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STRAWBERRY FRUIT DAMAGED BY THE TARNISHED PLANT BUG (*Lygus rugulipennis* L.)

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A B S T R A C T

The occurrence of the tarnished plant bug (*Lygus rugulipennis* L.), was observed in Poland on twenty strawberry cultivars from 1999-2002. Experiments were carried out in central Poland at the Experimental Orchard in Dąbrowice, near Skierniewice.

The number of mirid bugs, mainly larvae, was estimated during strawberry blossom. The number of fruit damaged by the mirid bugs was calculated during harvest. All of the twenty strawberry cultivars observed were susceptible to infestation by the tarnished plant bug.

The highest number of mirid bugs, 2.2-4.4 per 25 flower clusters, was observed on the cultivars 'Honeoye', 'Selection 1476', 'Vega', 'Selection 723', 'Elkat', 'Evita', 'Selva', 'Polka', and 'Senga Sengana'. The medium number of mirid bugs, 1.0-1.9 per 25 flower clusters, was noted on the cultivars 'Tenira', 'Kent', 'Seal', 'Marmolada', 'Elsanta', 'Karel', 'Tarda Vicoda' and 'Kastor' cvs. The lowest number of mirid bugs, below 1 specimen per 25 flower clusters, was observed on the cultivars 'Selection 1248', 'Malling Pandora' and 'Pegasus'. The highest number of malformed fruit, observed on average over two years at between 27.5-39.5%, was noted on the cultivars 'Selva', 'Marmolada', 'Honeoye', 'Elkat', 'Kent' and 'Evita' (one fruiting year). The number of malformed fruit, at between 12.5-22.5%, was observed on the cultivars 'Tarda Vicoda', 'Polka', 'Vega', 'Selection 1476', 'Tenira', 'Karel', 'Elsanta', 'Selection 723', 'Kastor', 'Selection 1248' and 'Seal'.

The lowest damage of fruit, below 5%, was observed on the cultivars 'Malling Pandora', 'Pegasus' and 'Senga Sengana'.

Key words: strawberry, *Lygus rugulipennis*, strawberry cultivars, tarnished plant bug

INTRODUCTION

The tarnished plant bug is a pest which occurs on many plants. It is known to cause damage to strawberry in many countries in Europe (Jay et al., 2004) and America (Rhainds and English-Loeb, 2003; Schaefers, 1980).

The adult tarnished plant bug is most predominant during the pre-bloom and blossom periods. The eggs are laid into blossom buds when these start to separate into clusters, and are continued to be laid until the fruit are approximately 12.5 mm in diameter. Small nymphs emerge after a few days and begin to feed on strawberry flower buds, flowers and small fruit. As a result, the damaged fruit are small, deformed and non-marketable. It has been observed that the level of damage caused to strawberry by the tarnished plant bug is dependent on the susceptibility of the cultivar (Easterbrook, 2000; Easterbrook and Simpson, 2000; Handley and Dill, 2003; Rhainds and English-Loeb, 2003).

The aim of this work was to estimate the susceptibility of twenty strawberry cultivars to the tarnished plant bug. The 'Senga Sengana' cultivar, commonly grown in Poland for processing fruit, was used as the standard cultivar (Łabanowska and Chlebowska, 1998).

MATERIAL AND METHODS

The experiments were carried out from 1999 to 2002 at the Dąbrowice Experimental Orchard, central Poland, belonging to the Research Institute of Pomology and Floriculture in Skierniewice. The experiments were carried out in a randomized block design with four replicates of fifty plants per plot. Each of the twenty cultivars was planted in the spring of 1999 in two 12 m long rows (24 m^2). 'Senga Sengana' was used as the standard reference cultivar. Because the field chosen for the experiments is planted with strawberries each year, the probability of infestation by the tarnished plant bug was high.

No chemical compounds were applied on the plantation during the experiment.

The number of mirid bugs, mainly larvae, was estimated once a year, during full blossom on 25 flower clusters per replicate, and on 100 flower clusters per cultivar. Individual larvae were collected on white trays of 12 cm in diameter. The fruit damaged by the mirid bugs were observed during the three fruiting seasons between 2000 and 2002. The number of fruit damaged by the mirid bugs was counted twice in the years 2000 and 2001, but only once in the year 2002, during harvest, and on randomly taken samples consisting of between 25 and 50 fruit per replicate,(100-200 fruit per cultivar). Four of such samples were taken from each cultivar.

