Repeated occurrence of maize redness disease in Hungarian post-control plots in Monorierdő (Central Hungary)

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Abstract

After the first observation in 2009, Maize redness (MR) disease caused by *stolbur phytoplasma* was identified at the Post-Control Station of National Food Chain Safety Office, Monorierdő (Central Hungary) in 2010. The presence of the main leafhopper vector of MR disease, *Reptalus panzeri* (Hemiptera: Cixiidae) was verified at the above-mentioned trial site and stolbur phytoplasma detected in one-third of the vector specimens captured. During the latest decade there have been sporadic infections at the post-control plots of maize genotypes (inbred lines and hybrids) practically each year. In the latest survey of October 2018, plant samples (leaves, stalks, roots) were collected from symptomatic and asymptomatic maize genotypes and bindweed (*Convolvulus arvensis* L.) plants for phytoplasma testing. As a result, in two out of three MR sym-tomatic maize samples and in one out of two bindweed samples proved to be infected by stolbur phytoplasma. In contrast, none of the asymptomatic maize plants were positive for any phytoplasmas. Significant differences in susceptibility of maize inbred lines were recorded since infection rate varied between 0,0 and up to 90 %.

Keywords: maize redness, stolbur phytoplasma, *Reptalus panzeri*, bindweed, susceptibility of maize genotypes

Összefoglalás

A 2009. évi első észlelést követően, a sztolbur fitoplazma okozta Kukorica vörösödés betegséget azonosítottuk a Nemzeti Élelmiszerlánc-biztonsági Hivatal Fajtakitermesztési Állomásán, Monorierdőn 2010-ben. Igazoltuk a betegség legfontosabb vektorának, a *Reptalus panzeri* (Löw) kabócafajnak (Hemiptera: Cixiidae) a jelenlétét a kísérleti téren és kimutattuk a sztolbur fitoplazmát a befogott kabócapéldányok 1/3-ában, valamint a tünetes kukorica-növényekben. Az utóbbi évtizedben gyakorlatilag minden évben sporadikus fertőzések fordultak elő a kukorica-genotípusok (beltenyésztett vonalak és F_1 hibridek) kitermesztési parcelláin. A legutóbb elvégzett, 2018. évi szemlézés alkalmával növényi (levél-, szár-, gyökér-) mintákat gyűjtöttünk be tünetes és tünetmentes kukorica- és apró szulák növényekről fitoplazma-vizsgálat céljából. Ennek eredmé-nyeként a betegségtüneteket mutató 3 kukoricamintából 2-ben, és a két tünetes apró szulák minta egyikében azonosítottuk a sztolbur fitoplazmát. Ezzel szemben a tünetmentes kukorica-növények egyike sem bizonyult fitoplazmával fertőzöttnek. Jelentős különbségeket észleltünk a kukorica beltenyésztett vonalak fogékonyságában: fertőzöttségük mértéke 0,0 és 95% között változott.

Kulcsszavak: kukorica vörösödés, sztolbur fitoplazma, *Reptalus panzeri*, apró szulák, kukorica-genotípusok fogékonysága

Introduction

Maize (*Zea mays* L.) is one of the most widely cultivated crops worldwide. A disease associated with reddening of maize plants was first observed in 1957 in the middle south Banat region of Serbia (Maric and Savic 1965). After the sporadic occurrence there have been some epidemic years during the late 1950s and early 1960s. According to Sutic et al. (2002) maize redness (MR) has occurred intermittently in Serbia, Romania and Bulgaria since 1960. The stolbur phytoplasma as the causal agent of MR disease was firstly identified by Duduk and Bertaccini (2006). After the first observation in 2009, MR disease caused by stolbur phytoplasma (‘*Candidatus* Phytoplasma solani’ subgroup 16SrXII-A) was identified in Monorierdő (Central Hungary) in 2010. The presence of the main leafhopper vector of MR disease, *Reptalus panzeri* (Hemiptera: Cixiidae) was verified and stolbur phytoplasma detected in one-third of the vector specimens captured (Ács et al., 2011).

