THE MONITORING RESULTS OF THE GREEN STINK BUGS (*NEZARA VIRIDULA L.*) IN CARAS SEVERIN COUNTY

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Abstract. *Nezara viridula, popularly known as the green stink bug, is a pentatomide species considered to be invasive for our country. Its place of origin is a tropical area in Africa. Continuous adaptation to other temperate, cooler areas is a feature of adaptability and serious consideration. Evolution of the species at European level highlights its presence in 25 countries. Being a species recently introduced in Romania (2010), monitoring activities are encouraged. Previous studies have highlighted the presence of the species in the western part of the country, more precisely in Timis County. Partial references of its presence in the southwest of the country have convinced us that through this paper we will focus on monitoring activities. The main purpose is to identify new places where the pest is present and, of course, to identify new host plants. The damage to crops and repercussions on the productions were detected. The observations were carried out between June and October 2017. The target area was Caras Severin County. There were 5 observation points (OP) for 8 localities or observation zones (OZ), so that the 40 OP cover the entire county. The research methodology is an adapted one, currently there are no monitoring methods and population evaluation with the specificity of the Nezara. For this purpose, field movements were conducted, where direct readings were made on the plants and also samples of attacked plants were taken. Field activity was mixed with laboratory activity to identify the stage of development and the host plant. The obtained results showed that most exemplars were found in BSZO3PO4 in the Bocsa area, August (with an average of 87.6 individuals/5 readings). Insects have also been observed in Oravita and Moldova Noua, Caransebes and Baile Herculane, respectively in the ORZO4PO2, MNZO5PO3, CSZO2PO2 and BHZO8PO3 (4) points. The host plants identified in 2017 were beans, tomatoes, cucumbers and raspberries. In the observation areas of Anina, Resita and Otelu Rosu, no individuals or plants with characteristic symptoms were found. In comparison to the previous years, the species has modified its habitats and also the population level.*

Keywords*: Nezara viridula, green stink bug, monitoring, invasive, observation points.*

INTRODUCTION

It is believed that the origin of this *Nezara viridula* (Pentatomidae: Hemiptera) is in Africa (Ethiopia). From Ethiopia, it subsequently extended to other tropical and subtropical regions of Africa, Asia, America and Europe. In America it was reported both in the southern and northern parts. In South America it was reported in Paraguay, Argentina and Brazil (PANIZZI, 2008). In North America it is present in USA, California, Texas, Virginia, Ohio and Arkansas. And in the islands and the Pacific area, these insects were reported: Hawaii, Japan, Australia and New Zealand. The first appearance in the Pacific was concentrated around the 1960s, then expanded to all major islands (CAPINERA, 2001). Green stink bug is an invasive species that prefers warmer areas and adapts hard in cooler areas, as compared to other species of stink bugs. Currently, it is present in warmer areas in Africa, America, Asia, Australia and Europe. In Europe, it is present in 25 countries, but is expected to expand in the future even in northern areas, especially in metropolitan areas (BARCLAY, 2004). In Romania it was first reported on the western side (Timisoara, Timis County) and has since then expanded to other counties (GROZEA et al, 2012). This is evident in the distribution maps developed and presented annually. The CABI/EPPO reports permanently centralize the distribution and spread of *Nezara viridula* species in Europe and the world (CABI, 2017). It can have up to 4-5

generations per year. The number of annual generations is different depending on the area (warm or cold). In warmer areas, the stink bugs have between 3 and 5 generations (HILL, 1983, CAPINERA, 2001) and 1-2 generations in cooler, temperate zones (SQUITER, 2010). This insect is extremely harmful especially for new buds and fruits. Possible damages are caused by soy, beans, peas and cotton (HARRIS and TODD, 1980, DRESS and RICE, 1990). The range of preferred plants includes food, fruit, vegetables, ornamental trees, field crops, and weeds too.

