Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2021, 11(9), 6-12, doi: 10.15421/2021_287

ORIGINAL ARTICLE

Study of aphid species (Hemiptera:Aphididae) dependent on potato cultivation and inventory of their natural enemies in northern Algeria (Staoueli)

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Received: 03.10.2021. Accepted: 10.11.2021.

Our study aims to identify the aphid species capable of colonizing the potato crop. The trapping techniques used are yellow basins and hand picking. This study shows a specific richness of 16 species belonging to two sub-families, namely the Aphidinae and the Pemphiginae. The results of the hand harvest showed that the species *Aphis nasturtii* is the most represented species with a relative abundance of 31.03%. Trapping of winged aphids showed that the species *Aphis gossypii* is the best represented with a relative abundance of 34.23%. The study of the evolution of aphid species according to the phenological stages of the potato has brought out four species, namely *Aphis fabae, Aphis frangulae, Aulacorthum solani* and *Macrosiphum euphorbiae* which seem to be the most subservient and which mark their presence from the start of the establishment of the culture. The inventory of natural enemies of aphids shows the presence of four predatory species and eight parasitoid species. The predators are *Coccinella septempunctata*, which is found to be the most abundant with a relative abundance of 48.57%, *Hippodamia variegata*, *Scymnus subvillosus* and *Chrysoperla carnea*. For the parasitoids, the species *Aphidius* sp is the most represented with a relative abundance of 24.76%.

Keywords: Aphids, Potato, Natural enemies, Parasioids, Northern Algeria.

Introduction

The potato *Solanum tuberosum* L. is a herbaceous plant, belonging to the Solanaceae family, known worldwide by its high consumption and ranked fourth behind wheat, rice, and maize (Jean-Marie 2006). In Algeria, Potato is one of the staple foods of the Algerian citizen with an average consumption of 60 kg/capita/year (Nouad, 2009). This crop is subjected to the pressure of a multitude of pests which can either cause severe losses in yield. Among insect pests, aphids occupy a very large place (Jansen, 2005). Belonging to the order of Homoptera and the suborder of the Sternorryncha, aphids are divided into more than 4000 species, 5 of which can cause remarkable damage to the potato cultivation by carrying numerous viruses. *Myzus persicae* can transmit more than a handred viruses while *Macrosiphum euphorbiae* can carry around forty (Robert and Bourdin, 2001). Aphids are probably the phytophagous insects causing the greatest economic losses in view of their morphological and biological characters which make them major crop pests (Blackman and Eastop, 1984). Aphids are naturally controlled by a large number of predators and parasitoids which are distributed within many entomological families. Probably the most known predator belongs to the family of Coccinellidae (ladybugs). Larvae and adults are the most popular aphidiphages that can reduce the density of aphid populations (Fraval, 2006b). Besides beetles, Lopes et al. (2011) report that Diptera (hoverflies and gall midge) are also effective entomophagous predators in larval stages. The parasitoids of aphids belong mainly to the order of Hymenoptera, they are represented by the subfamily of Aphidiinae and the genus *Aphidius* (Fraval, 2006b). Many studies are carried out on aphidofauna in Algeria. We quote the work of Laamari (2004) and Laamari, et al. (2009, 2011, 2013) who report the presence of 156 aphid species in Algeria, and the work of Mohammedi-Boubekka (2015) on citrus aphids in Eastern Mitidja. But few studies have been conducted on potato aphidofauna. Due to the lack of this works and in order to contribute to the knowledge of aphids subservient to this crop, we conducted this study which aims to see the proliferation of these pests and their natural enemies in an potato crop of open field land located in the ITCMI station Staoueli, (Algiers, Algeria) the sampling period is based on different stages of development of this speculation.

Material and Methods

The present study *was carried out within the Technical Institute* of *vegetable* and *industrial* crops *(I.T.C.M.I.) of Staoueli (*2°53 'East; 36°45' North; altitude 45 m). (Fig. 1)*. The* Sampling was conducted on a seasonal potato crop, planted in the field on February 18, 2016 and harvested on May 09, 2016.

