Scientific Papers. Series A. Agronomy, Vol. LXVII, No. 2, 2024
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

INCIDENCE OF *Nezara viridula* L. ATTACK ON SOME HOST PLANTS

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Abstract

Nezara viridula L. is a cosmopolitan, invasive species with a highly polyphagous. Some host plants are used as a food source and others for reproduction and food. The species attacks all aerial parts of herbaceous plants, but also the green leaves, the growth tips and the harvest of fruit trees and bushes. They are recorded considerable damages at the fruiting stage. This paper presents the attack of Nezara viridula L. species on several host plants (tomato, pepper, broccoli, peach, raspberry, rose, mallow, artichoke) by assessing the anatomical, morphological and organoleptic changes. Through optical microscopy studies, some changes are highlighted in the pericarp, mesocarp and vacuolar juice of affected pepper fruits, compared to healthy ones. The analyzed fruits show significant defects in shape, color, smell and taste which are confirmed by optical microscopy studies. That means these fruits are unsuitable for consumption, marketing and storage.

Key words*: Nezara viridula L., invasive species, host plants, polyphagous, microscopy studies.*

INTRODUCTION

In the last decade, the green bug *Nezara viridula* L. has caused considerable damage to horticultural and agricultural harvest. The species is noticeable by its pronounced polyphagism (Panizzi, 2008; Kurzeluk et al., 2015; Marcu, 2018). The host plants are used for food or reproduction and they are represented by cultivated plants and wild flora species. Their favourites food sources are flower buds, flowers, fruits and seeds. The damages are produced both in the adult and in the larval instar (Grozea et al., 2012; Ciceoi et al., 2017). The produced destructions differ according to plant species, variety and its phenological stage. The main cause of damage is the way insects feed: they penetrate and inject saliva into plant tissues, perforating them. The cells content is emptied, the fruits are deprived of nutrients and remain small. The fruits show little discoloration spots, which gradually become brown and blackish. Horticultural products are depreciated regarding their quality, so they are unsuitable for consumption and marketing. Also, the fruits which are improperly developed fall prematurely. Ornamental plants are affected at the level of the leaves, by the appearance of some spots, by the flower buds falling and the presence of an unpleasant smell (Grozea et al., 2015). In addition to these facts, the insect can mechanically convey spores of some pathogenic fungi and bacteria from one plant to another (Kaiser and Vakili, 1978; Rusin et al., 1988). In this regard, *Nezara viridula* L. has been observed to carry the spores of *Nematospora* spp., which causes internal rot of cotton, soybeans, tomatoes, citrus fruits, beans and other crops. The insect is also considered a potential vector for *Xanthomonas phaseoli* pv. *phaseoli* in beans (EPPO, 2023) and *Pantoea agglomerans* at cotton (Esquivel & Medrano, 2020). As a defense response of the plant to the attack produced by *Nezara viridula* L., Giacometti et al. (2020) show that a large amount of lignin is synthesized in attacked soybean seeds and the cell wall thickens compared to the mechanically damaged cells.
Observations on tissue and cellular changes, produced by bugs from Pentatomidae family, were initiated in Romania by Ciochina (2021).
The species *Nezara viridula* L. is a cause for concern for horticulturists, with difficulties in control and high ecological plasticity.

MATERIALS AND METHODS

Visual observations were made in different crops near to Bucharest, in the period 2021-2023, in order to detect and identify the attack

produced by the green bug *Nezara viridula* L. The attacked material was described and photographed for each affected plant species. There were established samples of attacked fruits for laboratory study, by optical microscopy techniques. At the same time, there was collected healthy material for comparison in microscopy studies of the tissues and cellular level. The collected material was also analysed regarding organoleptic features. In the beginning, the harvested fruits were used for visual analysis in connection to the changes of their aspect, the pericarp colour, the caused deformations, and also for observations regarding the changes in taste and smell. Then some incisions were made in the pericarp of pepper fruits, obtaining fragments of 3-4 cm in length which were used to determine the changes about the pericarp thickness, the colour and consistency of affected fruits in contrast to the healthy pepper fruits (Figure 1).

Figure 1. Material preparation in order to obtain microscopic sections

Utilizing a blade, there were made transversal cuts in the pericarp of the healthy pepper fruit, respectively in the pericarp of the attacked fruit. Based on these microscopic preparations (Figure 2), observations were made with Optika microscope regarding the occurred changes at the cellular and tissue level as a result of *Nezara viridula* L. attack.

