *Myzus varians* and *Myzus ornatus*. *E. lanigerum* and *A. spiraeicola* are permanently present on apple trees because they are anholocyclic in Europe [4].

According to some authors [1], plant aphids are spread in all continents in the world: in Europe, America, Africa, Asia, Australia, etc. The aphids are present also in Kosovo, in all regions where the apple is grown.

The most known aphid species that appear in our climatic conditions are: *Aphis pomi*, *Dysaphis plantaginea*, *Eriosoma lanigerum*, *Myzus persicae*, *Aphis nasturtii*, *Macrosiphum euphorbiae*, *Aphis fabae*, etc. Some authors [2] reported that the most frequent species during spring period on apple trees was *D. plantaginea*, causing severe infestation. The other aphids, *A. pomi* as well *A. spiraeicola*, were spread also in South Bulgaria.

The main feature of plant aphids that make this group of insects different from other groups of insects is the presence of tubes, located at the bottom of the abdomen and called siphons or cornicles [14, 16].

Plant aphids appear in two forms: wingless (*Aptera*) and winged (*Alate*). Regarding the developmental cycle they might be holocyclic, fully developed (characterized by gametogenesis and oviparity) and anholocyclic, incomplete

development (characterized by parthenogenesis and viviparity).

Plant aphids are small body-sized insects that possess two pairs of wings with membranous structure. Plant aphids are nourished by absorbing vegetable juices from the green soft plant parts. The mouthpart of these pests is adapted for perforating plant tissues and extracting plant sap from the affected parts. These pests secrete honey dew, a viscous sweet liquid, which covers various plant parts and attracts ants which are indicators of the presence of plant aphids. In the vegetable parts that are covered with honey dew the fungus develops which reduce the activity of the plants which leads to the weakening of the plant, and even to the failure of the whole plants. According to [20], aphids are very large group of insects that feed on phloem causing damages to the most majority crops worldwide. Plant aphids have a huge number of enemies [11, 28] of which the most important are *C. septempunctata*, *A. bipunctata*, *H. axyridis*, etc. The advantages of biological control are because they play an important role in aphid management without having any kind of negative impact to the environment and food quality [18].

*Aphis pomi* has body dimensions of 1.5 mm to 2 mm, light green or yellow in color. According to some authors this pest develops 10 to 15 generations within a year, sometimes even over 20 generations within a year.

*Dysaphis plantaginea* is a polyphagous pest, while the damages it causes is direct by feeding on apple plant tissues and indirectly as vectors of virus diseases. Adult insects wingless have body dimensions of 2–3 mm, are grey colored, possess a pair of antennae and plant suction mouthparts [24]. Honey dew pipes or siphons are long and light gray in color [22].

It is a heteroecious pest because it uses other host plants besides apples, but the primary host is apple, whereas the secondary hosts are plant species (*Plantago*), which means

that this pest causes damages only to apples [5, 9]. This pest overcome the winter as the egg [5] which is approximately 0.5 mm long, around the apple branch buds, but can also lay eggs in young seedlings and shoots [7, 8]. Some authors indicated that infestation with aphids and damages to apple varied greatly and are different among cultivars [17].

Some aphids are very polyphagous as it is case with *Aphis spiraecola* that affects over 90 species of different plants, including apples. It is also referred as the citrus green aphid (Citrus aphid) because it affects a considerable number of these crops [21].

*Eriosoma lanigerum* is from North America and the plant *Ulmus americana* is considered as the main host whereas apple as the secondary host. This aphid if the primary host is absent it develops on apple almost throughout the year [15]. This aphid in New Zealand is considered as a very serious pest, which infest the shoots and the roots of apple trees [23].

*Eriosoma lanigerum* Hausmann is a problem especially in intensive orchards where high agrotechnical and pomotechnical measures are applied [25, 26]. It lives in large groups on apple branches and trunk, especially on trees that are mechanically injured by various agents.

The purpose of the research was to a) identify the plant aphids which cause damage to apple crop cultivated in two Kosovo localities (Prishtina and Klina), b) to ascertain the susceptibility of apple cultivars being affected by these pests and c) to recommend adequate measures for their management in apple trees.

