

Raspberry Bushy Dwarf Virus (RBDV) Reduces Yield of ‘Marion’ Blackberry

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Keywords: Pollen, drupelet, crumbly fruit, *Rubus*

Abstract

In 1998, we discovered *Raspberry bushy dwarf virus* (RBDV) in a planting of 280 ‘Marion’ blackberry plants that was established using tissue-cultured plants in 1993 at the North Willamette Research and Extension Center. At that time, 128 of the 280 plants tested positive for RBDV. In 2000, 130 of the 280 plants tested positive for RBDV. In 1999 and 2000 we evaluated the impact of RBDV on the production of ‘Marion’. RBDV had no effect on cane growth or fruit number, but reduced yield (40 to 50%), fruit weight (23 to 40%), and drupelet number per fruit (36 to 39%) compared to uninfected plants. In 2000, we surveyed 32 commercial fields to test for the presence of RBDV using ELISA. The locations of sampled fields were selected to reflect the acreage distribution of ‘Marion’. Three grower fields tested positive for RBDV. We are continuing to study the rate of spread of this virus in ‘Marion’ at the research plot and in commercial fields.

INTRODUCTION

Oregon is the world’s leading blackberry production region with 3,130 hectares and 23,572 tonnes harvested in 2000. Over 92% of the total production is processed. ‘Marion’ trailing blackberry (Finn et al., 1997) accounts for 57% of the hectareage planted. The next most commonly planted blackberry is ‘Boysen’ (a raspberry-blackberry hybrid; 19%), followed by ‘Thornless Evergreen’ (Waldo, 1977) or ‘Everthornless’ (McPheeters and Skirvin, 2000) with 17% of the planted area.

Raspberry bushy dwarf virus (RBDV), a seed- and pollen-borne virus (Murant et al., 1974), is relatively common in raspberry fields in the Pacific Northwest (Oregon, Washington, and British Columbia, Canada) (Martin, 1999). RBDV was found in 84% of ‘Meeker’ red raspberry fields tested in northwestern Washington and southwestern British Columbia with most of those fields having greater than 50% infection (Martin, 1999). There is very little commercial production of blackberries in Washington or British Columbia. In southern Washington and Oregon, 16% of ‘Meeker’ fields tested had RBDV with none having infection greater than 50% (Martin, 1999). However, RBDV infection was found in 88% of the commercially cultivated black raspberry ‘Munger’ (*Rubus occidentalis* L.) fields tested with most of those having high levels of infection. In contrast, native black raspberry (*R. leucodermis* Douglas ex Torr. and A. Gray) plants adjacent to infected commercial ‘Munger’ fields tested negative for RBDV (Martin, 1999). Finn and Martin (1996) reported no RBDV infection in *R. leucodermis* seedlings grown from seeds collected from wild coastal and mountain plantings.

Symptoms of RBDV infection in red raspberry have varied from none (Converse, 1973), to the production of crumbly fruit (Murant et al., 1974) and reduced yield (Daubeny et al., 1978, 1982) and cane growth and yellow leaf color (Converse and Casper, 1977; Daubeny et al., 1982).

In the United States, the only blackberry reported to be infected with RBDV was ‘Boysen’ and it was symptomless (Converse, 1973). No RBDV infection was found in clonal or seed propagated wild blackberry (*R. ursinus* Cham. & Schlechtend.) or in *R. armeniacus* Focke collected from wild coastal and mountain plantings (Converse and

Bartlett, 1979; Finn and Martin, 1996). In New Zealand, RBDV was widespread in commercial 'Boysen' plantings (Wood, 1995). Also, leaf chlorosis and vein clearing occurred in RBDV-infected 'Marion' and 'Ollalie' blackberry plants, but no fruit quality or yield effects were studied (Jones et al., 1982).

In 1997, sampling for RBDV at the North Willamette Research and Extension Center (NWREC; Aurora, Oregon) found 50% of 'Marion' blackberry plants infected in a planting established in 1993 from tissue-cultured plants. The objectives of this study were to determine whether RBDV affects plant vigor, yield or fruit quality of 'Marion' blackberry and to look at its prevalence in commercial fields.

MATERIALS AND METHODS

This study was conducted in a mature 'Marion' planting at the NWREC partially infected with RBDV. Plants that were tested in 1997 and 1998 were re-tested for RBDV in the spring of 1999 and 2000 to confirm the RBDV status of plants. Triple antibody sandwich enzyme-linked immunosorbent assay (TAS-ELISA) was used to detect RBDV (Martin, 1999). Seventeen and 15 infected and non-infected, paired, side-by-side plants were selected for this study in 1999 and 2000, respectively. After fruit harvest in 1999 and 2000, the RBDV status of each plant was reconfirmed by repeat ELISA testing of each plant.

