SUSCEPTIBILITY OF RASPBERRY CULTIVARS TO THE RASPBERRY CANE MIDGE (*Resseliella theobaldi* BARNES)

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ABSTRACT

During the 2004 growing season, five raspberry cultivars were evaluated in terms of their susceptibility to the raspberry cane midge (*Resseliella theobaldi* Barnes). The trial was carried out at Berkenye, Nógrád County, Hungary. The cultivars evaluated were 'Rubaca' from Germany, 'Fertődi Zamatos' from Hungary, 'Tulameen' from Canada, and 'Autumn Bliss' and 'Golden Bliss' from the United Kingdom. Every other week, twenty-five split primocanes of each cultivar were randomly collected for laboratory examination. Data recorded for each cultivar included the mean number of larvae, the mean split length, and the mean extent of bark peeling per primocane. Pearson's linear correlation coefficients were calculated for the correlations between the annual mean number of larvae per primocane on the one hand, and the annual cumulative mean split length per primocane and annual mean extent of bark peeling per primocane on the other hand. There was a weak correlation between annual mean number of larvae and annual cumulative mean split length, and a stronger correlation between annual mean number of larvae and annual mean extent of bark peeling. Annual mean number of larvae per primocane and annual mean extent of bark peeling per primocane were both highest in 'Rubaca', which means that the number of larvae per cane largely depends on the extent of stem peeling, although longitudinal splitting may also play a role. Therefore, cultivars with hardly any bark peeling and few and small longitudinal splits can be presumed to be less susceptible to infestation by the raspberry cane midge. Using these criteria, the least susceptible of the five cultivars evaluated would be 'Tulameen' and 'Fertődi Zamatos'. Further research is needed to confirm this conclusion and to gather data on other factors which affect cultivar choice for new plantations, including winter hardiness, and susceptibility to cane diseases.

Key words: raspberry, cultivar damage, *Resseliella theobaldi*

INTRODUCTION

The raspberry has become the most important berry fruit in Hungary. In 1999, about 80% of the total raspberry yield was exported, which is much higher than for other fruits. The main target markets are western European countries such as Germany, Austria and the Netherlands, which have strict requirements pertaining to fruit quality.

Higher standards in raspberry production are needed to meet increasing consumer demand. Raspberry yields are about three times higher on modern, irrigated plantations than on traditional farms (Z. Kiss and Papp, 2001).

When establishing a new integrated raspberry plantation, it is important to choose a site with the right soil and climatic conditions and to adhere to good agricultural practices. It is also important to choose the cultivar which is best suited to local conditions.

Raspberries have long been grown in many regions of Hungary. In order to help growers implement integrated plant protection programs, the Department of Entomology at Corvinus University of Budapest has been carrying out a survey of serious raspberry pests on several plantations in the northern part of the country. The raspberry cane midge (*Resseliella theobaldi* Barnes) was the most common pest found. The rose stem girdler (*Agrilus cuprescens* Ménétriés) was also identified as a potentially serious raspberry pest.

Raspberry cane midge larvae can quickly overrun newly established plantations if introduced together with infested planting material or soil. After mating, emerged female midges lay their eggs under the peeling outer cortical tissues along natural splits on primocanes. When the hatched larvae invade the primocanes, they cause dark brown, clearly defined spots on the green background of the cane. Later, as they feed, plant tissues become visibly discolored. The damaged canes are thereby weakened. To make matters worse, the larval feeding sites are potential points of entry for the parasitic fungus *Leptosphaeria coniothyrium* (Fuckel) Sacc., which can cause cane death.

The aims of our studies were to select cultivars which are resistant or only slightly susceptible to the raspberry cane midge, and to determine the basis for the differences in susceptibility among cultivars.