**2. Material & methods**

**2.1 Localities and experimental design**

In order to investigate the presence of aphid species in apple trees, research was conducted during the years of 2018 and 2019 in apple plantations planted in two locations in Kosovo, in Prishtina and Klina. The apple plantation in Prishtina is at the experimental didactic farm of the Agriculture Faculty with a surface of about 1 ha, while the plantation in Klina belonged to private sector with a surface of 4 ha. In the experiment we have involved three cultivars of the apple that are cultivated in both localities where the research was conducted: Golden Delicious, Pink Lady and Granny Smith. The experimental pattern was according to randomized blocks method in three repetitions or replicates. At each replicate according to the random method, 100 shoots from apple cultivars were monitored all the time with ten day intervals, starting from the beginning of April, from which aphids were taken. The intensity of aphid infestation was assessed as the total aphid number present on the first 6 apical leaves in the shoots that were examined [12, 10]. The method applied was counting the aphids on the infested leaves in selected shoots which have provided the most accurate assessment of aphid density, but it has required the

most effort. Laboratory glassware made of plastic was used for collecting plant aphids from apple shoots, whereas the aphid collection was done by hand. The pests collected were placed in laboratory glasses containing 70% ethanol for the conservation of plant aphids for further work. The collected aphids were taken in nylon bags, separated for each cultivar separately, provided with relevant data such as: date of sampling, number of samples, type of cultivar, locality, etc.

**2.2 Laboratory work**

Insects collected in apple orchards under natural conditions were sent to the laboratory of the phytosanitary corporation "Sara & Meti" in Prishtina to identify and describe the aphids species present. For the most accurate identification, were prepared microscope slides carefully, and after that all morphological features such as body shape, size, color, mouthpart apparatus, antennae, etc. were carefully considered. Different entomological keys were used to identify aphids [3, 14].

**2.3 Statistical analysis**

The obtained results were statistically processed with statistical package MSTAT-C software by the University of Michigan. ANOVA and LSD-test were performed to confirm the differences in aphid concentrations in apple cultivars, whereas the level of significance for the differences was accepted at  $p < 0.05$  and  $p < 0.01$ . Interaction of factors also were computed from the ANOVA.

**3 Results and discussion**

**3.1 Obtained results**

During of these researches in different apple cultivars we have identified the following aphid species: green apple aphid (*Aphis pomi*), rosy apple aphid (*Dysaphis plantaginea*), green citrus aphid (*Aphis spiraecola*) and woolly apple aphid (*Eriosoma lanigerum*).

The timing and occurrence of plant aphids in apple cultivars has varied widely throughout the research period (Table 1 and 2). Aphids were present in all apple cultivars since the first days of April. Their frequency and maximum values recorded of plant aphids also varied by the locality, cultivar and type of the pest (Table 1 and 2). Thus, in Prishtina, at Golden Delicious the maximum number of *Aphis pomi* was 310 individuals, in the third decade of April, while in Granny Smith and Pink Lady cultivars in first days of May and had values of 318 and 388 individuals, respectively.

At Klina, in Golden Delicious the maximum number of *Aphis pomi* was 278 individuals in the third decade of April, while in Granny Smith in the third decade of April and had values of 240 individuals. At the cultivar Pink Lady the maximum number of this pest was confirmed in first decade of May with a frequency of 289 individuals.

**Table 1:** Aphid frequency in apple, locality Prishtinë (2018-2019)

Cultivar	Aphid species	Sampling frequency								
		1	2	3	4	5	6	7	8	9
Golden Delicious	<i>A. pomi</i>	95	211	310	285	216	94	103	78	46
	<i>D. plantaginea</i>	12	43	108	96	153	51	90	43	12
	<i>A. spiraecola</i>	7	21	97	44	62	17	46	19	28
	<i>E. lanigerum</i>	0	15	113	25	101	213	15	0	72
Granny Smith	<i>A. pomi</i>	34	176	261	318	314	186	84	97	95
	<i>D. plantaginea</i>	9	64	90	67	75	45	61	75	60
	<i>B. spiraecola</i>	5	18	45	58	114	16	16	44	17
	<i>E. lanigerum</i>	2	37	0	61	92	54	93	68	45