The data was analyzed using the functions $\mathbf{y = \log (x + 1)}$, where **x** – represents the mean number of damaged fruit per sample. All data was elaborated using analysis of variance, followed by means separation using Duncan's multiple range t-test at $P<0.05$. The results and observation dates are noted in Tables 1-3.

RESULTS AND DISCUSSION

Damaged fruit caused by the tarnished plant bug varied, depending on the year, the cultivar, and the time of harvest. The highest number of the tarnished plant bug was observed at the beginning of the experiment, in 2000. During this first fruiting year, the nymphs of mirid bugs were observed on all twenty tested strawberry cultivars (Tab. 1). On only three cultivars, 'Selection 1248', 'Malling Pandora' and 'Pegasus' was the number of mirid bugs lower or equal to that as on the cultivar 'Kastor', the economic threshold level, which was established as 1 individual per 25 flower clusters (Schaefers, 1980). The highest number of mirid bugs, 3.3-4.4 specimens per 25 flower clusters, was observed on the cultivars 'Honeoye', 'Selection 1476', 'Vega' and 'Selection 723'. On other cultivars such as 'Elkat', 'Evita', 'Selva', 'Polka', 'Senga Sengana', 'Tenira', 'Kent', 'Seal', 'Marmolada', 'Elsanta', 'Karel' and 'Tarda Vicoda', from 1.1 to 2.8 mirid bugs per 25 flower clusters was observed. This was higher than the economic threshold level. It is important to note that during the observation day, on late fruiting cultivars such as 'Malling Pandora' and 'Tarda Vicoda', the flower clusters were very young, with no open flowers, resulting in an observation of the presence of up to 11 specimens of mirid bugs per 25 flower clusters, especially on 'Tarda Vicoda' cv. two weeks later.

The lowest number of damaged fruit, at 3-4% during two harvest dates, was observed on the cultivars 'Karel', 'Pegasus' and 'Kastor'. The highest percentage of damaged fruit, at a level of 23-41% during two harvest dates, was observed on the cultivars, 'Marmolada', 'Elkat', 'Vega', 'Tenira', 'Polka', 'Selection 1476', 'Honeoye', 'Selva' and 'Kent'. The percentage of malformed fruit on the cultivar 'Tarda Vicoda', which was harvested only once during the second date, was high at 12%. On the standard cultivar 'Senga Sengana' as well as on others such as 'Elsanta', 'Seal', 'Selection 723' and 'Selection 1248', the level of malformed fruit, at between 8-16%, was observed. Significant differences between cultivars were not always visible.

Generally, on most cultivars during 2000, the number of tarnished plant bugs was higher than the economic threshold level, and should have been controlled by chemical administration just before or at the time of blossoming, when the bugs are feeding on flowers and young fruit sets. If this is not controlled, the damaged fruit are small, deformed and of no marketable value. The highest percentage of damaged fruit was noted on the cultivars 'Marmolada', 'Elkat', 'Vega', 'Tenira', 'Polka', 'Selection 1476', 'Honeoye', 'Selva', 'Kent' and 'Tarda Vicoda'. The lowest percentage was observed on the cultivars 'Karel', 'Pegasus', 'Kastor' and 'Malling Pandora'.

In 2001, during observation of the second fruiting year blossom, only single individuals of mirid bugs were present on flower clusters. No mirid bugs were found on the majority of the cultivars tested

during this period. This is probably due to the fact that the tarnished plant bug is aviatory and its numbers on the cultivars fluctuated. However, during the harvest, malformed fruit were observed. The lowest percentage of damaged fruit, at 10%, was noted at the beginning of harvest on the cultivars, 'Polka', 'Senga Sengana', 'Vega', 'Selection 1476', 'Tenira', 'Pegasus' and 'Selection 723' (Tab. 2). On average, about 30% of fruit were damaged by mirid bugs on the cultivars 'Elkat', 'Kent','Evita' and 'Karel', but on the cultivars 'Tarda Vicoda', 'Marmolada', 'Selection 1248', 'Kastor', 'Elsanta' and 'Seal' there were between 11.6-23.2%. The highest number of fruit malformed by the tarnished plant bug were noted on the cultivars 'Selva' and 'Honeoye', at 47.6-50.4%. In the following harvest period, and during full fruiting, a smaller number of strawberry fruit were damaged on the cultivars 'Marmolada', 'Polka' and 'Selection 723', at 11.6-13.6%.