Pitcher (1952) extensively studied susceptibility to the raspberry cane midge in several raspberry cultivars. Whether raspberry cane midge larvae are able to successfully infest a given cultivar depended on the amount and extent of natural splits on the canes. Cultivars were categorized according to their tendency to form splits. Differences in susceptibility between cultivars were correlated with several features, including the average spilt length, the average maximum height of splits, the degree of splitting, and the time the first splits appear. On the other hand, there were no proven correlations between these features and the number of larvae per cane. Other studies were not based on such exact data. For example, Fritzsche (1958) also evaluated susceptibility in

different cultivars in terms of some of their splitting characteristics. Stojanov (1963) did not carry out exact measurements of the peeling of the outer cortex, although he noted the importance of using cultivars with canes that hardly split.

MATERIAL AND METHODS

During the 2004 growing season, five raspberry cultivars were evaluated in terms of their susceptibility to the raspberry cane midge (*Resseliella theobaldi* Barnes). The trial was carried out at Berkenye, Nógrád County, Hungary. The cultivars evaluated were 'Rubaca' from Germany, 'Fertődi Zamatos' from Hungary, 'Tulameen' from Canada, and 'Autumn Bliss' and 'Golden Bliss' from the United Kingdom. On the 'Rubaca', 'Fertődi Zamatos' and 'Tulameen' plantations, no chemicals were used except some which are approved for use in organic farming.

Every other week, twenty-five split primocanes of each cultivar were randomly collected for laboratory examination. The primocanes were examined under a stereomicroscope with the help of a dissecting needle and a ruler.

Raspberry cane midge larvae were counted on each primocane under a stereomicroscope. The annual mean number of larvae per primocane was calculated for each cultivar.

Most splits typically occurred at the bottom 50 cm of the primocanes. Therefore, each longitudinal split was measured on each cane from the base to a height of 50 cm. The length of splits was added up for each primocane. Measurements were taken on each of the twenty-five primocanes sampled on every collection date during the vegetation period for each cultivar. Finally, the annual cumulative mean split length per primocane was calculated for each cultivar.

The extent of outer cortex peeling was determined for each cultivar with the help of the dissecting needle. The distance to which the needle could be freely inserted under the naturally peeled bark without causing further peeling was measured at several points along the cane splits. These distances were averaged for each primocane. The annual mean extent of bark peeling per primocane was calculated for each cultivar.

Data were statistically evaluated using ANOVA followed by means separation using the Games-Howell test at $P \leq 0.05$. Correlations between susceptibility and splitting characteristics were determined. Pearson's linear correlation coefficients were calculated for the correlations between the annual mean number of larvae per primocane on the one hand, and the annual cumulative mean split length per primocane and annual mean extent of bark peeling per primocane on the other hand. Statistical calculations were carried out using Ministat (Vargha, 2000)

RESULTS

The five raspberry cultivars evaluated differed in terms of annual mean number of larvae per primocane, annual cumulative mean split length per primocane, and annual mean extent of bark peeling per primocane (Tab. 1).

Table 1. Characterization of raspberry cultivars by the number of raspberry cane midge larvae, the accumulated length of splits and the average extent of bark peeling per primocane (Berkenye, 2004)

Cultivar	Annual mean number of larvae per primocane	Standard deviation	Annual mean cumulative split length per primocane [cm]	Standard deviation	Annual mean extent of bark peeling per primocane [cm]	Standard deviation
Tulameen	7.4 a*	14.1	83.2 a	71.5	0.19 a	0.09
Fertődi Zamatos	7.5 a	11.7	55.8 b	46.7	0.18 a	0.10
Rubaca	30.4 b	37.5	71.0 a	44.8	0.37 b	0.13
Autumn Bliss	16.0 c	41.3	25.5 c	23.8	0.27 c	0.24
Golden Bliss	10.4 ac	28.4	26.3 c	24.8	0.27 c	0.22

*Means in the same column followed by different letters are significantly different at $P \leq 0.05$ according to the Games-Howell test

Annual mean number of larvae per primocane was significantly highest in 'Rubaca', and significantly lowest in 'Tulameen' and 'Fertődi Zamatos'.