Pink Lady	<i>A. pomi</i>	81	269	285	388	328	211	114	193	133
	<i>D. plantaginea</i>	19	92	127	209	63	65	69	104	57
	<i>C. spiraecola</i>	10	43	53	143	57	49	51	71	43
	<i>E. lanigerum</i>	0	65	169	211	104	117	25	210	116

Note: the results represent the average value of two years (2018-2019)

In other apple cultivars also the appearance and aphid number showed to be different (Table 1 and 2).

It is worth to be mentioned that plant aphids have been present throughout the entire research period in all apple cultivars causing significant damages. During of this research, almost in all cases,

the maximum aphids number were recorded to inhabit the new growing shoots located in the top of the tree canopy compared to those in the bottom. These pests with their mouthparts extracted the nutrients from the soft plant tissues (leaves, flowers, buds) causing various deformities in the affected parts on the plant.

**Table 2:** Aphid frequency in apple, locality Klinë (2018-2019)

Cultivar	Aphid species	Sampling frequency								
		1	2	3	4	5	6	7	8	9
Golden Delicious	<i>A. pomi</i>	69	137	278	213	126	61	77	59	38
	<i>D. plantaginea</i>	23	25	126	75	94	36	61	35	17
	<i>D. spiraecola</i>	15	18	85	32	31	10	28	15	12
	<i>E. lanigerum</i>	38	10	123	19	67	161	10	23	6
Granny Smith	<i>A. pomi</i>	52	124	240	274	210	122	74	68	43
	<i>D. plantaginea</i>	14	71	97	48	49	58	49	40	29
	<i>E. spiraecola</i>	9	26	41	31	68	23	14	57	8
	<i>E. lanigerum</i>	11	72	15	85	57	17	65	26	35
Pink Lady	<i>A. pomi</i>	75	176	209	289	245	192	91	85	106
	<i>D. plantaginea</i>	24	57	121	175	19	76	47	72	41
	<i>F. spiraecola</i>	22	32	42	101	43	38	42	58	15
	<i>E. lanigerum</i>	16	29	118	136	74	52	18	127	64

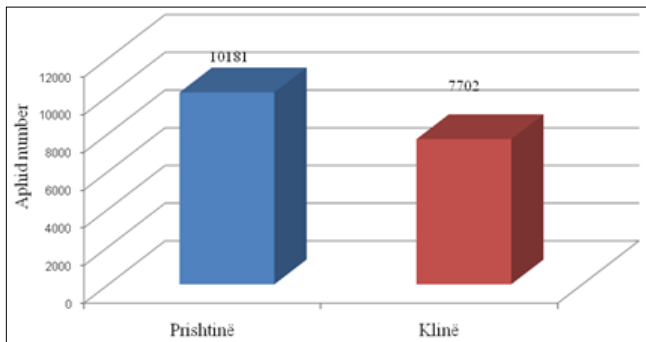
Note: the results represent the average value of two years (2018-2019)

The frequency of occurrence of aphids also varied according to the location where cultivars of the apple were grown (Figure 1).

From the number of aphids recorded (as average of two the years of research) in the three apple cultivars (17883), the highest number of these pests regardless of the type of aphids was confirm in Prishtinë with a total of 10181 individuals or 56.93%, while the least in Klinë with 7702 or 43.07%, (Figure 1).

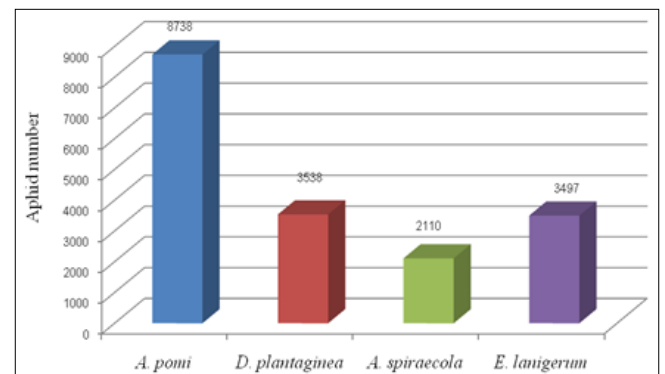
individuals or 41.78%, Granny Smith with 5218 or 29.18%, while the Golden Delishes cultivar was the least affected with 5194 or 29.047%, (Figure 2).

