Express PRA for *Serratia marcescens* – Research and Breeding –

Prepared by: Julius Kühn-Institute, Institute for national and international plant Health; Dr. Anne Wilstermann, Dr. Eva Fornefeld; on: 26-09-2019 (translated by Elke Vogt-Arndt)

Initiation: Application for an Express-PRA by the Federal State Lower Saxony resulting from a request for a special authorisation for the movement and use of the organism for research and breeding purposes.

Express PRA	*Serratia marcescens* Bizio 1823		
Phytosanitary risk for Germany	**high** ☒	**medium** ☐	**low** ☐
Phytosanitary risk for EU-Member States	**high** ☒	**medium** ☐	**low** ☐
Certainty of the assessment	**high** ☐	**medium** ☒	**low** ☐
Conclusion	Presumably, the bacterium *Serratia marcescens* is present throughout the world whereby the isolates of various origins differ significantly. So far, isolates proven as harmful for plants are not documented in the EU. Currently, the bacterium is not listed in the Annexes of the Regulation (EU) 2019/2072. From 1999 to 2002, the bacterium was listed in the EPPO Alert List. Severe damage on crops caused by *Serratia marcescens* is known for cucurbits (*Curcubita* spp.), maize, pepper and sunflower. Due to appropriate climatic conditions, it is assumed that *S. marcescens* can establish outdoors in Germany, and throughout the EU and under protected conditions. Due to its high damage potential for important crops like maize, pepper, pumpkin, melon and sunflower, *S. marcescens* poses a significant phytosanitary risk for Germany and other EU-Member States. Based on this risk analysis, it is assumed that the pest can establish in Germany or another Member State and cause significant damage. Thus, measures for the prevention of the release of this potential quarantine pest should be met according to Article 29 of the Regulation (EU) 2016/2031.		
Precondition for Express-PRA fulfilled?	Could be a pest; is not listed; currently it is not established in the area covered by the reporting Plant Protection Service.		
Taxonomy, common name, synonyms	Kingdom: Bacteria; Phylum: Proteobacteria; Class: Gammaproteobacteria; Order: Enterobacteriales; Family: Enterobacteriaceae; Genus: *Serratia;* Species: *Serratia marcescens* Bizio 1823 Synonyms: *Erwinia alfalfae; Erwinia amylovora* var. *alfalfae* Shinde & Lukezic 1974;		

Express PRA	*Serratia marcescens* Bizio 1823
	Cucurbit yellow vine disease (CYVD), Cucurbit yellow vine agent
Does a relevant earlier PRA exist?	No
Distribution and biology	Presumably, the bacterium is distributed worldwide. There are detections from China, India, Japan, Saudi Arabia, Kenya, USA, Mexico, Venezuela, Costa Rica, Columbia, Russia, Italy, England and Germany. The bacterium is facultatively present on and in humans. Thus, a significant broader distribution is assumed. Isolates of different origins vary significantly. Currently, there is little knowledge on the distribution of single isolates. The bacterium may occur as a harmless endophyte on plants (e.g. rice; GYANESHWAR et al., 2001) or as a pest in phloem. The known damage to crop plants is described in “Damage to be expected in the PRA area” (see below). Naturally, *Serratia marcescens* is present in soil, water, vertebrates, insects and plants. It can grow at temperatures from 5 to 40°C. The bacterium is particularly important in the context of human medicine, since despite the low virulence of all species of the genus *Serratia,* the bacterium is often associated with infections of humans. Infections and epidemics of *S. marcescens* in hospitals, too, (also in the EU) are frequently proven. As a opportunistic hospital germ, the bacterium is connected amongst others with pneumonia, sepsis, conjunctivitis, meningitis and urinary infection especially for new-borns or intensive care patients. *S. marcescens*-isolates in hospitals are often multi-resistant against various antibiotics (CRISTINA et al., 2019). Because of the capability to reduce Chitin (component of the skin of vertebrates and the cell wall of fungi), the potential of *S. marcescens* for biological pest control has been tested on rice in India. *S. marcescens* shows an antagonistic effect against the fungus *Magnaporthe oryzae* (=*Pyricularia oryzae*) (AMRUTA et al., 2016). In the USA, *S. marcescens* was detected as opportunistic pathogen on honeybees. Although the bacterium is regularly found in small numbers in the intestine and the haemolymph of bees all isolates showed to be lethal when the bacterium was injected into the abdominal cavity or the isolates deriving from the intestine were ingested. Thus, *S. marcescens* presumably is a further factor for the damage to honeybee colonies (RAYMANN et al., 2018). In the Caribbean, *S. marcescens* was identified as the causal agent of the dieback of corals of the endangered elkhorn coral (*Acropora palmata*). The bacterium reaches the coral reefs through human wastewater (SUTHERLAND et al., 2011).
Are host plants present in the PRA area? If so, which?	The bacterium may occur on or in plants or may be associated with plants in a broader sense, but it is not reliant on host plants.