Generally, during two harvest dates, the lowest percentage of damaged fruit, at between 1% and 11%, was observed on the cultivars 'Malling Pandora', at one harvest date and 'Senga Sengana', 'Pegasus', 'Vega' and 'Selection 1476'. The average level of damaged fruit, at between 13% and 26%, was observed on the culivars 'Kastor', 'Selection 723', 'Selection 1248', 'Seal', 'Elsanta', 'Tenira' and 'Polka'. The highest number of damaged fruit, at between 32-55% was observed on the cultivars 'Selva', 'Honeoye', 'Elkat', 'Tarda Vicoda', 'Karel', 'Marmolada', 'Kent' and 'Evita', at 28% on one date of harvest. It is interesting to note that on the very late cultivar 'Malling Pandora', at this time, many fruit were still green and not ready for harvest.

In 2002, observations were carried out on nineteen cultivars, with the exception of 'Evita' cv, given that it was dried out, probably due to frost damage during the winter. Mirid bugs were noted on all the tested cultivars. The highest number, more than 1 bug per 25 flower clusters, was observed on 'Marmolada' cv. (Tab. 3). Fruit malformation was estimated only once, due to poor fruiting on plantations. The lowest number of damaged fruit, 0-0.8%, was observed on the cultivars 'Selection 1248', 'Marmolada', 'Kastor', 'Malling Pandora', 'Seal', 'Tenira' and the standard cultivar 'Senga Sengana'. The highest number of malformed fruit, 8.4-11.6%, was observed on the cultivars 'Polka', 'Vega', 'Elsanta', 'Selection 1476', 'Selva', and 'Tarda Vicoda'. The number of malformed fruit at between 2.4-6.4% was observed on the cultivars 'Honeoye', 'Kent', 'Elkat', 'Pegasus', 'Karel' and 'Selection 723'.

Generally, the highest number of mirid bugs was observed during the first year of the experiment, and therefore the results from this year are the most representative of the three. The highest number of mirid bugs, 4.4-2.2 specimens per 25 flower clusters, was observed on the cultivars 'Honeoye', 'Selection 1476', 'Vega', 'Selection 723', 'Elkat', 'Evita',

Table 1. The number of mirid bugs - *Lygus* spp. on strawberry flower clusters and number of malformed fruit on 20 strawberry cultivars

Dąbrowice Experimental Orchard, 2000

Cultivar	Number of mirid bugs per 25 flower clusters May 17	Number of damaged strawberries per sample of 25 fruit		Average damage of strawberry fruit from two harvests [%]
		during first harvest June 1	during second harvest June 7	
Elkat	2.8 cde*	3.4 cd	4.4 e	32
Elsanta	1.2 a-e	1.3 a-d	1.9 cd	16
Evita	2.6 b-e	–	–	–
Honeoye	4.4 e	2.5 bcd	3.7 de	26
Karel	1.2 a-e	0.2 a	0.4 ab	3
Kastor	1.0 a-d	0.2 a	0.7 abc	4
Kent	1.6 a-e	2.3 bcd	3.2 de	23
Malling Pandora	0.5 ab	–	0.9 abc	4**
Marmolada	1.6 a-e	4.2 d	5.7 e	41
Pegasus	0.6 abc	0.4 a	0.2 a	3
Polka	2.4 b-e	2.3 bcd	3.7 de	27
Seal	1.6 a-e	0.4 a	1.2 bc	9
Selection 723	3.3 de	0.6 ab	1.1 abc	8
Selection 1248	0.2 a	0.4 a	1.2 bc	8
Selection 1476	4.4 e	2.6 bcd	3.7 de	27
Selva	2.6 b-e	1.5 a-d	3.6 de	24
Senga Sengana	**2.2 b-e**	**0.9 abc**	**1.1 abc**	**9**
Tarda Vicoda	1.1 a-d	–	2.9 de	12**
Tenira	1.9 b-e	3.2 cd	3.4 de	27
Vega	3.9 de	2.7 cd	4.4 e	29