MATERIAL AND METHODS

The observations were carried out in western part of Romania (in Caras Severin County) between June and October 2017. There were 5 observation points (OP) for 8 localities or observation zones (OZ), so that the 40 OP cover the entire county.

Table 1

Identification data of the research points in Caras Severin County, June-October 2017

No	Locality	Zone/Observation point	Geographical coordinates	Type of space analyzed
1	Anina	ANZO7PO1	E 2185020/N 4506046	Private garden
		ANZO7PO2	E 2185183/N 4507435	Private garden
		ANZO7PO3	E 2185090/N 4509086	Green space
		ANZO7PO4	E 2185410/N 4509366	Private garden
		ANZO7PO5	E 2185695/N 4509260	Private garden
2	Resita	RSZ01PO1	E 2191803/N 4529274	Private garden
		RSZ01PO2	E 2193431/N 4528932	Private garden
		RSZ01PO3	E 2189040/N4529058	Green space
		RSZ01PO4	E 2187606/N4531143	Private garden
		RSZ01PO5	E 2187293/N4532868	Green space
3	Bocsa	BSZO3PO1	E 2178544/N4537983	Private garden
		BSZO3PO2	E 2176624/N4537527	Private garden
		BSZO3PO3	E 2176699/ N4538028	Private garden
		BSZO3PO4	E 2173490/N 4537923	Private garden
		BSZO3PO5	E 2170445/N 4536859	Private garden
4	Caransebes	CSZO2PO1	E 2222342/N 4542300	Green space
		CSZO2PO2	E 2222914/N 4538990	Private garden
		CSZO2PO3	E 2221632/N 4541070	Green space
		CSZO2PO4	E 2221494/N 4541365	Green space
		CSZO2PO5	E 2220700/N 4541545	Private garden
5	Otelu Rosu	ORZO6PO1	E 2238936/N 4552638	Private garden
		ORZO6PO2	E 2235734/N 4551849	Private garden
		ORZO6PO3	E 2235234/N 4551580	Green space
		ORZO6PO4	E 2234788/N 4550900	Private garden
		ORZO6PO5	E2234135/N4550846	Private garden
6	Oravita	ORZO4PO1	E 2168420/N 4502878	Private garden
		ORZO4PO2	E 2169006/N 4503516	Private garden
		ORZO4PO3	E 2169789/N 4503084	Private garden
		ORZO4PO4	E 2170498/N 4503301	Private garden
		ORZO4PO5	E 2171164/N 4503618	Green space
7	Moldova Noua	MNZO5PO1	E 2161700/N 4472632	Private garden
		MNZO5PO2	E 2165939/N 4473232	Private garden
		MNZO5PO3	E 2166380/N 4473605	Private garden
		MNZO5PO4	E 2166777/N 4473548	Private garden
		MNZO5PO5	E 2167253/N 4473273	Private garden
8	Baile Herculane	BHZO8PO1	E 2242402/N 4488853	Green space
		BHZO8PO2	E 2241402/N 4487888	Green space
		BHZO8PO3	E 2241216/N 4487606	Private garden
		BHZO8PO4	E 2241092/N 4487404	Private garden
		BHZO8PO5	E 2239166/N 4486115	Private garden

The research methodology is an adapted one, currently there are no monitoring methods and population evaluation with the specificity of the Nezara. For this purpose, field movements were conducted, where direct readings were made on the plants and also samples of attacked plants were taken. Field activity was mixed with laboratory activity to identify the stage of development and the host plant.

Effective research consisted of two approaches, respectively activities to fix research areas and activities of movement, sampling and collection of biological material. By detailing, observations were made in the field of the occurrence of the invasive species *Nezara viridula* in new areas, field movement carried out during the invasive species when the temperature was over 20 consecutive degrees Celsius, direct observations in the research areas of the insect population but also on host plants. In other order, samples of plants affected by the invasive species were taken, its appearance was observed in different locations in the county and on different plant species. Finally, registration and centralization of data in special record in registers has been done.