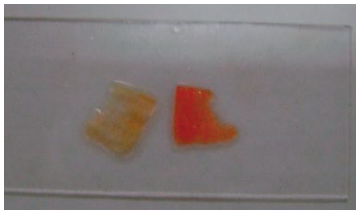

Figure 2. Sample preparation for microscopy technique

RESULTS AND DISCUSSIONS

Following these observations, the species *Nezara viridula* L. was detected on 9 host plants, a fact that is confirmed by specialized literature (Grozea et al., 2012). The pest was present on tomato (*Solanum lycopersicum* L.) and pepper (*Capsicum annuum* L.) plants from the field area and protected spaces, which weren't equipped with protective nets. Tomato and pepper fruits showed obvious changes regarding shape, colour and size (Figures 3 and 4).

Figure 3. Tomato fruits attacked by *Nezara viridula* L.

Figure 4. Pepper fruits attacked by *Nezara viridula* L.

Nectarine fruits (*Prunus persica* L.) show numerous discoloration spots. They are small and unsuitable for consumption (Figure 5).

Figure 5. Nectarine fruits attacked by *Nezara viridula* L.

Raspberry plants (*Rubus idaeus* L.) were used for both food and reproduction. The images highlight hatch larvae, which cluster and then spread, feed and continue their development (Figure 6).

Figure 6. *Nezara viridula* L. larvae on raspberry plants

The roses (*Rosa* spp.) display different larvae phases that feed on the growth tips, flower buds and flowers (Figure 7). The flower bugs stop opening or are transformed into small, asymmetrical and misshaped flowers.

Figure 7. Different larval instars on the rose plant

The mallow plants (*Althaea officinalis* L.) are used as a food source for larvae (Figure 8). The flower buds are preferred by larvae in their development process. Also, artichoke plants (*Cynara scolymus* L.) are attacked by both larvae and adult buds at the inflorescence level (Figure 9).

Figure 8. Different larval instars on the mallow plant

Figure 9. *Nezara viridula* L. on artichoke plant

Cauliflower plants (*Brassica oleracea* var. *botrytis* L.) are used as a food source for larvae (Figure 10), but also for reproduction.

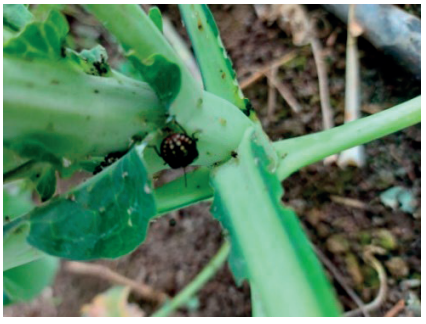

Figure 10. *Nezara viridula* L. on the cauliflower plant

Different plant species are used as food sources for larvae and adult bugs or for reproduction. Among the plant organs attacked, the fruits are the most affected.
There were highlighted colour and structure changes in the observations regarding the external and internal appearance of pepper and nectarine fruits.
The pulp of nectarine fruits shows white spongy areas under to the spots which are localized on the fruit skin (Figure 11).

Figure 11. Spongy areas in the nectarine fruits pulp

Attacked apple fruits (*Malus domestica* Borkh.) are depreciated (Figure 12). The lesions produced by larvae and adults are "gateways" for penetration and installation of various microorganisms.

Figure 12. Apple fruits attacked by *Nezara viridula* L.

Tomato fruits show discoloured areas on the skin and spongy tissue inside the fruit.
There are remarked areas with deep tissues, known as cloudy spots (Figure 13), on which different microorganisms settle and continue the deterioration of the fruits (Jones and Caprio, 1994).

Figure 13. Tomato fruits with discoloured and cloudy spots

In addition to these observations regarding the external appearance of the horticultural products, the taste of the fruits, which is generally sweet and slightly acidic in tomatoes, is quite affected in the attacked areas, being atypical, undergoing changes, and the smell is non-specific and unpleasant. The disturbing taste and aroma can be attributed to the enzymes introduced by the pest into the specific area via saliva. In that manner, the olfactory and gustatory properties are no longer the characteristic ones, but distorted because of the attack by which the pest injects its saliva into the fruit.
Attack on tomato fruit is described by Lye et al. (1988). Researchers sustain that in the bugs feeding process they inject enzymes that help to decomposing and liquefaction of the fruit cells, which are emptied of their contents. The tissues become spongy with a cork aspect.
Pepper fruits show spongy, whitish-coloured changes in their tissues, as a result of the emptying of cell contents by pricking and sucking (Figure 14).