From the total number of aphids found, the majority is represented by *Aphis pomi* with about 8738 individuals (48.86%), followed by *Dysaphis plantaginea* with 3538 individuals (19.78%), *Eriosoma lanigerum* with 3497 individuals or 19.55%, while *Aphis spiraecola* is represented by at least 2110 individuals (11.80%), as seen in figure3.

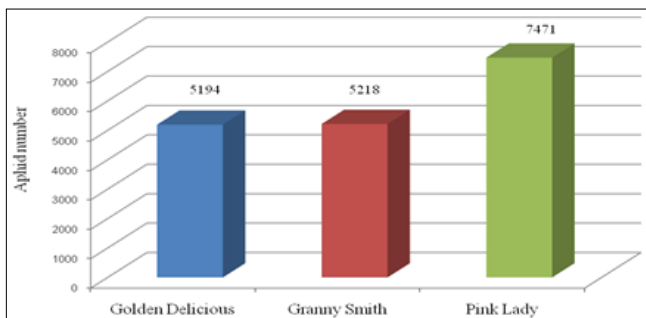


**Fig 1:** Frequency of aphid species by localities

From the total number of pests found in the three apple cultivars (17883), it is shown that the cultivars had different sensitivities.



**Fig 3:** Ratio among plant aphid species recorded



**Fig 2:** Frequency of the aphids by cultivars

The cultivar Pink Lady was the most affected with 7471

Concerning the occurrence of plant aphids in apples, different authors have reported the results approximately similar to the data of this research [8, 6].

Referring to the ANOVA and the LSD test, significant differences of the different levels of signification by localities, cultivars and pests were found (Table 3). The highest number of pests, irrespective of the type of plant aphids, as average during vegetation was found in Prishtina (94.27 individuals) and the minimum in Klinë (71.35).

The observed differences in the number of pests as an average in the two investigated localities were highly significant. In this regard, we say that apple cultivars as an average are less affected in the locality Klinë compared to

those planted in Pristina. This was expected given that apples and other types of fruits are less cultivated in Klina compared to locality of Prishtina. Also, better protection measures have been undertaken in Klina compared to Pristina. In Klina, the farmer in whose orchard we conducted the research has been well-trained and has applied protective measures on a timely basis as well as at a high professional level.

Statistical differences of different levels of significance were found between the investigated cultivars as well

(Factor B). The highest frequency of pest occurrence (103.76) was found in apple cultivar Pink Lady and the lowest in Golden Delishes (72.14). In this context we say that apple cultivars differed in terms of the aphids recorded as an average and the differences found are not only accidentally but that they really exist. There were no statistical differences between the cultivars Golden Delishes and the Granny smith. This was also expected given that these pests are polyphagous and affect a huge number of fruit trees, in this context also of different apple cultivars.

**Table 3:** Frequency of aphid occurrence in apples (ANOVA)

Locality (A)	Cultivar (B)	Aphid species ©				Average (AxB)	Average (A)	
		C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>			
Prishtinë	Golden Delicious	159.78	67.56	37.89	61.56	81.69	94.27**	
	Granny Smith	173.89	60.67	37.00	50.22	80.44		
	Pink Lady	222.44	89.44	57.78	113.00	120.67		
Average (AC)		185.37	72.56	44.22	74.93			
Klinë	Golden Delicious	117.56	54.67	27.33	50.78	62.58	71.35**	
	Granny Smith	134.11	50.56	31.22	42.56	64.61		
	Pink Lady	163.11	70.22	43.67	70.44	86.86		
Average (AC)		138.26	58.48	34.07	54.93	Average (B)		
Average (BxC)	Golden Delicious	138.67	61.11	32.61	56.17	72.14**		
	Granny Smith	154.00	55.61	34.11	46.39	75.53		
	Pink Lady	192.78	79.83	50.72	91.72	103.76**		
Average ©		161.82	65.52	39.15	64.76	Interactions (A x B x C) **		
FaktorS A B C AB AC BC ABC								
LSD	1 %	13.5748	20.5069	22.5240	29.0011	34.2119	43.5189	69.5001
	5 %	10.3125	15.5789	17.1113	22.0319	25.3349	31.7697	48.3721

