



Severe damage to vegetables by the invasive brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae), in Hungary

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Abbreviations:

BMSB – brown marmorated stink bug

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Abstract

Background and purpose: The brown marmorated stink bug (BMSB), *Halyomorpha halys*, is native to East Asia and has recently become an invasive pest in North America and Europe. It is considered a nuisance pest as well as a significant economic pest causing damage to a wide range of crops. Following its first record in Budapest, Hungary, in 2013, repeated reports confirmed its establishment in the country. In late summer 2016, growers began to complain about stink bug damage to dry bean and forced green hot pepper, both grown in the vicinity of a site in Budapest where BMSB had been present for at least the past three years. The aims of our study were to identify if the damage in green hot pepper and dry bean has been caused by BMSB and to estimate the level of the damage.

Materials and methods: We collected 50 dry bean pods ('Etna') randomly from a 0.1 ha large plot on 2 September, and we checked the seeds in each pod for the symptoms of feeding in the laboratory. To assess the rate of damaged hybrid green hot pepper ('Daras') fruits, 100 fruits picked by the grower in a greenhouse were studied *in situ* on 8 September for damage from stink bugs. A vacuum device was used to collect stink bug samples from both sites.

Results: We found damaged seeds in 47 dry bean pods (94%), and all the green hot pepper fruits (100%) were affected. We identified BMSB as the causal organism in both cases.

Conclusions: Our results call the attention to the severe threat posed by BMSB to the European crop production.

INTRODUCTION

The invasive alien brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål, 1855) (Hemiptera: Heteroptera: Pentatomidae) is native to China, Korea, Taiwan, Japan, and northern Vietnam (1, 2), and has been introduced in the USA as well as in Europe, where it was first recorded in Switzerland in 2004 (3, 4, 5). Soon afterwards, it has also been recorded in Liechtenstein, Greece, Germany, France, Italy and Hungary (6). Recent records include Austria (7), Romania (8), Serbia (9), Russia (10, 13), Spain (11), Bulgaria (12), Abkhazia, Georgia (13) and Slovakia (14). In the UK, BMSB was first intercepted in passenger luggage arriving from the USA in 2010, and then later, in 2013, in a consignment of stone imported from China (15).



Figure 1. Stink bug damage symptoms on an 'Etna' dry bean seed (Photo: D. Korányi)

The first records of BMSB in Hungary date back to 2013, when a few individuals were found at two locations in Budapest, and one specimen was photographed at Ócsa. In 2014, many detections were reported from different parts of the capital (16, 17, 18). In 2015, BMSB was found at further locations, namely Budakalász and Martonvásár (19). As a result of a public survey initiated in autumn 2016, the species was soon reported as present at additional sites in various parts of Hungary, however, mass occurrence (out of Budapest and its close region) was observed only at Pécs (South Hungary) (20).

Brown marmorated stink bug has been documented feeding on a wide range of plant species worldwide, including economically important plants, with many of them reported as having suffered major damage (e.g. 3, 21, 22, 23, 24, 25, 26, 27). Several vegetables have already been identified as being at a risk of heavy infestation by the pest, but the significance of BMSB in this group of crops seems to have been studied less so far (e.g. 28, 29, 30, 31, 32, 33). Beans (in particular *Phaseolus vulgaris* L.) and peppers (*Capsicum annuum* L.), the plants being in the focus of our survey, have been shown to be attractive hosts of the stink bug species (23, 25, 29, 30, 31, 32, 33). Symptoms of damage differ according to the plant species affected, and these have been described and illustrated by Kuhar et al. (29) and Rice et al. (25).

The objective of our study was to reveal if BMSB has caused the damage on dry bean and forced green hot pepper. We have also tried to estimate the level of BMSB damage in these crops.

MATERIALS AND METHODS

We conducted the study in the area of the Experimental and Research Farm of the Szent István University, Budapest, Hungary, in September 2016. Neither the dry bean ('Etna') nor the forced hybrid green hot pepper ('Daras') were sprayed with any insecticides prior to the survey.

For the dry bean 'Etna' we collected 50 pods randomly on a 0.1 ha large dry bean field (6 rows of 100 m length each, 2 m row spacing) (47.4033°N, 19.1498°E), on 2 September. We used a vacuum device (McCulloch BVM 250) to collect 6 insect samples, each from a separate row, along a diagonal transect of the plot. The No. 1–6 samples contained the stink bugs which were present on bean plants growing between the 7–8th, 25–26th, 42–43rd, 59–60th, 76–77th, and 93–94th metres of the row. We checked all the seeds in each collected pod for the symptoms of feeding, and determined the stink bug species and their numbers present in the samples in the laboratory of the Department of Entomology, Szent István University.