Plants were trained in August, 1998 and 1999 such that individual plant yield could be obtained in 1999 and 2000. On June 30 1999, the total number of primocanes/plant was counted; two long and two short, representative canes were measured for length and a weighted mean calculated. On June 21 2000, total primocane number and total length/plant were determined. In 1999 and 2000, fruit were hand harvested about every 5 days from each plant. A 50-berry sub-sample was weighed from each harvest to obtain average berry weight in each year; a weighted average berry weight was calculated. Ten of the 50 berries were sub-sampled and total drupelet number counted in each year. Data were analyzed using a SAS, t-test for each year (Version 6.2, SAS Institute Inc., Cary, NC, USA).

A grower survey was done in 2000. Thirty-two commercial 'Marion' fields were sampled, 72 leaflets, in groups of three, per field were tested for the presence of RBDV using ELISA. The location of sampled fields was selected to reflect the acreage distribution of 'Marion' or based on the occurrence of suspect symptoms.

RESULTS

Impact of RBDV on 'Marion'

There was no effect of RBDV on cane number or length in either year (data not shown). Yield was low in 1999, even on uninfected plants, due to winter damage. However, RBDV infected plants had reduced yield (50%), berry weight (40%), and drupelet number per berry (39%) (Table 1). There was no effect of RBDV infection on fruit number. Yield of uninfected plants was 23 times greater in 2000 than in 1999, as there was no winter cold injury in 2000. In 2000, RBDV-infected plants had reduced yield (40%), berry weight (23%), and drupelet number (36%) (Table 1). In our 'Marion' planting that was established using tissue-cultured plants in 1993, testing all 280 plants in the plot in August 2000 using ELISA showed that 130 plants (46%) were infected with RBDV. In both years, visual symptoms of RBDV infection were apparent in 'Marion'. Some primocane leaves showed chlorosis and vein clearing particularly later in the growing season, fruiting lateral leaves were often chlorotic and were silver in color on the abaxial surface, and fruit were malformed and small on infected plants. Newly infected plants seemed to show intermediate symptoms with fruit showing slight malformation.

Incidence of RBDV in Commercial 'Marion' Fields

Of the 32 commercial 'Marion' blackberry fields sampled, 3 tested positive for RBDV. All the fields tested were more than 15 years old. Of these infected fields, one had

red raspberries planted close by, another had red raspberries located about 0.5 km away, and the third was propagated using tip-rooted plants from a known infected field. The RBDV-infected 'Marion' fields had only a low level of incidence of infection.

DISCUSSION

Our results show that RBDV-infection has no effect on cane growth in 'Marion' blackberry, unlike reports for some red raspberry cultivars (Converse and Casper, 1977; Daubeny et al., 1978, 1982) or fruit number. RBDV infection reduced yield (40 to 50%), berry weight (23 to 40%), and drupelet number per fruit (36 to 39%). Thus, RBDV infection in 'Marion' has an effect on yield and quality similar to what has been reported in some red raspberry cultivars (Daubeny et al., 1978, 1982; Murrant et al., 1974).

Our survey of the commercial 'Marion' blackberry industry in Oregon has shown that RBDV is present in some grower fields. The fields that did have RBDV only had a low level of infection. This suggests several possibilities: first, the virus has been in 'Marion' for quite sometime and moves very slowly in this crop; or second, there has been a recent mutant of RBDV that now is able to infect 'Marion' blackberry. 'Marion' blackberry has been grown for 40 years and the symptoms are so dramatic that growers would likely have noticed the disease if it had been around for a long time. However, although almost 50% of a tissue-culture established 'Marion' planting at the NWREC was infected four years after planting, there was essentially no spread of the virus from 1997 to 2000. It is possible that RBDV does not move rapidly in 'Marion' in most years.

It will be necessary to learn more about the rate of spread of RBDV in commercial situations to get a better idea of the impact of this virus. However, considering the large effect RBDV has on the yield and quality of 'Marion', this is a virus to monitor closely in this crop.

ACKNOWLEDGEMENTS

We acknowledge the support of the Oregon Raspberry and Blackberry Commission and the assistance of Sophie Somnard and Caroline Godard (Interns, INA P-G, France), Jason Lett (former Research Assistant, NWREC) and Gil Buller (Research Assistant, NWREC).

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Tables

Table 1. The effect of RBDV infection on yield, fruit weight and drupelet number of 'Marion' trailing blackberry in 1999 and 2000.

Treatment	Total yield (kg/plant)	Fruit weight (g)	Drupelet no./fruit	Fruit number^z
1999				
<i>RBDV</i> -infected	0.13	1.7	36.6	51.4
Non-infected	0.25	2.9	59.8	58.9
Significance ^y	**	***	***	NS
2000				
<i>RBDV</i> -infected	3.43	3.3	38.7	—
Non-infected	5.65	4.3	60.7	—
Significance ^y	***	***	***	—

^zAn average of fruit number per plant on the first and third harvest in 1999; no data collected in 2000

^y** , *** , NS: significant at P<0.01, 0.001, non-significant