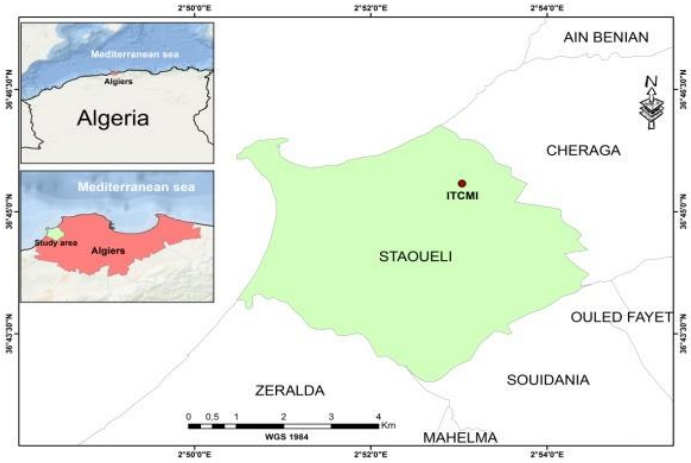

Fig. 1. Location of the Staoueli region (Algeria).

Aphids were monitored from the appearance of the first potato leaves by weekly surveys. The field work is based on the capture of adults by the use of yellow basins, and the monitoring of wingless by visual checks and manual captures. To follow the evolution of wingless aphids we divided the plot into four homogeneous plots, from each plot we randomly sampled a branch of around 10 leaflets. Each sample is placed separately in a tightly closed paper bag which is labeled beforehand. In order to capture the aphidofauna found in the study plot, we placed two yellow plastic basins 20 cm in diameter and 10 cm deep, two-thirds full of water with a little added soap in order to reduce the surface tension of the water, the two basins are placed on the ground.. The census of the various natural enemies of aphids was carried out once a week at the same time as that of aphids. Aphid predatory insects were detected by direct approach and by trapping using yellow water tanks. As for the parasitoids, we counted, during each trip, the number of mummies on the leaves where the wingless aphids are sampled. The mummified aphids are recovered, after counting, and they are kept in Petri dishes until their emergence.

Results

During the present study, 16 aphid species were identified. (Table 1) (Fig. 2).

Table 1. 16 aphid species.

Sub-families	Tribe	Genera	Species
Aphidinae	Aphidini	*Aphis*	*Aphis fabae* Scopoli, 1763
			Aphis gossypii Glover, 1877
			Aphis frangulae Kaltenbach, 1845
			Aphis nasturtii Kaltenbach, 1843
		Aulacorthum	*Aulacorthum solani* Kaltenbacher, 1843
		Acyrthosiphon	*Acyrthosiphon pisum* Harris, 1776
		Brachycaudus	*Brachycaudus helichrysi* Kaltembacher, 1843
			Brachycaudus cardui Linné, 1758
		Lysaphis	*Lypaphis erysimi* Kaltembacher, 1843
	Macrosiphini	*Brevicoryne*	*Brevicoryne brassicae* Linné, 1758
		Hyperomyzus	*Hyperomyzus lactucae* Linné, 1758
		Macrosiphum	*Macrosiphum euphorbiae* Thomas, 1878
			Macrosiphum rosae Linnaeus, 1758
		Myzus	*Myzus persicae* Sulzer, 1776
		Urelecon	*Uroleucon sonchi* Hille Ris Lambers, 1939
Pemphiginae	Pemphigini	*Pemphigus*	*Pemphigus* sp

Fig. 2. Original photos of the main aphid species collected.

The number of aphid individuals sampled by the yellow basin technique is 222 individuals. *Aphis gossypii* is the best represented species with a relative abundance of 34.23% followed by *Brachycaudus helichrysi* with a relative abundance of 16.67%. The species *Myzus persicae* with 7% ranks third. The two species *Aphis fabae* and *Brevicoryne brassicae* with 6.31% each occupying the fourth position. The other species show values which are relatively low and which vary between 0.45% and 5.41% (Fig. 3).

