Scientific Papers. Series B, Horticulture. Vol. LXIII, No. 2, 2019
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

INSECT SPECIES DIVERSITY IN STEFANESTI VITICULTURAL CENTRE FROM ROMANIA

Diana Elena VIZITIU, Elena-Cocuța BUCIUMEANU, Ionela-Cătălina GUȚĂ, Dorin Ioan SUMEDREA

National Research and Development Institute for Biotechnology in Horticulture Stefanesti - Arges, 37 Bucharest - Pitesti Rd., Arges, Romania

Corresponding author email: vizitiud@yahoo.com

Abstract

The grapevine, being a multiannual crop, favors the installation, growing and spreading of insect populations whose attack increases proportionally with the number of years of cultivation, unless rigorous plant protection measures are applied. In this work were studied the beneficial and harmful fauna from the Stefanesti vineyards, identifying 43 species of insects, of which 14 species belong to the beneficial fauna and 29 species are pests. The data were interpreted using the diversity indices: K - Dominance, Rarefaction, SHE analysis and Bray - Curtis analysis both for the insect of the beneficial fauna but also for the other species identified in the Stefanesti - Arges vineyard, Romania.

Key words*: biodiversity, fauna, precipitation, temperature, vineyards.*

INTRODUCTION

Grapevine, one of the most spread horticultural crop in the temperate climate, is exposed, as all plants, to the influence of diseases (fungal and bacterial diseases, phytoplasmas, virus and virus-like diseases), pests (insects, mites, nematodes), and climatic changes.

Among the pests, the insects can lead to serious economic losses in the quality and quantity of grapes (Goussard, 2013). The range and the behavior of harmful insects is influenced by the environmental temperatures (Boudon-Padieu & Maixner, 2007; Reineke & Thiéry, 2016; Bois et al., 2017). Monitoring of beneficial and harmful insects in vineyards has been done in different viticultural countries and conditions (Altieri et al., 2005; Retallack, 2011; Soares et al., 2016).

The paper deals with the evolution of the insect diversity in Stefanesti Arges vineyard, located in the South of Romania.

MATERIALS AND METHODS

The study was carried out on the territory of the National Research and Development Institute for Biotechnology in Horticulture Stefanesti - Arges, located in the Stefanesti vineyard, in the southern central part of the Subcarpathian Mountains.

During the study, the temperature, relative air humidity and precipitation were monitored using the iMETOS 1 weather station, positioned near to the vineyards, at 44°85' latitude, 24°95' longitude and 278 m altitude.

The Stefanesti microclimate is relatively wet due to the proximity of the forests to the north, the fragmentary platform relief of deep valleys located almost perpendicular to the corridor formed by the Arges river on the one hand and the human settlements with woody vegetation on the other hand, which shuts down the airflows to the south.

The wind influences by its nature and intensity. The winds of NW, E and NE have the highest intensity and the NW, E and NE - the smallest.

The cutting system in the vineyard is Guyot. The distance between the rows is 2.5 m and between the plants 1 m in a row. The rows are NS oriented.

In the studied plots, the soil is the Eutric Regosol type in association with the Eutricambosol type (Toti et al., 2017). The upper horizons are mixed at the depth of 0-40 cm as a result of the soil works and the Bv horizon presents "in situ" clay. Soil texture being loamy-clayey on the whole soil profile, its content is moderately good in humus, good in nitrogen but decreasing on the soil profile, and weak in mobile phosphorus. The soil

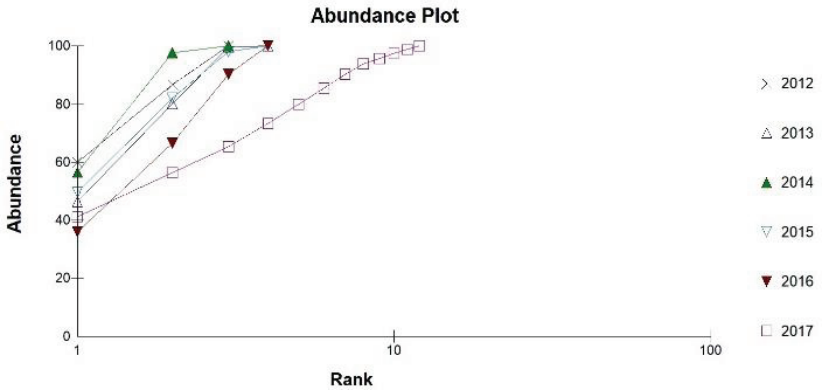
response ranges from weak acid to neutral, between 6.2 and 7, and increases with depth.
The insects have been captured using sticky traps and butterfly net and monitoring have been done for a period of 6 years, between 2012 and 2017.
The results were interpreted with the BioDiversity Professional 2 program. With this program were calculated: K - Dominance, Rarefaction, SHE analysis and Bray - Curtis analysis.
SHE analysis examines the relationship between S (species richness), H (information - the Shannon-Wiener diversity index) and E (evenness as measured using the Shannon-Wiener evenness index). This approach highlights the impact of the number of species and the balance between them on biodiversity changes.
The Bray-Curtis similarity is based on abundance data and was measured to show the difference between years both in the case of beneficial insects and in the case of pests.