Express PRA	*Serratia marcescens* Bizio 1823
	There is damage to pumpkin (*Curcubita* spp.), watermelon (*Citrullus lanatas*) (BRUTON et al., 2003), pepper (*Capsicum annuum*) (GILLIS et al., 2014), maize (*Zea mays*) (WANG et al., 2015) and sunflower (*Helianthus annuus*). The cited crops are of significant economic importance and are cultivated on large areas in Europe.
Is a vector/further plant needed for host alternation? Which? Distribution?	In the USA, the squash bug (*Anasa tristis*) was confirmed as the vector for the bacterium on *Cucurbita* (BRUTON et al., 2003). Currently the bug is limited to the USA and Mexico. The presence in various other habitats shows that *S. marcescens* is not necessarily dependent on a vector or a host plant.
Climate in the distribution area comparable to PRA-area?	The species *Serratia marcescens* may grow at temperatures between 5-40°C and presumably, it is distributed worldwide. It is assumed that the bacterium can establish throughout Europe, outdoors and in protected cultivation, if that has not happened yet.
If no, are host plants present in protected cultivation?	In Europe and Germany, pepper (*Capsicum annuum*) is of great importance as greenhouse crop.
Damage to be expected in the PRA-area?	In the USA, damage of 5-100% on pumpkins and watermelons caused by the "Cucurbit yellow vine disease" (CYVD) were observed. Symptoms are yellowing, distorted growth and a slow dieback of the plant 10-14 days before the harvest. Occasionally, spontaneous wilting of the plant without yellowing can be observed at the time of flowering or fruit development. Then the plants collapse within one day. A honey-brown colouring of the phloem of the plants is typical for the infection (BRUTON et al., 2003). In 2011, sunflowers (*Helianthus annuus*) with yellow, wilted leaves were found in commercial fields in North Caucasus in Russia. Approx. 20% of the plants were affected. The phloem in plant stems leading to the infected leaves showed brown colouring. The causal agent for the symptoms was *S. marcescens* (IGNATOV et al., 2016). Recently, *S. marcescens* was identified as causal agent of the "Corn whorl rot" in maize (*Zea mays*) in the Huang-Huai-Hai-Plain in China. Infected plants develop brown necrosis on young leaves of the plant that are soaked with water. Often, the complete leaf vertebra is dying. The disease was observed in the field for several consecutive years. 10-80%, rarely 100% of the plants in the infected fields were affected. The disease may occur in every growing stage but occurs increasingly from the 5-leaf-stage. The symptoms start at the leaf margins or leaf tips, affected leaf parts may get thinner and break. Newly growing leaves are necrotic and sticky. This leads to a growth deformation. In case of a long light period and high

Express PRA	*Serratia marcescens* Bizio 1823
	temperatures, the symptoms are more serious. There were total losses in some affected fields (WANG et al., 2015). Since 2006, increasing cases of soft rot were observed on pepper (*Capsicum annuum*) in greenhouses in Venezuela that led to significant crop and quality losses. An isolate of *S. marcescens* (not identical with the CYVD-isolate) is a causal agent for soft rot-symptoms (GILLIS et al., 2014). In the case of release and establishment of a pathogenic isolate for cultivated plants, significant damage are expected in Germany and Europe.
Remarks	Although *Serratia marcescens* presumably is common worldwide and some isolates may have positive effects on individual plants (growth promotion, degradation of herbicides, biological pest control), the use of the bacterium in outdoor areas seems not justifiable because of the manifold of potentially negative impacts on humans, important crops and the environment (GILLIS et al., 2014). In case of movement and use of the organism the prevention of the release must be ensured.
Literature	AMRUTA, N., M. K. PRASANNA KUMAR, S. NARAYANASWAMY, M. GOWDA, B. C. CHANNAKESHAVA, K. VISHWANATH, M.E. PUNEETH, H. P. RANJITHA, 2016: Isolation and Identification of Rice Blast Disease-suppressing antagonistic bacterial strains from the Rhizosphere of Rice. J. Pure Appl. Microbiol. 10(2), 1043-1054. BRUTON, B. D., F. MITCHELL, J. FLETCHER, S. D. PAIR, A. WAYADANDE, U. MELCHER, J. BRADY, B. BEXTINE, T. W. POPHAM, 2003: *Serratia marcescens*, a Phloem-Colonizing, Squash Bug-Transmitted Bacterium: Causal Agent of Cucurbit Yellow Vine Disease. Plant Diseaeses 87(8), 937-944. CRISTINA, M.L., M. SARTINI, A. M. SPAGNOLO, 2019: *Serratia marcescens* Infections in Neonatal Intensive Care Units (NICUs). Int. J. Environ. Res. Public Health 16(4), DOI: 10.3390/ijerph16040610 GILLIS, A., M. RODRÍGUEZ, M. A. SANTANA, 2014: *Serratia marcescens* associated with bell pepper (*Capsicum annuum* L.) soft-rot disease under greenhouse conditions. Eur J Plant Pathol 138, 1-8. DOI 10.1007/s10658-013-0300-x GYANESHWAR, P., E. K. JAMES, M. NATARAJAN, P. M. REDDY, B. REINHOLD-HUREK, J.K. LADHA, 2001: Endophytic colonization of rice by a diazotrophic strain of *Serratia marcescens*. J. Bacteriol. 183, 2634-2645. IGNATOV, A. N., M. V. KHODYKINA, V. A. POLITYKO, M. V. SUKHACHEVA, 2016: First report of *Serratia marcescens* causing yellow wilt disease on sunflower in Russia. New Disease Reports 33, 8. http://dx.doi.org/10.5197/j.2044-0588.2016.033.008

	SUTHERLAND, K. P., S. SHABAN, J. L. JOYNER, J. W. PORTER, E. K. LIPP, 2011: Human pathogen shown to cause disease in the threatened Eklhorn Coral *Acropora palmate*. PLoS ONE, https://doi.org/10.1371/journal.pone.0023468 WANG, X.-Q., B. TAO, X.-D. LI, L.-Q. ZHANG, S.-E. LU, 2015: First report of corn whorl rot caused by *Serratia marcescens* in China. Journal of Phytopathology 163(11-12), 1059-1063. https://doi.org/10.1111/jph.12366