RESULTS AND DISCUSSIONS

The partial monitoring results for the year 2017 highlighted the fact that *Nezara viridula* expanded its preferences to other monitored sites in Caras Severin County, but also to other plants that were not affected in the previous monitored period, respectively 2015- 2016. All stages of active development (LNA) of the species were observed throughout the monitoring period (June to October) (Figure 1).

Figure 1 The larva (left), the nymph (middle) and the adult (adult) of *Nezara viridula* during the attack on the cucumber plants founded in OP from Bocsa research area

However, most individuals were present in August, with average values of up to 87.6 exemplars (LN). Of all the 8 monitored areas/localities, the Bocsa area was marked by the large number of green stink bugs (Table 2). The total number of insects quantified over the entire monitoring period was 728 LNA/all plants analyzed. The presence of the species was felt in several observation points, as follows: BSZO3PO4 (LNA), BSZO3PO5 (LNA), CSZO2PO2 (LNA), ORZO4PO3 (LNA), ORZO4PO4 (N), ORZO4PO5 (LA), MNZO5PO3 (NA) and BHZO8PO4 (N/A).

The plants that the insect was observed were: tomatoes, cucumber, beans, raspberry and common lilac (Table 2).The maximum values were recorded at the observation point BSZO3PO4, where the monitored plants were present in the mixed crop of three crops: tomatoes + cucumber + beans (25.5 L monthly average /85.2 N / 87.6 LN / 72.8 NA / 19.6 A)

(Table 2). Of all active forms of development (LNA), predominantly in the OP were nymphs and larvae associated or individually observed on each category.

Table 2

Monitoring status of *Nezara viridula* species at various observation points in Caras Severin County, with the identification of new host plants, between June and October 2017

Observation points/ research zone	Presence (+) Absence (-)	Average number of green stink bugs/ Average of 5 monitored plants (private garden) or1-2 plants (green space)/month					Host plant
		June	July	August	Sept	October	
ANZO7PO1	-	0	0	0	0	0	Beans, tomatoes
ANZO7PO2	-	0	0	0	0	0	Tomatoes
ANZO7PO3	-	0	0	0	0	0	Mulberry tree
ANZO7PO4	-	0	0	0	0	0	Beans, tomatoes
ANZO7PO5	-	0	0	0	0	0	Beans
RSZ01PO1	-	0	0	0	0	0	Beans
RSZ01PO2	-	0	0	0	0	0	Tomatoes
RSZ01PO3	-	0	0	0	0	0	Common lilac
RSZ01PO4	-	0	0	0	0	0	Beans
RSZ01PO5	-	0	0	0	0	0	Common lilac
BSZO3PO1	-	0	0	0	0	0	Tomatoes, beans
BSZO3PO2	-	0	0	0	0	0	Tomatoes, beans
BSZO3PO3	-	0	0	0	0	0	Tomatoes, beans
BSZO3PO4	+++ (LNA)	25.5 (L)	85.2 (N)	87.6 (LN)	72.8 (NA)	19.6 (A)	Tomatoes, cucumber, beans
BSZO3PO5	+++ (LNA)	8.07 (L)	15 (LN)	81.7 (LN)	20.1 (NA)	7,33 (A)	Tomatoes
CSZO2PO1	-	0	0	0	0	0	Common lilac
CSZO2PO2	+++ (LNA)	1 (L)	12(LN)	56.6 (N)	15.5 (A)	14.6 (A)	Beans, raspberry, tomatoes
CSZO2PO3	-	0	0	0	0	0	Common lilac
CSZO2PO4	-	0	0	0	0	0	Mulberry tree
CSZO2PO5	-	0	0	0	0	0	Bean, raspberry
ORZO6PO1	-	0	0	0	0	0	Beans
ORZO6PO2	-	0	0	0	0	0	Raspberry
ORZO6PO3	-	0	0	0	0	0	Mulberry tree
ORZO6PO4	-	0	0	0	0	0	Raspberry
ORZO6PO5	-	0	0	0	0	0	Beans, raspberry
ORZO4PO1	-	0	0	0	0	0	Tomatoes
ORZO4PO2	-	0	0	0	0	0	Tomatoes
ORZO4PO3	+++ (LNA	11.3 (L)	24 (LN)	32 (LN)	11.7 (NA)	10 (A)	Tomatoes
ORZO4PO4	+ (N)	0	0	6 (N)	0	0	Tomatoes, raspberry
ORZO4PO5	++ (LA)	0	0	3.56 (LA)	4.7 (A)	2.2 (A)	Mulberry tree
MNZO5PO1	-	0	0	0	0	0	Tomatoes
MNZO5PO2	-	0	0	0	0	0	Tomatoes, beans
MNZO5PO3	++ (LA)	0	0	27 (LA)	5.9 (A)	2.0 (A)	Tomatoes
MNZO5PO4	-	0	0	0	0	0	Tomatoes
MNZO5PO5	-	0	0	0	0	0	Vine
BHZO8PO1	-	0	0	0	0	0	Mulberry tree
BHZO8PO2	-	0	0	0	0	0	Mulberry tree
BHZO8PO3	-	0	0	0	0	0	Raspberry
BHZO8PO4	+++(NA)	0	36.8 (N)	67.1(N)	43.4(A)	16.9(A)	Beans, tomatoes
BHZO8PO5	-	0	0	0	0	0	Vine
Total number of insects 728 LNA/all plant analyzed							*Plant monitored*