RESULTS AND DISCUSSIONS

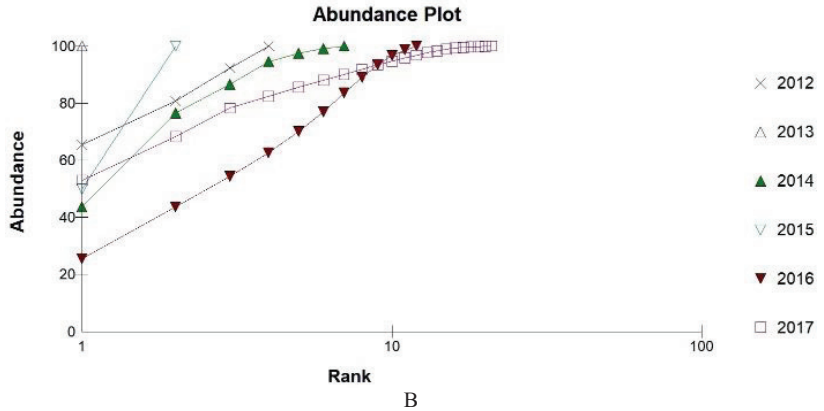
In a vineyard, where the grapevine is the dominant species, it is important to have a spontaneous flora to encourage the insect species that can provide beneficial services to the grapevine plants.
In the studied vineyard plantations, the following insect species were captured and identified with the aid of yellow sticky traps: *Harmonia axyridis, Psyllobora 22-punctata, Coccinula 14-pustulata, Adalia 10-punctata, Vibidia duodecimguttata, Scymnus frontalis, Cantharis rustica, Panorpa* sp., *Mordella sp., Andrena* sp., *Coccinella 7 punctata, Adalia bipunctata, Pirates hybridus, Apis melifera, Empoasca vitis, Lygus spinolai, Musca domestica, Culex* sp., *Poecilimon schmidti, Diplolepis rosae, Lytta versicatoria, Sialis* sp., *Centrotus cornutus, Anthaxia nitidula signaticollis, Anthaxia nitidula, Agrilus sp., Cercopis vulnerata, Forficula auricularia, Philaenus spumarius, Cortodera diferens, Polistes dominulus, Anthomyia procellaris, Paederus fuscipes, Sarcophaga* sp., *Vespula vulgaris, Trichaetipyga juniperina, Tettigonia viridissima, Neomyia cornicina, Cicadella viridis, Meiosimyza* sp., *Stenolophus teutonus, Helophilus* sp., *Graphosoma lineatum*.
None of the species mentioned above caused damage in the studied vineyard plantations. The first 14 listed species are part of the beneficial fauna, as in Bairrada region where losses due to insects were almost negligible in all vineyards (Nereu et al., 2018).
At the same time, with the help of the butterfly net, were also identified the species: *Colias croceus, Eucarta amethystina, Diacrisia sannio, Thymelicus sylvestris, Pieris sp., Apatura ilia f. clytie, Argynnis paphia*.
Other insect species have been identified, but not quantified, as well: *Lucanus cervus* (has not been captured because it is a protected species in Romania), *Oryctes nasicornis, Oulema obscura, Dermestes murinus, Harpalus pubescens*.
It is important to understand the biodiversity (existing and potential) from a vineyard due to the complex range that taking place between flora (grapevine, cover crops, shelterbelts etc), fauna (insects, birds, soil and aquatic organisms) and the natural balance of this environment (Altieri et al., 2005; Retallack, 2011).
The insect populations growing and spreading in a vineyard is influenced by the soil maintenance system. For example, the grassing experimental variants favoured diversity and abundance of insect species as compared with the black field variant (Vizitiu et al., 2018).
The following weeds species have been frequently encountered in the studied vineyards: *Convolvulus arvensis, Polygonum convolvulus, Amaranthus retroflexus, Setaria* sp., *Galium aparine, Chenopodium album, Sonchus arvensis, Stenactis annua, Polygonum aviculare, Agrostis alba, Erigeron canadensis, Echinochloa crus-galli, Rumex obtusifolius, Agropyron repens, Calamagrostis epigejos, Cirsium arvense, Matricaria inodora, Xanthium strumarium, Taraxacum officinale, Veronica hederifolia, Avena fatua, Poa pratensis, Cardaria draba, Agropyron repens, Digitaria sanguinalis, Senecio vulgaris, Stachys annua, Matricaria chamomilla, Daucus carota, Dactylis glomerata*.
The forest vegetation near the vineyard is represented mainly of: *Quercus robur, Prunus*