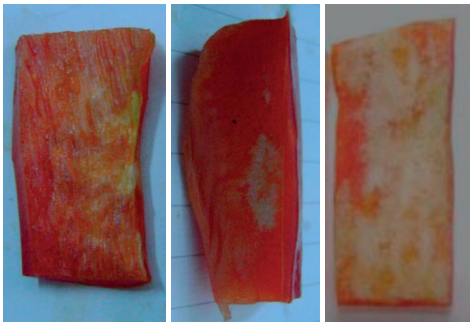

Figure 14. Spongy-looking tissues in pepper fruits

In the organoleptic analysis, the healthy fruit has a smooth aspect, being uniformly coloured, having characteristic red colour, with a specific and crunchy taste. The attacked fruit is discoloured, slightly deformed, yellowish, having an orange or off-white colour. The pericarp thickness of the attacked fruit has a reduced size compared to the healthy one. Also, it has a bland taste, unpleasant smell and spongy consistency (Table 1).

Table 1. Organoleptic, morphological and anatomical changes induced by *Nezara viridula* L. in pepper fruits

Characteristics		Healthy fruit	Attacked fruit
Organoleptic changes	External aspect	smooth, glossy, characteristic red colour	deformations, discolorations, slightly deep areas
	Taste	specific	unpleasant
	Smell	pleasant	unpleasant, repulsive
Internal changes	Consistency	crispy	porous, spongy
	The average thickness of the pericarp	0.65 mm	0.3 mm
	Mesocarp cells	normally hydrated	atrophied
	Vacuolar fluid	in normal quantity	low quantity

Transverse sections made in the pericarp of healthy pepper fruits and peppers attacked by *Nezara viridula* L. show anatomical changes, at the histological and cellular level. Analysing the epidermis of the healthy fruit and the attacked one, it is observed that the epidermis of the healthy fruit has a normal aspect (Figure 15).

Figure 15. Healthy pepper fruit epidermis

The epidermis of the attacked fruit contains necrosis in the intercellular spaces (Figure 16).

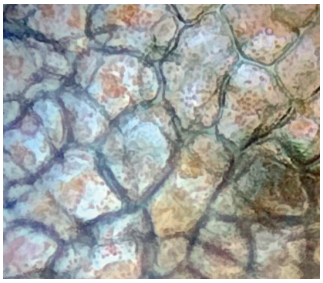

Figure 16. The epidermis of pepper fruit attacked by *Nezara viridula* L.

The mesocarp of the healthy pepper fruit has a normal appearance, being composed by polygonal cells which present vacuolar fluid, with normal chromoplasts (Figure 17).

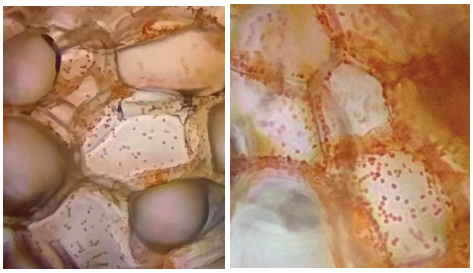

Figure 17. The mesocarp of the healthy pepper fruit

At the same time, the mesocarp cells of the target areas from attacked fruits, are atrophied, dehydrated, lacking vacuolar fluid, with necrotic chromoplasts. These facts are a result of the bugs feeding method. After stinging the fruit, they suck the vacuolar content, which remains poor in nutrients, air enters through the fruit wall and necrosis occurs, including at the level of the epidermis (Figure 18).

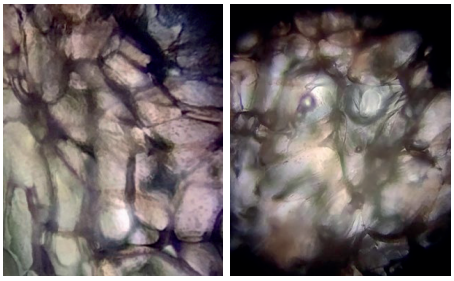

Figure 18. The mesocarp of the pepper fruit attacked by *Nezara viridula* L.