+++ (LNA)-larvae, nymphs and adults are present; ++ (LN/NA/LA)-larvae, nymphs/nymphs and adults/larvae and adults are present; + (A)-adults.

Table 3

Evaluation of attack produced by *Nezara viridula* species in different research zones from Caras Severin County, with the identification of insect stages, between June and October 2017

Observation points/ research zone	Presence /absence Symptoms (+/-)	Number of damaged plants/Average of 20 plants analyzed (private garden) or1-5 plant (green space)					Type of analyzed plants
		June	July	August	September	October	
ANZO7PO1	-	0	0	0	0	0	Beans, tomatoes
ANZO7PO2	-	0	0	0	0	0	Tomatoes
ANZO7PO3	-	0	0	0	0	0	Mulberry tree
ANZO7PO4	-	0	0	0	0	0	Beans, tomatoes
ANZO7PO5	-	0	0	0	0	0	Beans
RSZ01PO1	-	0	0	0	0	0	Beans
RSZ01PO2	-	0	0	0	0	0	Tomatoes
RSZ01PO3	-	0	0	0	0	0	Common lilac
RSZ01PO4	-	0	0	0	0	0	Beans
RSZ01PO5		0	0	0	0	0	Common lilac
BSZO3PO1							Tomatoes, beans
BSZO3PO2	++	0	3(L)	8.6(N)	5.5 (NA)	8 (A)t	Tomatoes, beans
BSZO3PO3	+(A)	0	0	0	5(A)	2(A)	Tomatoes, beans
BSZO3PO4	+++ (LNA)	5.1 (L)	14.9 (L)	18.2(LN)	19.5(NA)	4.6(A)t	Tomatoes, cucumber, beans
BSZO3PO5	+++ (LNA)	7.5 (L)	16.7(LN)	19.7(N)	16.1(NA)	0	Tomatoes
CSZO2PO1	-	0	0	0	0	0	Common lilac
CSZO2PO2	+++ (LNA)	1.5(L)	8.8(L)	9.8(N)	12.1(N)	8.0 (A)t	Beans, raspberry, tomatoes
CSZO2PO3	-	0	0	0	0	0	Common lilac
CSZO2PO4	+(A)	0	0	0	0	1(A)	Mulberry tree
CSZO2PO5	-	0	0	0	0	0	Bean, raspberry
ORZO6PO1	+(LN)	1.0 (L)	6.7(L)	9.1(N)	0	0	Beans
ORZO6PO2	-	0	0	0	0	0	Raspberry
ORZO6PO3	+++ (LNA)	7.3 (L)	18 (LN)	19.7 (LN)	7.3 (NA)	4.5 (A)	Mulberry tree
ORZO6PO4	+(N)	0	0	4.6 (N)	0	0	Raspberry
ORZO6PO5	++(LA)	0	0	2.5 (LA)	4.7 (A)	2.2 (A)r	Beans, raspberry
ORZO4PO1	-	0	0	0	0	0	Tomatoes
ORZO4PO2	-	0	0	0	0	0	Tomatoes, beans
ORZO4PO3	++(LA)	0	0	11.1 (LA)	4.9 (A)	1.0 (A)	Tomatoes
ORZO4PO4		0	0	0	0	0	Tomatoes
ORZO4PO5		0	0	0	0	0	Vine
MNZO5PO1	-	0	0	0	0	0	Mulberry tree
MNZO5PO2	-	0	0	0	0	0	Mulberry tree
MNZO5PO3	-	0	0	0	0	0	Raspberry
MNZO5PO4	-	0	0	0	0	0	Beans, tomatoes
MNZO5PO5	-	0	0	0	0	0	Vine
BHZO8PO1	-	0	0	0	0	0	Tomatoes
BHZO8PO2	-	0	0	0	0	0	Tomatoes, beans
BHZO8PO3	++(NA)	0	0	3.0(N)	3.4(A)	2.0(A)	Tomatoes