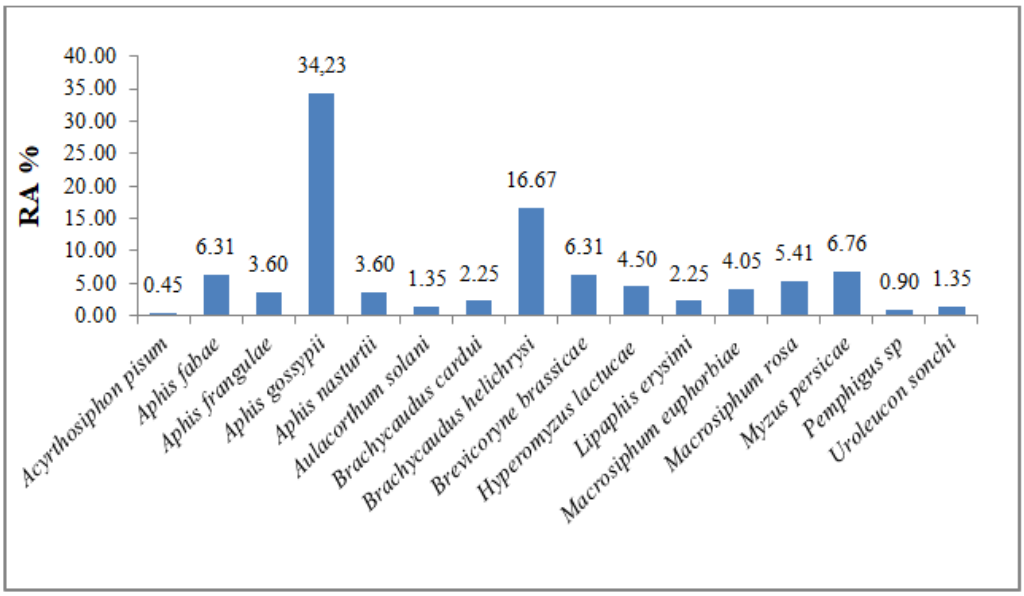

Fig. 3. Relative abundances of aphidofauna captured by yellow basins.

The technique of direct capture on leaves made it possible to collect 7 species which are:*Aphis fabae*, *Aphis frangulae, Aphis gossypii, Aphis nasturtii, Macrosiphum euphorbiae, Myzus persicae* and *Aulacorthum solani. Aphis nasturtii* is the most dominant with an RA% of 31.03%. The second place goes to *Aphis frangulae* with a value of 25.42%. The species *Macrosiphum euphorbiae* ranks third with 11.08%. Fourth place goes to the two species *Aulacorthum solani* and *Myzus persicae* with 10.42% and 9.98% respectively. In fifth place, we find *Aphis gossypii* with 8.08% and in last place is *Aphis fabae* with 3.28% (Fig. 4).

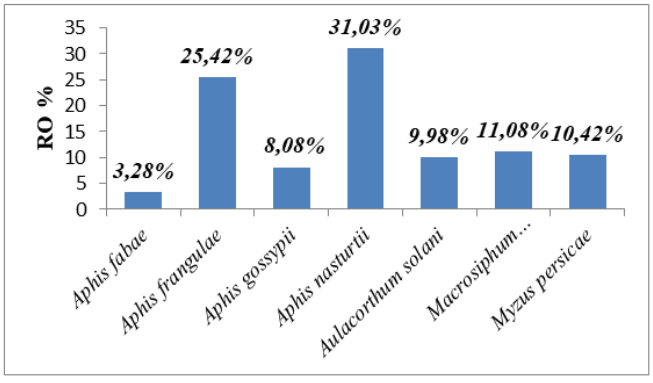

Fig. 4. Relative abundances of hand-collected aphid species.

The 7 species captured manually are different in terms of their presence during the different phenological stages of the plant. In general, apart from the species *Aulacorthum solani*, no species shows its presence during the 6 phenological stages. The presence of species varies between 4 to 5 stages. We can however notice that all the species mark their presence during the T3, T4 and T5 stages which correspond to the flowering stage, the fruiting stage and the leaf yellowing stage. It should be noted that this presence is relatively different according to the species. *Aphis nasturtii* marks a remarkable presence. It is observed that this species is present during the T2, T3, T4, T5 and T6 stages. *Aphis fabae*, does not seem to be subservient to the different stages of development of the plant. Its presence is found only in four stages of the plant's phenology. These stages are T2, T3, T4 and T5. The species *Aphis frangulae* shows a strong presence compared to the previous species. This one is practically displayed only at the level of the last four phenological stages of the plant. This species no longer seems to be dependent on stage T4. At stage T3 its presence is very low and at stages T4 and T5 its development is maximal. The *Aulacorthum solani* species seems to follow the evolution of the plant because it is present during all phases of crop development with maximum development during the T4 stage. This species seems to have a very strong trophic link with potato crops. However, it can be noted that the numbers of *Aulacorthum solani* are relatively low. The species *Macrosiphum euphorbiae*, even if its presence is noted at the level of five phenological stages of the plant, it presents a peculiarity compared to all the other species. Its maximum is observed during the T2 and T3 stage unlike other species. *Myzus persicae* marks a total absence at the T1 stage and a timid presence at the T2 phrenological stage. Its presence is even lower during stage T3. Its numbers are relatively large only during the T4 and T5 stages and a rapid decline is noted during the last phenological stage (Fig. 5).