padus, Fagus sylvatica şi *Carpinus betulus, Salix* sp., *Alnus glutinosa.*

In order to compare diversity between years was used the K - Dominance graphical method. So, the dominance curves of beneficial fauna during the 2012-2017 period show that 2017 had the higher diversity than the other years (Figure 1A). On the other hand, the beneficial fauna was smaller as compared with the other identified insects (Figure 1B).



A



B

Figure 1. K - Dominance curves of insect diversity during the 201-2017 period (A - beneficial insects and B - harmful insects)

No community had the same biodiversity, even in homogeneous landscapes, due to site-specific characteristics of vegetation, soil, topography, climatic factors, and other environmental factors that may govern each species settlement (Mokam et al., 2014).

The assessment of beneficial species richness from 2012-2017 period shows their increasing number in 2016 both for beneficial fauna as well as for pest insects (Figure 2 A, B).

SHE analysis is useful for identifying ecotones (regions where different ecological communities intersect) (Hayek & Buzas, 1997).

Through the SHE analysis it has been examined the relationship between S (Species Richness), H (Information) and E (Evenness as measured using Shannon-Wiener evenness index) in the 2012-2017 period.

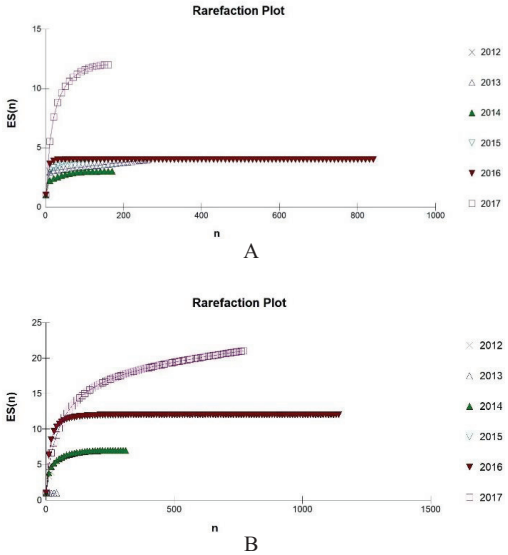


Figure 2. The assessment of species richness in 2012-2017 period (A - beneficial insects and B - harmful insects)

SHE analysis of diversity for the species identified from the grapevine plantations in 2012-2017 period indicates a mixture of comunities because H increase while ln(E) and ln(E)/ln(S) decrease (Figure 3).

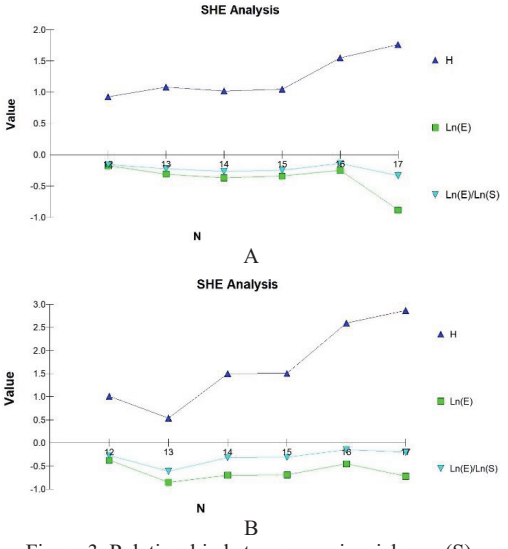


Figure 3. Relationship between species richness (S), Shannon-Wiener diversity index (H) and evenness (E) during 2012-2017 period (A - beneficial insects and B - harmful insects)

For each data set a multivariate cluster analysis using Bray-Curtis similarity measure was applied to ascertain the similarity between the years.

