Rubus Stunt Disease

a. Virus/pathogen name, including accepted acronyms and synonyms

'*Candidatus* Phytoplasma rubi'- Genus *Phytoplasma,* Family *Acholeplasmataceae,* Order *Acholeplasmatales'*, usually associated with Rubus stunt disease

Synonym- *Rubus stunt phytoplasma*

b. Host range, including resistance or tolerance within the crop hosts, alternate hosts

Rubus stunt disease has mainly been reported in *Rubus spp*. It has been found in wild and cultivated red raspberries, blackberries and loganberries (Davies, 2000). Although, the phytoplasma associated with the disease was believed only to infect *Rubus spp*. it has also been reported in dog rose plants (*Rosa canina*) and great mallow (*Malva sylvestris*) in France (Jarausch et al., 2001).

b. Symptoms on crop host including varietal differences with images of symptoms when available

Rubus stunt is a disease usually associated with the presence of *'Candidatus Phytoplasma rubi*', a phytoplasma belonging to the elm yellows group of phytoplasmas (16SrV). However, other phytoplasmas from other groups were found in symptomatic *Rubus* plants, such as aster yellows phytoplasmas (16SrI-B) (Borroto et al., 2007; Reeder, Kelly and Arocha, 2010), X-disease phytoplasma (16SrIII) (Davies, 2000) and stolbur phytoplasma (16SrXII-A) (Borroto et al., 2007; Kuzmanović, S. et al., 2011). Rubus stunt disease symptoms include stunting, witches' broom, small leaves, short internodes, enlarged sepals, phyllody, flower and fruit malformations and flower proliferations (Mäurer and Seemüller, 1995; van der Meer, 1987). All affected *Rubus* species have similar symptoms (Mäurer and Seemüller, 1995) except for raspberry cv. 'Mailing Promise', which is rather tolerant and rarely shows flower malformations (van der Meer, 1987). So far there are no *Rubus* cultivars where phytoplasma infections remain latent yet infected plants usually stay symptomless for the first year of infection (Converse 1991).

c. Geographic distribution:

As cited by van der Meer (1987), Rubus stunt disease was documented in Europe for the first time probably by de Vries (1896). Since then the disease has been documented in Great Britain (Wormald and Harris 1932), Russia (USSR)

(Vertogradova 1938), Bulgaria (Trifonov 1961), Denmark (Kristensen 1962), Hungary, Czechoslovakia, Norway, (Ramsfjell 1952), Italy (Marani et al., 1977; Marcone et al., 1994), France (Jarausch et al., 2001) and Germany (Mäurer and Seemüller, 1995). *'Candidatus* Phytoplasma rubi', associated with Rubus stunt disease, has been reported infecting plants in Europe, in countries such as Belgium (De Jonghe et al., 2019), Portugal (Fránová et al., 2016), United Kingdom, Russia, Bulgaria, Slovakia, Denmark, Norway, Germany, Netherlands, Switzerland and Italy (EPPO 2019)

e. Means of spread:

The phytoplasmas associated with Rubus stunt disease can be transmitted by an insect vector, graft inoculation between *Rubus* species (van der Meer, 1987) and vegetative propagation (Linck, H, Reineke, A., 2019). The raspberry leafhopper also known as brambleberry leafhopper, *Macropsis fuscula,* is the only insect vector associated with the transmission of *Rubus stunt* phytoplasma. (de Fluiter and van der Meer, 1953; Arnaud et al., 2007; Davies, 2000; Jarausch et al., 2001; Malembic-Maher et al., 2010).

f. Recognized diagnostic tests with cited references:

Presence of phytoplasmas in plants, associated with Rubus stunt disease can be detected with fluorescence microscopy (Davies 2000), transmission fluorescence microscopy, direct polymerase chain reaction (direct PCR) (Sertkaya, G. et al., 2004), nested polymerase chain reaction (nested PCR) (Bertaccini et al., 1995; Sertkaya et al., 2004) and real-time PCR (Linck, Krüger and Reineke, 2016). Characterization of phytoplasmas involved in the disease can be done by restriction fragment lenght polymorphism (RFLP) (Bertaccini et al., 1995; Sertkaya et al., 2004; Fránová et al., 2016).

g. Sampling recommendations for each pathogen including timing and tissue to be sampled

According to International Standard for Phytosanitary Measures (ISPM) diagnostic protocol, the best time to sample plants for phytoplasmas is at the end of the summer. Leaves with symptoms are the best sources of samples for phytoplasma disease diagnosis and since they are known to reside in the phloem, the leaf petioles and mid-veins, stems or inner bark are often used for DNA extraction. Phytoplasmas can also be detected in roots and bark scrapings. Collected plant samples can be stored at -20°C up to six months before testing. Longer term storage is at -80°C.

h. Management strategies for the pathogen and the vector(s) of the pathogen

The main control method to avoid the spread of phytoplasma diseases in commercial *Rubus* plantations, relies on the use of insecticides in order to eliminate the insect vector (Firrao et al., 2007). Control measures of phytoplasma diseases such as Rubus stunt should also focus on the application of phytosanitary measures during plant production and in plantation environments (Linck and Reineke, 2019). Since the phytoplasmas associated with the disease, are known to be transmitted by vegetative propagation, a management strategy that can be implemented is the use of certified phytoplasma free-tested planting material.

i. References

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Date of last update: February 2020