In a survey of 2013 and 2014, stolbur phytoplasma was repeatedly detected in half and one-third of the MR symptomatic maize samples originated from the post-control plots, respectively (Elek et al., 2015). Based on the characterization of Hungarian stolbur isolates, all of them were classified into the VK-II group and associated with the field bindweed (*Convolvulus arvensis* L.) which is widely distributed throughout Hungary (Ember et al., 2010).

During the epidemic phase, disease symptoms can be present in up to 90 % of the plants, and yield losses can be over 50 % (Starovic et al., 2004). The outbreaks of MR observed in 2002 and 2003 reduced yield by 40 to 90 % in the maize-growing district of Banat in Serbia (EPPO report, 2013).

Materials and methods

In October 2018 plant samples (leaves, stalks, roots) were collected from symptomatic and asymptomatic maize and bindweed (*Convolvulus arvensis* L.) plants for phytoplasma testing. A total of 5 maize plants (3 symptomatic and 2 asymptomatic) and 3 bindweed plants (2 symptomatic and one asymptomatic) were collected from the post-control plots. The typical syndrome of MR disease are as follows: (a) reddening of the leaf midrib, leaves and stalks, (b) abnormal ear development and poor seed set with shrivelled grains and thus reduced cob weight, (c) wilting, early ripening and desiccation of the whole plants. Identification of the pathogen was performed using the DNA-based nested PCR method. The DNA was isolated by NucleoSpin Plant II (MACHEREY-NAGEL) Kit. The STOL11 region of Phytoplasma genome was amplified by STOL11f2/r1 primers, thereafter STOL11f2 and STOL11r1 primers were applied (Daire et al., 1997, Claire et al., 2003) (Table 1).

Table 1. Primers for Nested PCR

Primer name	Sequence	bp	Reference
STOL11f2	5'-TAT TTT CCT AAA ATT GAT TGG C-3'	22	DAIRE *et al.,* 1997
STOL11r1	5'-TGT TTT TGC ACC GTT AAA GC-3'	20	DAIRE *et al.,* 1997
STOL11f3	5'-ACG AGT TTT GAT TAT GTT CAC-3'	21	*Claire et al., 2003*
STOL11r2	5'-GAT GAA TGA TAA CTT CAA CTG-3'	21	*Claire et al., 2003*

Results and discussion

Based on the DNA-based testing, in two out of three MR symptomatic maize samples and in one out of two bindweed samples proved to be infected by stolbur phytoplasma. In contrast, none of the asymptomatic maize plants were positive for any phytoplasmas. Significant differences in susceptibility of maize inbred lines were recorded since their infection rate varied between 0,0 and up to 90 %. Searching for sources for field resistance to MR disease, more than two-thirds of the genetic material tested was discarded due to its susceptibility to the disease, and only the population NS 1-257 CRS proved to be promising for resistance breeding in Serbia (Bekavac et al., 2007).

One of the known weedy host plants of stolbur phytoplasma, field bindweed (*Convolvulus arvensis* L.) was present on the entire territory of our trial site. *Reptalus panzeri* nymphs were found feeding on bindweed plants under field conditions (South Banat region of Serbia), and adults were occasionally found on these weedy dicots in the field (Jovic et al., 2009).

Conclusions

Repeated occurrence of maize redness disease was confirmed on the post-control plots of maize genotypes in Central Hungary, Monorierdő where the presence of the main leafhopper vector of stolbur phytoplasma, *Reptalus panzeri* (Löv) was detected in 2010.

Outbreaks of MR disease and severe yield losses seem to be associated with hot and dry weather conditions during spring and summer especially when it happens in subsequent years.

Additional investigation is needed to get more information on the field resistance of maize genotypes to MR disease in order to improve Integrated Pest Management strategies.

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