Notes: C<sub>1</sub>=*A. pomi*, C<sub>2</sub>=*D. plantaginea*, C<sub>3</sub>=*A. spiraecola*, C<sub>4</sub>=*E. lanigerum*

Statistical differences of different levels of significance were also found regarding aphid species (Factor C). Thus, the highest number of pests was in *Aphis pomi* with 161.82 individuals as average during vegetation and the lowest in *Aphis spiraecola* with 39.15 individuals. Other species such as *Dysaphis plantaginea* and *Eriosoma lanigerum* were also present throughout high frequency vegetation and their average number was 65.52 and 64.76 individuals, respectively (Table 3).

Differences in their numbers between *A. pomi* and *A. spiraecola* compared to *D.plantaginea* and other aphid *E. lanigerum* were highly significant, whereas between the aphids *D. plantaginea* as well to other species *E. Lanigerum* these differences are no-significant. With respect to the factor interactions: A x B, A x C, B x C and A x B x C, statistical differences were also confirmed (Table 3).

**3.2. Measures for the management of apple aphids**

The measures to manage or to keep the plant aphids under control are quite numerous and varied. Of the measures which show the advantage of combating plant aphids in apple, we must first apply agrotechnical ones, such as winter pruning to remove winter eggs, planting resistant cultivars, to combat weeds that offer food and the shelter for aphids, preservation of predators known as natural enemies that affect the diminishing populations of this pest [19, 27], etc.

As with any other pest, as well as combating plant aphids in apples, it is extremely important that the pest to be identified in advance and to assess the level of pest presence, threshold level. If during the winter inspection of apple twigs more than 25 eggs per meter length are found, mineral oils are recommended to be applied. The critical threshold level for deciding to apply protective measures against green apple

aphids in the post-flowering period is 8-10 colonies per 100 shoots.

Apart from the above measures, the application of chemicals is of great importance. In the fight against plant aphids the treatment is carried out at most twice, with preference being given to preparations based on active primicarb and flonikamide substances, which are known as aphicides and have shown no adverse action against natural enemies. Neonicides can also be used.

Among the chemicals that successfully combat this pest are: pyrimiphos methyl, thiaclopride, acetamipride, thiamethoxam, deltamethrin, alpha cipermethrin, dimethoate, etc. These insecticides are recommended to be used as needed and always according to instructions as well recommendations given by manufacturers.

**4. Conclusions**

During the research conducted in two localities of Kosovo, Prishtina and Klina, we can conclude that:

- There were recorded *A. pomi*, *A. spiraecola*, *D. plantaginea* and *E. lanigerum*.
- The timing, level and frequency of occurrence of different aphid species in apple cultivars have varied widely during of these researches.
- From the total number of aphids recorded, the majority is represented by *Aphis pomi* 48.86%, followed by *Dysaphis plantaginea* 19.78%, *Eriosoma lanigerum* with 19.55%, while *Aphis spiraecola* is represented by 11.80%.
- Cultivars have had different sensitivities against plant aphids, the Pink Lady cultivar being the most affected and the Golden Delishes cultivar the least affected.
- From the ANOVA it was clear that there are statistical

significant differences regarding the aphids, by the cultivars investigated and localities as well.

- The highest number of apple aphids was recorded in the second half of April when necessary plant protection measures should be undertaken to control them.
- Measures concerning plant protection should be incorporated in IPM programs where priority must be addressed to other measures like planting tolerant cultivars, healthy seedlings, regular agrotechnical and pomotechnical measures, etc. and as a last alternative the use of insecticides.

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