Annual cumulative mean split length per primocane was highest in 'Tulameen' and 'Rubaca', and significantly lowest in the late-bearing cultivars 'Autumn Bliss' and 'Golden Bliss'.

Annual mean extent of bark peeling per primocane was significantly highest in 'Rubaca', and significantly lowest in 'Tulameen' and 'Fertődi Zamatos', which had hardly any bark peeling.

The correlation between annual mean number of larvae and annual cumulative mean split length was weak, with a correlation coefficient of 0.150 (0.084, 0.215). The correlation between annual mean number of larvae and annual mean extent of bark peeling was stronger, with a correlation coefficient of 0.484 (0.431, 0.534).

DISCUSSION

Annual mean number of larvae per primocane and annual mean extent of bark peeling per primocane were both highest in 'Rubaca', which means that the number of larvae per cane largely depends on the extent of stem peeling, although longitudinal splitting also plays a role. Therefore, cultivars with

hardly any bark peeling and few, small longitudinal splits can be presumed to be less susceptible to infestation by the raspberry cane midge. Using these criteria, the least susceptible of the five cultivars evaluated were 'Tulameen' and 'Fertődi Zamatos'. Further research is needed to confirm this conclusion and to gather data on other factors which affect cultivar choice for new plantations, including winter hardiness, and susceptibility to cane diseases.

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PODATNOŚĆ ODMIAN MALIN NA ZASIEDLENIE PRZEZ PRYSZCZARKA NAMALINKA ŁODYGOWEGO (*Resseliella theobaldi* BARNES)

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STRESZCZENIE

W roku 2004, w rejonie Berkenye i Nógrád na Węgrzech, oceniano podatność pięciu odmian malin na zasiedlenie przez pryszczarka namalinka łodygowego (*Resseliella theobaldi* Barnes).

Oceniano następujące odmiany: niemiecką 'Rubaca', węgierską 'Fertődi Zamatos', kanadyjską 'Tulameen' oraz 'Autumn Bliss' i 'Golden Bliss' pochodzące z Wielkiej Brytanii.

Co dwa tygodnie z każdej odmiany pobierano losowo dwadzieścia pięć pędów, w których określano liczbę żerujących larw, długość spękań kory oraz stopień złuszczenia zewnętrznej skórki pędów. Za pomocą liniowego współczynnika korelacji Pearsona określono zależność pomiędzy średnią liczbą larw pryszczarków żerujących na jednym pędzie a łączną długością spękań kory przypadającą na jeden pęd oraz stopniem złuszczenia zewnętrznej skórki pędów. Badania wykazały, że liczba żerujących larw pryszczarków w większym stopniu związana jest ze stopniem złuszczenia skórki pędów niż z długością spękań kory. Wskazywały na to wyniki obserwacji dotyczące odmiany 'Rubaca', gdzie zarówno liczebność żerujących larw pryszczarków, jak i stopień złuszczenia pędów były najwyższe. Wpływ rozmiaru spękań kory pędów malin na stopień ich zasiedlenia przez pryszczarka namalinka pędowego nie może być jednak wykluczony. Przypuszczalnie więc odmiany wykazujące słabą tendencję do złuszczania się skórki oraz charakteryzujące się małymi rozmiarami spękań kory są mniej podatne na zasiedlenie przez tego szkodnika. Biorąc pod uwagę takie kryteria oceny, wśród badanych odmian najmniej podatne na tego szkodnika byłyby odmiany 'Tulameen' i 'Fertődi Zamatos'. Aby założenia takie były potwierdzone, niezbędne jest jednak wykonanie dalszych badań, w których odmiany malin ocenione będą także pod względem innych parametrów użytkowych, decydujących o ich wyborze do uprawy.

Słowa kluczowe: malina, wrażliwość odmian, *Resseliella theobaldi*