BHZO8PO4	+++ (LNA)	4.0 (l)	10.3 (L)	10(N)	11.1(A)	6.5(A)	Tomatoes
BHZO8PO5	-	0	0	0	0	0	Vine
Total number of damaged plants: 310							*Plants under analyze*

+++ (LNA)-symptom produced by larvae, nymphs and adults; ++ (LN/NA/LA)-symptom produced by larvae+ nymphs/nymphs and adults+ larvae and only adults; + (A)-symptom produced by adults.

Plants affected by stink bugs were present in the research areas of Bocsa, Oravita, Caransebes, Moldova Noua and Baile Herculane (Table 3). Plants with characteristic symptoms, with or without insects present at the time of observation, were present in the following OPs: BSZO3PO2, BSZO3PO3, BSZO3PO4, BSZO3PO5, CSZO2PO2, CSZO2PO4, ORZO6PO1, ORZO6PO3, ORZO6PO4, ORZO6PO5, ORZO4PO3, BHZO8PO3 and BHZO8PO4.

Preferred crops were included in private garden spaces, respectively tomatoes, cucumbers and beans, in individual or mixed crops. Green grass plants such as mulberry tree and common lilac (Table 3) have also been attacked. Plants belonging to the above mentioned categories have characteristic symptoms of discoloration and dehydration of tissues.

The most attacked plants were those of cucumbers that were affected until 80% of the whole analyzed plant (Figure 1). In the Bocsa area, more precisely BSZO3PO4 and BSZO3PO5, there were the most damaged by green stink bugs. In this research area, almost all the plants analyzed showed symptoms of the attack by larvae, nymphs and adults in July, August and September.

CONCLUSIONS

Not in all the 40 observation points monitored, the invasive insects were recorded. In most areas with higher altitude, and cooler, Nezara viridula was not reported. However, the presence of the favorite plants such as tomatoes, beans, raspberries and more recently cucumbers, could also attract the pest in these areas. The rule is not valid for the Moldova Noua area, where the altitude is small and the species was not present during the monitored period.

All this leads to the conclusion that the species is adaptable to new living conditions, new host plants, hence the need to continue monitoring activities in Caras Severin County.

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