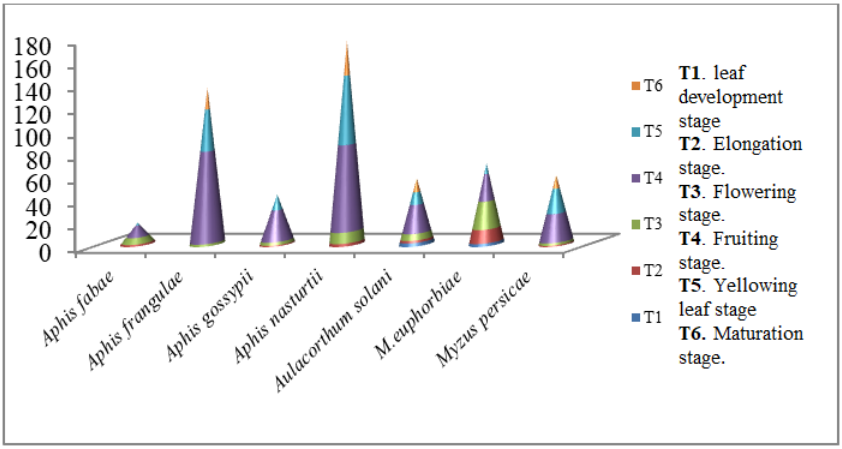

Fig. 5. Amplitude of the presence of aphid species according to the different stages of development of the potato crop.

The inventory of natural enemies of aphids shows the presence of four predatory species and eight parasitoid species. Predators belong to two different orders and two different families. The Coccinellidae family is represented by three species which are *Coccinella septempunctata, Hippodamia variegata* and *Scymnus subvillosus*. The Chrysopidae family is represented by a single species which is *Chrysoperla carnea* (Fig. 6). As for the parasitoids, they are represented by eight species belonging to five different families, namely the Aphelinidae, the Aphidiidae, the Braconidae, the Eulophidae and the Ichneumonidae.

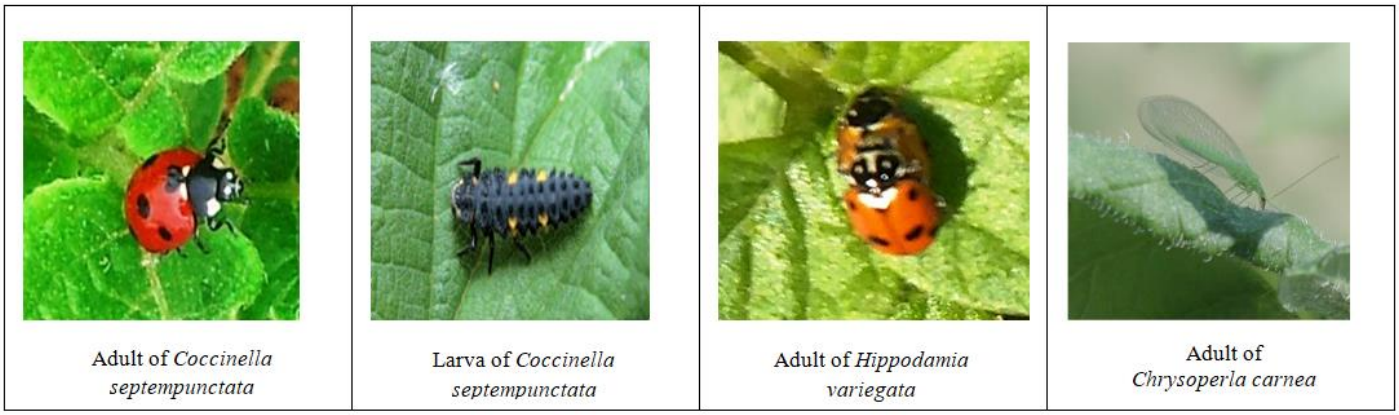

Fig. 6. Original photos of the main predatory species of aphids.

