Mini data sheet on Maize redness

Added in 2012 – Deleted in 2016

Reasons for deletion:
Maize redness has been included in EPPO Alert List for more than 3 years and during this period no particular international action was requested by the EPPO member countries. The Panel on Phytosanitary Measures agreed that it could be deleted. In 2016, it was therefore considered that sufficient alert has been given and the disease was deleted from the Alert List.

Maize redness - a disease associated with stolbur phytoplasma

Why	Unusual symptoms of reddening and poor cob development were first observed on maize (*Zea mays*) in 1957 in the Banat district of Serbia. The disease, called 'Maize redness', was subsequently reported from neighbouring countries, and more recently from Italy and Hungary. The disease generally remained sporadic in Serbia, but severe outbreaks were reported during some periods (e.g. in the 1990s and the early 2000s). Although Maize redness might be caused by a complex of pathogens, recent studies have showed that stolbur phytoplasma ('*Candidatus* Phytoplasma solani', subgroup 16SrXII-A) is its major causal agent and that a planthopper *Reptalus panzeri* (Hemiptera: Cixiidae) is its main insect vector. The emergence of a new maize disease caused by stolbur phytoplasma which is also known to be associated with other diseases (e.g. on grapevine (Bois Noir), or solanaceous crops such as potato, tomato and capsicum) is not yet fully explained and it is acknowledged that further studies are needed to better understand its taxonomy, biology and ecology. As maize is an important crop in the EPPO region, the EPPO Panel on Phytosanitary measures suggested the addition of Maize redness to the Alert List.
Where	Despite the fact that Maize redness has been known to occur for decades in Europe, it remained localised to parts of Serbia for more than 50 years. It was then found in neighbouring countries (Bulgaria, Croatia, Romania). In 2009, symptoms of Maize redness were observed in on a small number of maize plants in Northern Italy (Mantova province, Lombardia). Preliminary studies detected the presence of stolbur phytoplasma, together with other phytoplasmas (belonging to 16SrI and 16Sr II groups). In August/September 2010, the occurrence of reddening symptoms was also observed in some maize fields in different localities in Hungary. The presence both stolbur phytoplasma and its vector, *R. panzeri* could be confirmed in one of these localities. **EPPO region**: Bulgaria, Bosnia and Herzegovina, Croatia, Hungary, Italy, Romania and Serbia. The geographical distribution of *R. panzeri* remains to be further studied but it is considered to be widespread in Europe. *R. panzeri* has been recorded at least in the following countries: Austria, Bulgaria, Bosnia and Herzegovina, Croatia, Hungary, Italy, Romania, Serbia.
On which plants	The main host of the disease is: *Zea mays* (maize). However, studies carried out in Serbia in infected maize fields and their surroundings have showed that the phytoplasma could also be detected in the roots of a perennial weed *Sorghum halepense* and of *Triticum aestivum* (wheat). Roots of these plants also harboured overwintering populations (nymphs) of *R. panzeri*. It is noted that these plants play an important role in the disease epidemiology. In particular, a maize/wheat rotation could favour the disease development because winter wheat roots can constitute a bridge (by harbouring both the overwintering stages of the vector and the phytoplasma) between two maize crops.
Damage	Symptoms of Maize redness are characterized by midrib, leaf, and stalk reddening (usually in late July), and by abnormal ear development with poor, shriveled grains. Soon after the appearance of symptoms, affected plants wilt, their foliage desiccates rapidly and most of the red-violet pigmentation disappears, and they eventually die. The disease reduces grain filling and maize cob weight. Compared to healthy plants, symptomatic plants ripen earlier, but

they do not show stunting as in the cases of Maize bushy stunt phytoplasma or Corn stunt (caused by *Spiroplasma kunkelii*). The outbreaks of Maize redness observed in 2002 and 2003 reduced yields by 40 to 90% in the maize-growing district of Banat in Serbia.

Transmission

In the field, Maize redness is transmitted by *R. panzeri*. This insect is also suspected to transmit Bois Noir disease in grapevine (also associated with Stolbur phytoplasma but whose main vector is *Hyalesthes obsoletus*). *R. panzeri* is a monovoltine species and adults are only observed during a short period in summer. Like most cixiids, females lay eggs in the soil surrounding their host plants, and nymphs develop on host plant roots. Although detailed information is generally lacking on the biology of *R. panzeri*, it is considered to be a polyphagous species, primarily living on the tree species that inhabit scattered shrublands. Early stages develop on grasses. Both, larvae and adults are covered by wax and live 9 months 20-30 cm under the soil surface. In Serbia, adults emerge from mid-June to early July, and can migrate to maize fields from July to September. According to the literature, *R. panzeri* has been observed on cultivated species (e.g. *Triticum aestivum, Vitis vinifera, Zea mays*) and numerous wild species (e.g. *Artemisia, Cirsium arvense, Clematis, Convolvulus arvense, Crataegus, Datura stramonium, Pinus, Prunus spinosa, Rosa, Salix, Sorghum halepense, Ulmus, Urtica dioica*).

In the Southern part of the district of Banat, it has been observed that adults of *R. panzeri* transmitted Stolbur phytoplasma to maize plants during summer (i.e. around mid-July). Adult females of *R. panzeri* lay eggs on roots of maize or other host plants, and nymphs living on these roots may acquire the phytoplasma from infected plants. Resulting adults will then be able to further transmit the disease in the field. Because severe outbreaks of maize redness have usually been observed during warm and dry summers, it has been hypothetized that when these climatic conditions prevail, *R. panzeri* moves from its dessicating wild host plants to green maize crops.

Over long distances, the possible pathways for spreading Maize redness across the EPPO region appears to be limited because maize is not normally traded as plants for planting. Seed transmission of phytoplasma is still a controversial issue and is generally considered as unlikely. However, preliminary studies on Maize redness have suggested that a low percentage of seed transmission might occur but more studies are needed to confirm this.

Pathway

Natural spread via infected *Reptalus panzeri* seems to be the main pathway. Nevertheless, plants for planting of species liable to carry infected *R. panzeri* might also be a pathway. Seed transmission needs to be clarified.

Possible risks

Maize is an important crop for the EPPO region. The epidemic character of Maize redness and possible correlation with longer periods of higher temperatures and droughts can cause significant economic damage in maize production. Disease control is difficult in the field, and there is little information about effective methods against the insect vector or about the availability of resistant/tolerant maize varieties. In disease epidemiology, the wide range of the vector's host plants and stolbur phytoplasma plant hosts are factors which should be considered. Possible management practices to reduce the risk of Maize redness may include crop rotation over 3 or more years (avoiding the short wheat/maize rotation – see above), weed control, vector control, drainage and irrigation channels. Concerning maize tolerance/resistance, differential sensitivity to Maize redness has been observed in some maize hybrids. Hybrids with a short growing period tend to be less affected by Maize redness than those with longer growing period or which are sown late in the season for silage production. Insecticide treatments against *R. panzeri* adults might be envisaged. Finally, it has been suggested that climate change might significantly influence the epidemiology of Maize redness, since the most severe damage was recorded during the warmest decade in 1990s and early 2000s.

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