*Numbers followed by the same letter do not differ at $P<0.05$ according to Duncan's multiple range t-test
**Not enough fruit during second harvest date on cvs. 'Malling Pandora' and 'Tarda Vicoda' – data from one harvest only

Table 2. The number of mirid bugs – *Lygus* spp. on strawberry flower clusters and the number of malformed fruit on 20 strawberry cultivars

Dąbrowice Experimental Orchard, 2001

Cultivar	Number of damaged strawberries per sample of 25 fruit		Average damage of strawberry fruit from two harvests [%]
	during first harvest June 6	during second harvest June 26	
Elkat	7.9 fgh *	1.0 bcd	37
Elsanta	2.9 cde	0.2 ab	14
Evita	7.0 fgh	–	28**
Honeoye	11.9 gh	0.9 bcd	53
Karel	7.0 fhg	1.6 cde	36
Kastor	4.0 def	2.1 de	26
Kent	7.1 fgh	0.7 abc	32
Malling Pandora	–	0.2 ab	1**
Marmolada	5.1 ef	3.4 e	35
Pegasus	1.3 bc	0.2 ab	8
Polka	0.2 a	2.9 e	13
Seal	2.9 cde	0.9 bcd	16
Selection 723	1.9 bcd	2.9 e	23
Selection 1248	5.2 ef	0.2 ab	22
Selection 1476	0.6 ab	1.9 cde	11
Selva	12.6 h	0.9 bcd	55
Senga Sengana	**0.6 ab**	**0.9 bcd**	**7**
Tarda Vicoda	5.8 efg	1.9 cde	33
Tenira	1.2 bc	1.9 cde	14
Vega	0.6 ab	1.9 cde	11

*Explanations, see Table 1
**Data from one fruit harvest only

Table 3. The number of mirid bugs - *Lygus* spp. on strawberry flower clusters and the number of malformed fruit on 20 strawberry cultivars

Dąbrowice Experimental Orchard, 2002

Cultivars	Number of mirid bugs per 25 flower clusters in May 20	Damaged strawberry fruit during harvest in June 4	
		Number damaged fruit per sample of 25 fruit	%
Elkat	0.6 abc*	1.2 a-d	4.8
Elsanta	0.2 ab	2.3 cd	9.2
Evita	–	–	**
Honeoye	0.6 abc	1.6 bcd	6.4
Karel	0.0 a	0.6 abc	2.4
Kastor	0.4 abc	0.2 ab	0.8
Kent	0.4 abc	1.6 bcd	6.4
Malling Pandora	0.2 ab	0.2 ab	0.8
Marmolada	1.4 c	0.0 a	0
Pegasus	0.2 ab	0.9 a-d	3.6
Polka	0.2 ab	2.9 d	11.6
Seal	0.9 bc	0.2 ab	0.8
Selection 723	0.2 ab	0.6 abc	2.4
Selection 1248	0.6 abc	0.0 a	0
Selection 1476	0.2 ab	2.1 cd	8.4
Selva	0.0 a	2.1 cd	8.4
Senga Sengana	**0.0 a**	**0.2 ab**	**0.8**
Tenira	0.4 abc	0.2 ab	0.8
Tarda Vicoda	0.0 a	2.1 cd	8.4
Vega	0.2 ab	2.7 d	10.8

*Explanations, see Table 1

** No plants, frost damaged plants of this cultivar

'Selva', 'Polka', and 'Senga Sengana'. The number of mirid bugs, at between 1.0-1.9 per 25 flower clusters, was observed on 'Tenira', 'Kent', 'Seal', 'Marmolada', 'Elsanta', 'Karel' and 'Tarda Vicoda' cvs. The lowest number of mirid bugs below 1 specimen per 25 flower clusters, was observed on the cultivars 'Selection 1248', 'Malling Pandora' and 'Pegasus', and 1 bug per flower cluster on 'Kastor'. High numbers of malformed fruit were observed during the first and second year of the experiment. During these two years of observation, the highest number of malformed fruit, at between 27.5-39.5% on average, was observed on the cultivars 'Honeoye', 'Selva', 'Elkat', 'Marmolada', and 'Kent' but only observed during one year fruiting on 'Evita'. The average number of malformed fruit, 12.5-22.5%, was observed on the cultivars 'Tarda Vicoda', 'Tenira', 'Vega', 'Polka', 'Karel', 'Selection 1476', 'Selection 723', 'Elsanta', 'Kastor', 'Selection 1248' and 'Seal'. The lowest number of damaged fruit below 5% on average per year, was only observed on the cultivars 'Malling Pandora', 'Senga Sengana' and 'Pegasus'; it is possible however, that the time of observation for the late fruiting cultivar 'Malling Pandora' was not optimal.