The studied hybrid green hot pepper 'Daras' was grown together with other 48 pepper cultivars and candidate varieties in a 0.15 ha large Filclair plastic greenhouse (47.3973°N, 19.1519°E). We checked *in situ* 100 'Daras' fruits chosen randomly from the items just harvested by the grower on 8 September. The number of fruits showing stink bug damage symptoms was recorded. We collected 5 insect samples from 2 parallel 'Daras' rows (50 m long each, 0.9 m row spacing) by using the aforementioned vacuum device on 9 September. Sample No. 1 was taken at the 5th metre of the adjacent rows, and the samples No. 2–5 were collected at the 15th, 25th, 35th, and 45th metres, respectively, of both rows. Each sample included insects present on 8 (4–4 opposing) plants of ca. 2.8 m height.



Figure 2. Mass occurrence of BMSB nymphs in the studied 'Etna' dry bean plot at Budapest, 2 September 2016 (Photo: G. Véték)



Figure 3. Stink bug damage symptoms on green hot pepper (Photo: G. Vétek)

RESULTS

In the case of the ‘Etna’ dry bean samples, we found at least one damaged seed (Fig. 1) in 47 pods (94%), and in 20 pods (40%) all the seeds were damaged. This means that less than 10% of the pods could be estimated as having remained unaffected by stink bugs by early September, close to harvest. Only two phytophagous stink bug species, *Halyomorpha halys* and *Nezara viridula* (L.) were present in the samples collected with the vacuum device, with total numbers of 176 and 19, respectively. Regarding BMSB, each sample was largely dominated by nymphs (Fig. 2). Their rate in the 6 samples as a total was 98.9%. We found the largest numbers of BMSB individuals in samples No. 1 (62 nymphs, 0 adult) and 6 (57 nymphs, 1 adult female), representing the two opposite corners along the diagonal transect of the dry bean plot. We recorded the smallest numbers of specimens (4 nymphs in sample No. 3, and 13 nymphs and 1 adult female in sample No. 4) in the middle of the plot.

In the forced hybrid green hot pepper (‘Daras’), we could identify stink bug damage symptoms (Fig. 3) on each fruit of the collected sample, which means 100% damage. BMSB was the only stink bug species collected (6 nymphs) with the vacuum device. We could also find exuviae of BMSB nymphs in samples No. 2–5.

DISCUSSION

Our results show that following the first detection of BMSB at Péterimajor (also within the territory of the Experimental and Research Farm), Budapest, in autumn 2013 (16), populations of the pest reached densities within a couple of years that could cause significant damage to the studied crops. Although we do not have season-long data on the occurrence of stink bug species either in the dry bean or the forced green hot pepper, we have been informed by the growers that prior to the (mass) occurrence of the „brown stink bugs”, identified as *H. halys*

during this study, only a few individuals of *N. viridula* could be observed in both crops. Moreover, populations of *N. viridula*, the only phytophagous stink bug species found besides BMSB, remained insignificant also in early September. The clear dominance and high abundance of BMSB nymphs (and exuviae) present and the severe feeding damage recorded in the two crops confirm the results of previous studies (e.g. 25, 29, 31, 32) that bean and pepper are major hosts of BMSB.

The high abundance of specimens found close to the borders of the bean field seems to indicate the edge effect described by Venugopal et al. (34). In our case, the bean was surrounded on three sides by wooded areas, which might be the sources of invasion. The strong dispersal capacity of BMSB nymphs (35) might also lead to the heavy infestation of the bean field.

Compared to the high level of damage, the relatively small number of BMSB specimens collected from the pepper on 9 September might be explained partly by that the individuals might be present on comparatively small numbers on the plants during the morning hours when the samples were taken. The growers here experienced higher activity of BMSB specimens during the sunny daylight hours. Furthermore, previous plant manipulations (regular pruning in the growing period; the latest one was carried out a week before the sampling) resulting in less dense foliage the specimens could rest on and be concealed in (36) might also lead to moderate catches. Symptoms on fruits, however, could develop due to feeding at any time during fruit development and ripening. Nevertheless, this phenomenon requires further investigations.

As the Extra class and Class I green hot pepper is sold by the piece, even some minor aesthetic feeding damage caused by stink bugs and noticed by the customer may result in a price drop. Although the exact economic loss due to the stink bug damage alone would be difficult to calculate, we could see that many of the affected peppers had to be categorized into a lower class, depending on the severity of the symptoms, meaning a reduced price. Furthermore, the need for an intervention with a combination of broad-spectrum insecticides (with the active substances thiamethoxam and deltamethrin) in September so as to moderate damage by BMSB caused not only extra costs but also led to the disruption of the biological pest management program conducted successfully prior to the occurrence of the stink bug species in the greenhouse.

This is an early report of damage to vegetables by BMSB in Europe. Scientific reports on damage to any crops by BMSB all over the continent are still rather limited, and are concentrated to the regions of Switzerland and Italy (6, 36, 37, 38, 39), although there is a recent report also from Romania (40). Hopefully, the results of our survey can call the attention to the rapidly increasing threat posed by this pest to the European plant production, including the vegetable-growing sector, and may

facilitate a rapid response to prevent or at least to moderate the number of major damage events in the future.

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