CONCLUSIONS

The green bug *Nezara viridula L.* was detected on 9 species of horticultural host plants such as: *Solanum lycopersicum* L., *Capsicum annuum* L., *Prunus persica* L., *Rubus idaeus* L., *Rosa* spp., *Althaea officinalis* L., *Cynara scolymus* L., *Brassica oleracea* var. *botrytis* L. and *Malus domestica* Borkh. There was recorded significant damage following the attack on pepper, tomato and nectarine fruits.

Optical microscopy studies, carried out on pepper fruits attacked by *Nezara viridula* L., reveal changes at the tissue and cellular level.

The highlighted anatomical-morphological changes are reflected by organoleptic damage and qualitative deterioration of the attacked fruits.

REFERENCES

Ciceoi, R., Dumbravă, M., Jerca, I.O., Pomohaci, C. M., & Dobrin, I. (2017). Assessment of the Damages on Maize Crop by the Invasive Stink Bugs *Halyomorpha halys* (Stål, 1855) and *Nezara viridula* (Linnaeus, 1758) (Hemiptera: Pentatomidae). *Acta Zoologica Bulgarica,* Suppl. 9, 2017: 211-217.

Ciochină, E. (2021). Incidences and impact of Pentatomide invasives pests on some horticultural crops. International Students Symposium "Hortus Academicus". USAMV Bucharest, Romania: Oral presentation.

Esquivel, Jesus, F., Medrano, & Enrique G. (2020). Retention of *Pantoea agglomerans* Sc1R across stadia of the southern green stink bug, *Nezara viridula* (L.) (Hemiptera: Pentatomidae). Ag Data Commons. Dataset. https://doi.org/10.15482/USDA.ADC/1520160

Giacometti, R., Jacobi, V., Kronberg, F., Panagos, C., Edison, A. S., & Zavala, J. A. (2020). Digestive activity and organic compounds of *Nezara viridula* watery saliva induce defensive soybean seed responses. *Scientific Reports* 10, 15468. https://doi.org/10.1038/s41598-020-72540-3

Grozea, I., Ştef, R., Virteiu, A. M., Cărăbeţ, A., & Molnar, L., (2012). Southern green stink bugs (*Nezara viridula* L.) a new pest of tomato crops in western Romania. *R. Journal of Agricultural Science*, 44(2):24-27.

Grozea, I., Virteiu, A. M., Ştef, R., Cărăbeţ, A., Molnar, L., Florian, T., & Vlad, M., (2015). Trophic Evolution of Southern Green Stink Bugs (*Nezara viridula* L.) in Western Part of Romania. *Bulletin UASVM Horticulture* 72(2), 371-375.

Jones, V. P., & Caprio, L. C. (1994). Southern green stink bug (Hemiptera: Pentatomidae) feeding on Hawaiian macadamia nuts: the relative importance of damage occurring in the canopy and on the ground. *Journal of Economic Entomol*ogy 87: 431 - 435.

Kaiser, W. J., & Vakili, N.G. (1978). Insect transmission of pathogenic Xanthomonads to bean and cowpea in Puerto Rico. *Phytopathology* 68: 1057 – 1063.

Kurzeluk, D. K., Fătu, A-C., & Dinu, M. N. (2015). Confirmation of the presence of the southern green stink bug, *Nezara viridula* (Linnaeus, 1758) (Hemiptera: Pentatomidae) in Romania. *Romanian Journal for Plant Protection*, Vol. VIII, 2015 ISSN 2248 – 129X; ISSN-L 2248 – 129X.

Lye, B. H., Story, R. N., & Wright, V. L. (1988). Damage threshold of the southern green stink bug, *Nezara viridula* (Hemiptera: Pentatomidae) on fresh market tomatoes. *Journal of Entomological Science* (1988) 23 (4): 366–373. https://doi.org/10.18474/0749-8004-23.4.366.

Marcu, V.C. (2018). Evaluarea populaţională a speciei invazive *Nezara viridula* în sud-vestul României şi limitarea extinderii prin strategii de combatere non-poluante. Teza de doctorat, BUASVMT, 158 p.

Panizzi, A. R. (2008). *Southern green stink bug, Nezara viridula (L.) (Hemiptera: Heteroptera: Pentatomidae)*. pp. 3471-3471. Encyclopedia of Entomology. Capinera (editor). Springer, Heidelberg.

Russin, J. S., Layton, M. B., & Boethel, D. J. (1988). Incidence of microorganism in soybean seeds damage by stink bug feeding. *Phytopathology* 78: 306 – 310.

https://gd.eppo.int/taxon/NEZAVI/vectorof.