On most cultivars during the year 2000, the number of tarnished plant bugs was higher than the accepted economic threshold level. This should be chemically controlled during blossom time, when the bugs are feeding on flowers and young fruit sets.

CONCLUSIONS

1. The tarnished plant bug (*Lygus rugulipennis*) – malformed fruit were noted on all evaluated strawberry cultivars.
2. The highest number of mirid bugs was noted on the cultivars, 'Honeoye', 'Selection 1476', 'Vega', 'Selection 723', 'Elkat', 'Evita', 'Selva', 'Polka' and 'Senga Sengana'.
3. The medium number of mirid bugs was noted on 'Tenira', 'Kent', 'Seal', 'Marmolada', 'Elsanta', 'Karel', 'Tarda Vicoda' and 'Kastor' cvs.
4. The lowest number of mirid bugs was observed on the cultivars, 'Selection 1248', 'Malling Pandora' and 'Pegasus'.
5. The highest number of malformed fruit during the three years was noted on the cultivars, 'Selva', 'Marmolada', 'Honeoye', 'Elkat', 'Kent' and 'Evita' (one fruiting year).
6. The medium number of malformed fruit was noted on the cultivars, 'Tarda Vicoda', 'Polka', 'Vega', 'Selection 1476', 'Tenira', 'Karel', 'Elsanta', 'Selection 723', 'Kastor', 'Selection 1248' and 'Seal'.
7. The lowest number of damaged fruit was noted on 'Malling Pandora', 'Pegasus' and 'Senga Sengana'.

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USZKODZENIE OWCÓW TRUSKAWKI PRZEZ ZMIENIKA LUCERNOWCA – *Lygus rugulipennis* L.

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S T R E S Z C Z E N I E

Doświadczenia nad występowaniem i uszkodzeniem owoców przez zmienika lucernowca *Lygus rugulipennis* L. wykonano na 20 odmianach truskawki w latach 1999-2002 w Sadzie Doświadczalnym Instytutu Sadownictwa i Kwiaciarstwa w Dąbrowicach koło Skierniewic. Liczebność szkodnika na kwiatostanach truskawki oceniano w okresie kwitnienia roślin, liczbę zaś owoców uszkodzonych przez zmienika oceniano w okresie dojrzewania i zbioru owoców. Obecność zmienika i zdeformowanych przez niego owoców notowano na wszystkich ocenianych odmianach. Największą liczbę zmieników notowano na odmianach: 'Honeoye', 'Selection 1476', 'Vega', 'Selection 723', 'Elkat', 'Evita', 'Selva', 'Polka' i 'Senga Sengana', średnią na: 'Tenira', 'Kent', 'Seal', 'Marmolada', 'Elsanta', 'Karel', 'Tarda Vicoda' i 'Kastor' cvs., a najniższą na: 'Selection 1248', 'Malling Pandora' i 'Pegasus'.

Największy procent owoców zdeformowanych przez zmieniki podczas trzyletnich obserwacji stwierdzono na odmianach: 'Selva', 'Marmolada', 'Honeoye', 'Elkat', 'Kent'i 'Evita' (ta odmiana owocowała tylko w jednym roku). Średnią liczbę uszkodzonych przez zmieniki owoców notowano na odmianach: 'Tarda Vicoda', 'Polka', 'Vega', 'Selection 1476', 'Tenira', 'Karel', 'Elsanta', 'Selection 723', 'Kastor', 'Selection 1248' i 'Seal'. Najmniej uszkodzonych owoców było na odmianach: 'Malling Pandora', 'Pegasus' i 'Senga Sengana'.

Słowa kluczowe: truskawka**,** *Lygus rugulipennis*, odmiany truskawki, zmienik lucernowiec