Among the species captured, *Coccinella septempunctata* was found to be the most abundant with a relative abundance of 48.57%, followed by the parasitoid *Aphidius* sp with a relative abundance of 24.76%. The other species show very low numbers, resulting in low relative abundances which vary from 4.76% for the species *Ichnomonidae* sp. and 0.95% which is the lower value for the species *Aphytis* sp. (Fig. 7).

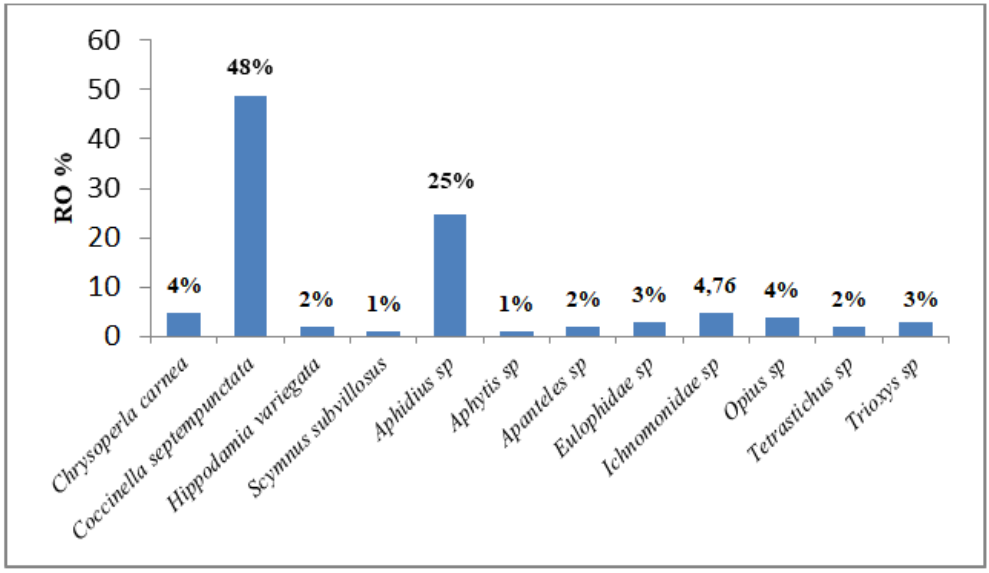

Fig. 7. Relative abundances of natural enemies of aphids.

The numbers of aphids are regulated during the early phenological stages of the plant. In fact, it is observed during this period that aphids are less important due to the strong presence of their natural enemies. This remark is far from being verified during the phenological stages when the physiology of the plant seems to offer better conditions for the development of aphids, whose numbers have not been reduced despite the strong presence of natural enemies (Fig. 8).

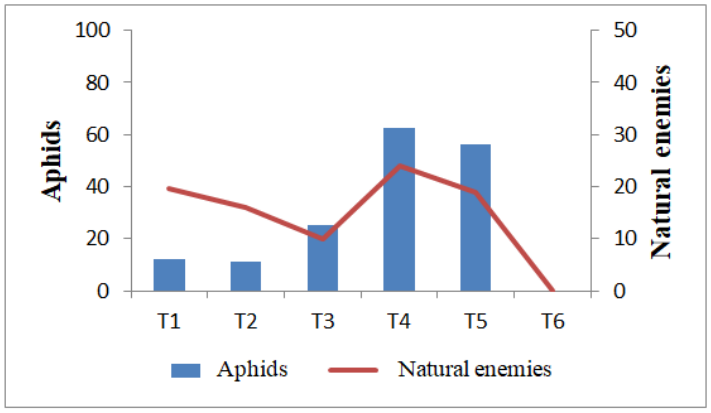

Fig. 8. Evolution of aphids and their natural enemies according to the phenological stages of the potato.

