Raspberry Ringspot Virus

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

Raspberry ringspot virus, RpRSV - Genus *Nepovirus*, Family *Secoviridae,* Order *Picornavirales*.

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

RpRSV has a broad host range, infecting species belonging to at least 14 families. Some of the hosts are strawberry, red raspberry and blackberry, cherry, grapevine, black and red currant, gooseberries, daffodils (narcissus) and sugar beet. In red raspberry, resistance to RpRSV have been reported and cultivars differ in susceptibility; for instance, Norfolk Giant is highly susceptible to the type strain, whereas Lloyd George is immune to it. RpRSV infect nearly all commonly used herbaceous test plants, such as *Chenopodium amaranticolor*, *Chenopodium quinoa* and *Nicotiana tabacum*. *Nicotiana clevelandii* is the best host for propagation and *Chenopodium amaranticolor* is the most reliable local lesion host. *Chenopodium quinoa* and *Petunia hybrida* are useful "bait" plants for use in nematode transmission experiments.

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

RpRSV is often found in association with tomato black ring virus (TBRV), as they are both transmitted by nematodes of the genus *Longidorus*. The viruses cause few or no symptoms in the early stages of Infection. In mixed infection, these viruses cause the disease known as “raspberry leaf curl disease”, as some of the symptoms they cause in raspberries is downward curling of leaves that are brittle in texture. Other symptoms in raspberry may include chlorotic ringspot symptoms on infected leaves, that may fade or disappear in midsummer but return later in winter, yellow leaf blotches, stunting and chlorotic mottling. A reduced fruit yield and an increase in fruit crumbling are observed. In susceptible cultivars, such as Norfolk Giant, canes may die in winter. In cultivars that have tolerance to these viruses, such as Malling Jewel, Malling Enterprise and Malling Notable, the leaves of new shoots present symptoms during spring, while the leaves of fruiting canes don’t; some necrosis and dieback may occur. Lloyd George, a resistant cultivar, is immune to the common strain. Stunting of the blackberry cultivar Himalaya Giant by RpRSv infection has been noted.

Strawberry is susceptible to both viruses. Infected plants leaves develop yellow blotching, ringspots, crinkling, stunting and eventually die. On some cultivarslocal necrotic spots may be develop whereas in others chlorotic blotches may appear. On cherries, RpRSV causes rasp-leaf symptoms in cherry trees, the leaves are usually reduced in size, tough and narrow. Outbreaks of disease caused by RpRSV and TBRV occur in patches due to the

horizontal distribution of the vector in the soil. If the infection occurs due to infected planting material, infected plants are distributed randomly throughout the crop. Most hosts show milder symptoms in hot weather.

The symptoms produced by RpRSV in the herbaceous indicators are similar to the ones induced by other nepoviruses. Isolates of both viruses differ considerably in virulence, but *C. amaranticolor* and *C. quinoa* develop symptoms with all isolates; these symptoms consist of chlorotic or necrotic local lesions. In *N. tabacum*, the virus causes chlorotic local lesions and systemic chlorotic spots and rings. Generally, the herbaceous test plants do not become infected systemically or show symptoms following inoculation of the roots by nematodes.

d. Geographic distribution:

RpRSV is a European virus and has a limited extent spread to other continents. It has been detected in Luxembourg, Poland, Yugoslavia. Found Widespread in France, Latvia and Norway. The virus is locally established in Belgium, Bulgaria, Czech Republic, Finland (Bremer, 1983), Germany (Jones et al., 1994), Greece (Rana et al., 1985), Hungary (unconfirmed), Ireland, Netherlands, Norway, Slovenia, Spain, Switzerland, Russia (European, Far East), Turkey (Rana et al., 1985) and United Kingdom (Cadman, 1956, Harrison, 1958). The vector *Longidorus elongatus* has been reported in Canada, United States and New Zealand (Yeates et al., 2008) but the viruses are not reported there. Susceptible cultivars are widely grown in the United States.

e. Means of spread:

Natural transmission is by nematodes of the genus *Longidorus*, *L. elongatus* and *L. attenuatus*. Also, there is one report of RpRSV also being transmitted by *Paratrichodorus* and *Xiphinema* species. The virus particles adsorb to regions within the nematode esophagus and may be retained and able to be transmitted for long periods. RpRSV is known to be pollen and seed-transmitted in some hosts, although transmission of this virus by pollen is no known to occur in Rubus spp. This virus can be also spread through vegetatively propagated hardwood cuttings.

f. Recognized diagnostic tests with cited references:

RpRSV can be detected by serological tests such as enzyme-linked immunosorbent assays (ELISAs); antibodies are commercially available. These viruses have broad host ranges and can be detected by mechanical transmission to a number of herbaceous hosts (Stace-Smith, 1987). Also, full sequences have been obtained for these viruses, enabling their detection by reverse transcription polymerase chain reaction (RT-PCR) (MacFarlane et al., 2015).

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

Spring and early summer is the ideal time for sampling nepoviruses. Ideally, the samples should be taken from leaves that are symptomatic and young (3/4 expanded leaves). Sampling from different sites of the same plant increases chances of detection since the pathogen propagules are not evenly distributed within a plant. As this virus can be transmitted through pollen, precaution needs to be taken during flowering periods as pollen from infected material may land on virus-free material which would test positive for the virus. A thorough wash with water before extraction is recommended

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

The main management strategy is the use of certified virus-tested planting material, the virus may be distributed in infected planting material especially because few or no symptoms are visible in tolerant cultivars or in the early stages of infection in sensitive cultivars. Fumigating soil with nematicides prior to planting and keeping the field weed-free, is essential for removing potential reservoirs of the viruses. Crop rotation can be a measurement as well, not all plants are equally good hosts of vector nematodes, for example, populations of the vector nematodes increase rapidly on strawberry, but decrease on raspberry, so infection can be minimized by not planting raspberry after strawberry. Also, maintaining a cover crop between rows helps minimizing soil movement in the field. This virus spread very slowly from an infection source and can be controlled by removing infected plants and plants around the infection foci; removing as much of the root system as possible, followed by a spot treatment with a nematicide. Another cultural control measure that is effective decreasing the numbers of *L. elongatus*, is the practice of pulverizing old raspberry canes and returning them to the soil.

i. References

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