The Figure 4 demonstrates a high degree of dissimilarity between group A and B, recording a larger number of species and individuals in the case of harmful fauna in 2015, 2016 and 2017 years (Figure 4B), as compared to the same period but corresponding to the beneficial fauna (Figure 4A).

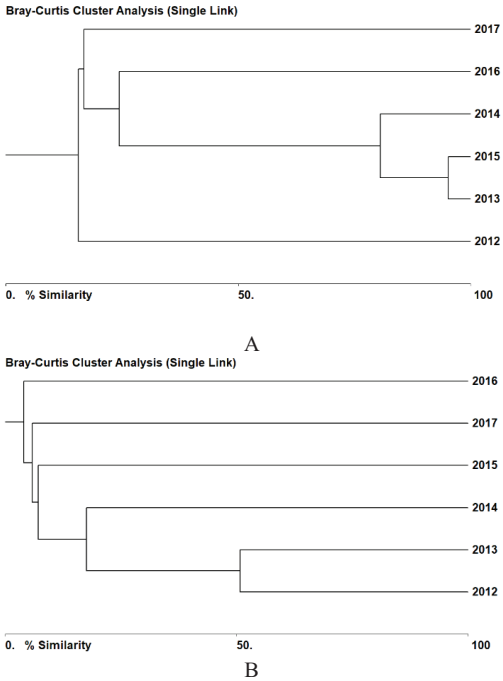


Figure 4. Bray-Curtis analysis for the insect identified in 2012-2017 period from the vineyard plantations (A - beneficial insects and B - harmful insects)

The medium temperature evolution and the level of precipitation registered along the 2012-2017 period showed differences from one year to another.

In 2012-2017 period have been registered 8 months/year with temperature ranged in 5-45˚C interval, favourable to the biological activity development of the insects (Figure 5).

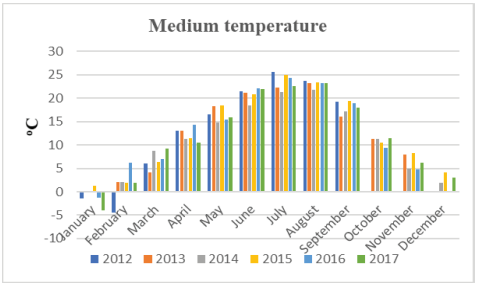


Figure 5. Medium temperature evolution in 2012-2017 period

Also, the precipitations level influence the insects evolution and development.

The lack of precipitation in the winter months were improper for biological stages of the insect which are wintering at the soil surface or to a small depth of the soil.

The precipitation abundance (Figure 6) in the summer period had a negative influence in 2012 and 2013 on the number of individuals (Figure 2) as a results of their eggs and larvae deposited on the vegetative organs lavation.

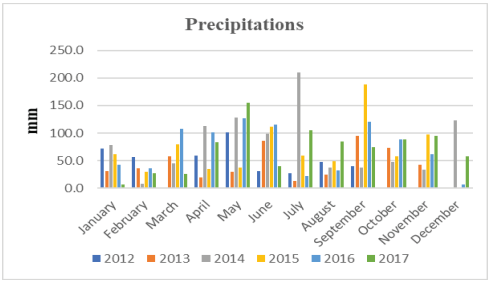


Figure 6. Level of precipitation in the 2012-2017 period

However, was not correlation between the annual sum of precipitations and number of individuals in the vineyard plantation along the entire studied period (Figure 7).

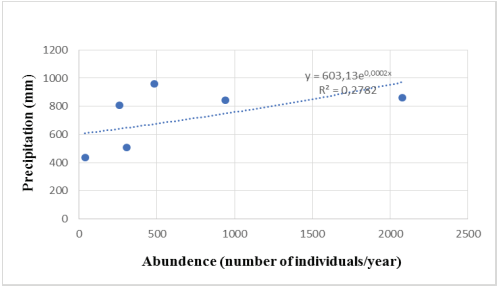


Figure 7. Relationship between the total number of insects and annual sum of precipitation from 2012-2017 period

CONCLUSIONS

In 2012-2017 period, the number of insect species identified and quantified in the grapevine plantation located in the Stefanesti vineyard was 43, of which 14 insects are part of the useful fauna and the remaining 29 were other insects species.