Discussion and Conclusion

This study focused on two parts. The first concerns wingless aphid species whose trapping technique is the picking of species stuck to the leaves, as for the second part, it concerns winged aphid species and whose trapping technique used is the yellow basin technique. The first part of the present study concerns only the species restricted with the cultivation of potatoes and which are:*Aphis fabae Aphis frangulae, Aphis gossypii, Aphis nasturtii, Macrosiphum euphorbiae, Myzus persicae* and *Aulacorthum solani.* Hulle et al. (1999) report the presence of five species on potato which are *Aphis fabae, Aphis gossypii, Aulacorthum solani, Macrosiphum euphorbiae* and *Myzus persicae*. The second part of this study made it possible to collect 16 species of aphids using the yellow basin technique. These species belong to two subfamilies namely the Aphidinae and the Pemphiginae. During the establishment of the culture, many species of aphids come to prospect the places. Indeed, thanks to the yellow basin technique, two groups of aphids were collected. The first group includes the potato-dependent species which are *Aphis fabae, Aphis gossypii, Aphis frangulae, Aphis nasturtii, Aulacorthum solani, Macrosiphum euphorbiae* and *Myzus persicae*, as it is reported by numerous studies such as Hulle et al. (1999) Boiteau (1983) and Jansen (2005). The second group concerns species that are looking for host plants that meet their needs and requirements. These species in this case *Acyrthosiphon pisum, Brachycaudus helichrysi, Brachycaudus cardui, Lypaphis erysimi, Brevicoryne brassicae, Hyperomyzus lactucae, Macrosiphum rosae, Uroleucon sonchi* and *Pemphigus* sp. are species that are probably looking for a host plant. Indeed, studies show that the distribution of aphids on host plants is often determined by the quality of the plant material, including potassium (Meyers et al., 2005) and nitrogen (Hulle et al., 1998). Shusen et al. (1994) followed the distribution of aphids on soybean plants over time. The results of their work suggest that the distribution of aphids is linked to plant growth and climate. It is therefore reported through this study that a whole panoply of aphid species are constantly in search of a host plant and when they find everything that suits them, they make their landing and colonize the plant in question. This is confirmed by the results of the same study which is carried out on winged and wingless aphids. It should be noted, however, that whatever the conditions, the aphid-plant trophic relationship is maintained, unlike the results obtained by other authors who note that climatic conditions can influence this relationship. The nature of aphid species varies depending on the phenology of the potato plant (Beland, 1999). Adults visit many plants and the selection is based on

various physical and chemical factors. Chemical factors include stimulating or inhibiting substances. We think, with Masson (1982), that such substances should be classified as allelochimics when a behavioural effect is generated. According to HERRBACH,(1985), aphid behaviour is influenced by semiochemicals that evoke the influence of aphid alarm pheromones. It is clear that the quality of the nutrients of the plant can affect the distribution of aphid. The behavior of aphids is influenced by semiochemical substances. The nature of aphid species varies according to the phenology of the potato plant (Beland, 1999). This author noted that there are gradually more green peach aphids and in total, more aphids from the lifting of the potato plant until his senescence. However, the potato aphid and the glasshouse-potato aphid would be unequal as much as the lifting of the plant and at the stage of his senescence as observed in the present study. The natural enemies identified during the present study are 12 species distributed in three orders (hymenoptera coleoptera) and 9 families. The *Coccinella Seempunctata* species is the most dominant. This species with a stenophagous diet, aphids constitute 60% of their food. *Aphidius* SP is the parasitoid micro-hymenoptera introduced into a preventive or curative control scheme against aphids. Its presence is strongly marked and whose value of RA% is significantly superior to other parasitoids. According to Roitberg et al. (1979) and Gonzales et al. (2001) the presence of natural enemies affects the distribution of many species of aphids in plants. Natural enemies are able to suppress all populations of soybean aphids. Therefore, it is reasonable to assume that the presence of natural enemies may have an effect on the distribution of aphids at the plant level (Tierney et al., 2010). It should be noted that even in the absence of natural enemies, aphid populations still decrease dramatically after a hinge date. It is largely due to the maturation of the plant, making the sap less attractive for aphids. These leave the plot in search of another source of food.

Acknowledgment

Our sincere thanks go to Professor Ghezali Djelloul may God welcome him into his vast paradise for his help and for his precious information. My thanks to engineer Saharaoui Lounes who identifed the species of aphids and parasitoid.

References

Beland, M. (1999). Etude phénologique des populations de trois espèces de pucerons (Homoptera:Aphididae) présentes dans la culture de pommes de terre au Québec. PhD Thesis University of Quebec at Three Rivers, p:90.

Blackman, R.L., Eastop, V.F. (1984). Aphids on the world's Crops. Journal of Wiley, Chichester, p:466.

Boiteau, G. (1983). The arthropod community of potato fields in New Brunswick 1979, 1981. The Canadian Entomologist, 115:847-853.

Fraval, A. (2006). B-Les pucerons- 2ème partie. Insectes, 142:27-38.