The K - Dominance graphical method showed that 2017 year had the higher diversity than the other years; however, the beneficial fauna was smaller as compared with the pest insects

The assessment of beneficial species richness from 2012-2017 period shows that how richness increases in 2016 both for beneficial fauna and for pest insects.

In the 2012-2017 period in vineyard plantations the SHE analysis indicated a mixture of insects comunities.

REFERENCES

Altieri, M.A., Ponti, L., Nicholls, C.I. (2005). Manipulating vineyard biodiversity for improved insect pest management: case studies from northern California. *International Journal of Biodiversity Science & Management, 1*, 191-203. doi: 10.1080/17451590509618092

Bois, B., Zito, S., Calonnec, A. (2017). Climate vs grapevine pests and diseases worldwide: the first results of a global survey. *OENO One, 51*, 133-139. doi: 10.20870/oeno-one.2017.51.2.1780

Boudon-Padieu, É., & Maixner, M. (2007). Potential effects of climate change on distribution and activity of insect vectors of grapevine pathogens in *Proceedings of the International and multi-disciplinary Colloquim-Global warming, which potential impacts on the vineyards?* Retrieved from https://pdfs.semanticscholar.org/22a1/de6d85279d1fa3d61c86feaae2a61c7af138.pdf

Goussard, P. (2013). *A guide to grapevine abnormalities in South Africa: Grapevine pests – leafhoppers, boll-worm, leaf roller caterpillars, spring beetles, wilting beetles and thrips*. Retrieved from https://www.wineland.co.za/a-guide-to-grapevine-abnormalities-in-south-africa-grapevine-pests-leafhoppers-boll-worm-leaf-roller-caterpillars-spring-beetles-wilting-beetles-and-thrips-part-5-6/

Hayek, L.A.C., & Buzas, M.A. (1997). *Surveying Natural Populations*. Columbia University Press. ISBN 9780231102414

Mokam, D.G., Djiéto-Lordon, C., Bilong Bilong, C.F. (2014). Patterns of Species Richness and Diversity of Insects Associated With Cucurbit Fruits in the Southern Part of Cameroon. *Journal of Insect Science,* 14, 1-9. doi: 10.1093/jisesa/ieu110

Nereu, M., Heleno, R.H., Lopez-Núñez, F., Agostinho, M., Ramos, J.A. (2018). Effects of native biodiversity on grape loss of four castes: testing the biotic

resistance hypothesis. *Web Ecology,* 18, 15-27. doi: 10.5194/we-18-15-2018

Reineke, A., & Thiéry, D. (2016). Grapevine insect pests and their natural enemies in the age of global warming. *Journal of Pest Science, 89*, 313–328. doi: 10.1007/s10340-016-0761-8

Retallack, M. (2011). Vineyard biodiversity and insect interactions - Establishing and monitoring insectariums! Retrieved from https://www.wineaustralia.com/getmedia/fba82be2-ae5d-4b18-a59e-1129854199ac/Rmjr0811VineyardBiodiversityandInsectInteractionsBookletFINAL

Soares, J.B.C., Costa, E.M., Da Silva, F.E.L., Arauho, E.L. (2016). Insect diversity in an experimental vineyard in the state of Rio Grande Do Norte, Brazil. *Revista Caatinga,* 29, 239-245. doi:10.1590/1983-21252016v29n128rc

Toti, M., Dumitru, S., Vlad, V., Eftene, A. (2017). Harta solurilor din Podgoriile Ștefănești și Dealul Mare in *Atlasul pedologic al podgoriilor României*, Publishing House Terra Nostra Iași

Vizitiu, D., Nedelea, G., Radomir, A. M. (2018). The influence of the soil maintenance system on the fauna from the Stefanesti viticultural center. *Annals of the University of Craiova*, Vol. XXIII (LIX), 261-264. Editura Universitaria, Craiova. ISSN 1453-1275, ISSN online 2393-1426.Enhancing Biodiversity in the Vineyard -Workshop Notes (2013). Retrieved from https://mail.yahoo.com/d/compose/0838844396