Gonzalez, C.I., Bhattacharya, A., Wang, W., Peltz, S.W. (2001). Nonsense-mediated mRNA decay in Saccharomyces cerevisiae. Gene, 274:15.

Herrbach, E. (1985). Role des sémiochimiques dans les relations pucerons-plantes. II.-Les substances allélochimiques. Agronomie, EDP Sciences, 5:375-384.

Hulle, M., Turpeau, E., Leclant, F., Rahn, J.M. (1998). Les pucerons des arbres fruitiers. Cycles biologiques et activités de vol. Paris, p:80.

Hulle, M., Turpeai-Ait I.E., Robert, Y., Monnet, Y. (1999). Les pucerons des plantes maraîchères. Cycles biologiques et activités de vol. Ed Acta Inra, Paris, p:136.

Jansen, J.P. (2005). Pucerons en pomme de terre de consommation:bilan de 12 années d'observation. Journée d'étude Pomme de terre-CRA-W Gembloux, pp:41-51.

Jean-Marie, P. (2006). La culture des pommes de terre. Editions Artémis, France, p:95.

Laamari, M. (2004). Etude écobiologique des pucerons des cultures dans quelques localités de l'Est algérien. PhD Thesis Science Agroculture, El-Harrach, p:204.

Laamari, M., Khenissa, N., Merouani, H., Ghodbane, S., Stary, P. (2009). Importance des Hyménoptères parasitoides des pucerons en Algérie. In Proceeding du colloque International sur la Gestion des risques Phytosanitaires, Merrakech, Maroc, pp:581-587.

Laamari, M., Tahar Chaouche, S., Benferhat, S., Abbes, S.B., Merouani, H., Ghodbane, S., Khenissa, N., Stary, P. (2011). Areview of aphid parasitoids and their association in Algeria (Hymenoptera:Braconidae:Aphidiinae; Hemiptera:Aphidoidea). Afric. Entomolecular, 20:161-170.

Laamari, M., Coeur D'Acier, A., Jousselin, E. (2013). New data on aphid fauna (Hemiptera, Aphididae) in Algeria, Research Articulture, Zookeys, 319:223-229.

Lopes, T., Brosquee, E., Polo Lozano, D., Lian Chen, J., Deng, FAC., Yong, L., Fang-Qiang, Z., Haubruge, E., Bragard, C., Francis, F. (2011). Evaluation de la diversité des pucerons et de leurs ennemis naturels en cultures maraîchères dans l'est de la chine. Faunistic Entomology, 64:63-71.

Masson, C. (1982). Apports de la neurophysiologie pour l'identification des médiateurs chimiques par les insectes. Symp Internal Médiateurs Chimiques, Versailles, 7:19-30.

Meyers, S.W., Gratton, C., Wolkowski, R.P., Hogg, D.B., Wedberg, J.L. (2005). Effect of soil potassium availability on soybean aphid (Hemiptera:Aphididae) population dynamics and soybean yield. Journal of Economic Entomology, 98:113-120.

Mohammedi B.N. (2015). Les pucerons des agrumes et leurs ennemis naturels en Mitidja orientale (Algérie). Ecole Nati Sup Agro, El Harrach, p:193.

Nouad, M.A. (2009). Problématique sur la pomme de terre. Revue, Filaha Innove, pp:5-6.

Robert, Y., Bourdin, D. (2001). Aphid transmission of potato viruses. Virus and virus-like diseases of potatoes and production of seed-potatoes. Dordrecht:Kluwer, pp:195-225.

Roitberg, B.D., Myers, J.H., Frazeer, B.D. (1979). The influence of predators on the movement of apterous pea aphids between plants. Journal of Animal Ecology, 48:111-122.

Shusen, S., Boren, Y., Dianshen, L., Yanjie, Y. (1994). Study on space dynamics of a natural population of Aphis glycines Matsumura. Journal of Jilin Agricultural University, 16:75-79.

Tierney, R., Brosius, L., Higley, G., Thomas, E.H. (2010). Biotic and abiotic influences on within-plant distribution of soybean aphid (Hemiptera:Aphididae:Aphis glycines). Journal of the Kansas Entomological Society, 83:273–282.

Citation:

Slimani, I., Fekkoun, S. (2021). Study of aphid species (Hemiptera:Aphididae) dependent on potato cultivation and inventory of their natural enemies in northern Algeria (Staoueli). *Ukrainian Journal of Ecology* 11 (9), 6-12.