EFFECT OF PRIMOCANE RENOVATION ON YIELD COMPONENTS OF 'MARION' BLACKBERRY

Neil C. Bell and Bernadine C. Strik. Department of Horticulture, Oregon State University, ALS 4017, Corvallis, OR 97331-7304

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Abstract

In 1991, primocanes were cut at ground level from plants on a single occasion at one month intervals from late April to late July, with an uncut control included. Four canes per plant were either trained during August 1991, or in February 1992, with all other canes on the plant removed and measured. Yield components were measured separately on basal, middle, and terminal sections of each cane after harvest in 1992.

Yield per cane of renovated plants declined compared to the control, but cane number per plant was doubled for April-, May-, and June-renovated plants. Consequently, whole plant yield of April- and May-renovated plants was higher than control plants. Total branch cane length per plant declined and percent budbreak increased with later renovation date.

Yield of August-trained plants was 35% higher than February-trained due to a higher percent budbreak and a greater number of fruit per main cane lateral. The basal section of canes was the most productive in all renovation dates, because of more productive branch canes, a higher node number and increased percent budbreak.

1. Introduction

Approximately 98% of the blackberry hectarage in Oregon is planted with cultivars having a trailing growth habit. The most important of these is 'Marion', which accounts for over 50% of the blackberry hectarage in the state and continues to be widely planted (Strik, 1992). Although 'Marion' is a vigorous cultivar with excellent fruit quality, yields in many growers' fields are often disappointingly low. The possibility of alternative systems of primocane suppression is of interest as a means to increase yields and stabilize production.

Yield of red raspberry can be significantly increased by removing the first flush of primocanes from plants (Freeman and Daubeny, 1986; Waister et al., 1977). The increased yield was associated with specific changes in yield components such as fruit size and fruit number per lateral (Freeman et al., 1989). Increased yield as a result of primocane suppression has also been demonstrated in trailing blackberry (Sheets and Kangas, 1972).

Studies in red raspberry have shown that timing and frequency of primocane removal can have a major impact on the productivity of plants in subsequent years (Freeman and Daubeny, 1986). Removing canes too late can cause a particularly swift and severe decline in vigor (Lawson and Wiseman, 1983). If primocanes are not suppressed, then potential yield increases are forfeited, and the longer canes become a nuisance for either hand or mechanical harvest.

The present study was undertaken to examine the effect of different primocane removal dates and training time on the productivity of individual canes and whole plants of 'Marion' blackberry.

2. Materials and Methods

A seven-year-old planting of 'Marion' blackberry on a Latourell loam soil at the North Willamette Research and Extension Center near Aurora, Oregon was studied. Plants were spaced at 2.44 m within rows spaced 3.05 m apart. The trellis consisted of posts with two horizontal wires at 1.20 m and 1.52 m. Pest management and fertilization followed standard commercial practice. Five primocane removal treatments were randomly assigned to two-plant plots. Each of the two plants in the plots was then assigned to one of two training-time treatments. The experiment was a completely randomized design with five replications.

The primocane removal treatment involved cutting all primocane growth at ground level with pruning snippers (Lawson and Wiseman, 1983). Canes on both plants in each plot were removed on a single occasion on one of four dates spaced at one month intervals, beginning in late April 1991. A control treatment was included in which primocanes were not cut. These treatments are referred to as April-, May-, June-, and July-renovated, or unrenovated, respectively. After removing primocanes on each date, all primocanes subsequently produced by the plants in those plots were allowed to grow for the rest of the season.

One plant in each plot was trained on the trellis in late August 1991, while canes of the other plant were allowed to lie on the ground through the winter and were trained before budbreak in late February 1992. The August, or summer-trained treatment, was not possible with July-renovated plants, since the new growth on these plants in late August was not long enough to reach even the bottom wire of the trellis. Four canes were trained from each plant and all others were removed, counted and measured for both main cane and branch cane length.

Total yield per plant, fruit size and drupelet number per fruit were measured during harvest in 1992. On July 20, the four canes on each treatment plant were unwrapped from the trellis and separated. Cane diameter at 30 cm from the base and total main cane length were measured. Each cane was then divided into equal length basal, middle and terminal sections. All of the following yield component data were collected by cane section: node number, number of nodes with a fruitful lateral or branch cane, lateral length and number of fruit per lateral were measured on the main cane. The branch canes for each section were similarly measured for length, number of nodes, number of nodes with a fruitful lateral, lateral length and number of fruit per lateral.

Analysis of variance (SAS, 1987) was used to compare the main effects of primocane removal date and training time and their interaction. Mean separation was done using the Waller-Duncan K-ratio test. Data on cane section are presented as means with standard errors only, as the treatments were not randomly assigned to the canes and so these data were not suitable for statistical analysis.

3. Results

3.1. Primocane removal date

Cane diameter and main cane length decreased linearly with later renovation date (table 1). However, because cane number was increased in all renovated plants, total main cane length per plant was highest for April-renovated, followed by May- and June-renovated plants. Branch cane production, however, was greatest on the unrenovated plants and tended to decline linearly with date of renovation. July-renovated plants tended not to produce branch canes (table 1). Node number per cane was similar for unrenovated, April- and May-renovated plants, but lower for the later primocane removal dates (data not shown).

Over 70% of the basal fruit of unrenovated plants was on branch canes and 40% of terminal fruit (data not shown). The contribution of branch canes for each cane section of April and May-renovated plants ranged from 10% to 25% of total yield. Branch cane productivity was negligible for later dates of renovation.

Percent budbreak on main canes increased with later primocane removal date (table 1). There were no significant differences among treatments in either main cane lateral length or branch cane lateral length. The number of fruit per lateral on either main canes or branch canes showed no particular trend with renovation date (data not shown). Trends in drupelet number and fruit size were comparable with both being highest for the April-renovated and lowest for the July-renovated plants (data not shown).

Yield per plant (four cane) declined linearly with later renovation date, indicating that productivity per unit length of the individual canes declined as the growing season was effectively shortened. Yield per meter of cane was highest for unrenovated plants and lowest for July-renovated plants, with the other treatments similar and intermediate (table 1). However, because total main cane length per plant was much increased by renovation, April-renovated plants had the highest potential yield, followed by the May-renovated plants. Unrenovated and June-renovated plants gave somewhat smaller, similar potential yields, followed by the July-renovated plants (table 1).

3.2. Training time

Training time had a significant effect on yield, with August-trained plants producing 35% more than February-trained over all primocane renovation treatments (table 2). There was also a tendency for summer-trained plants to produce a greater percentage of yield early in the season, particularly in early-renovated plants. Summer-training also significantly increased main cane length, percent main cane budbreak, and the average number of fruit per main cane lateral (table 2).

3.3. Cane section

Yield was highest for basal sections across all renovation treatments (data not shown). The most fruitful main cane laterals for each treatment were found in either the basal or middle parts of the canes, and the terminal laterals were less

productive. This trend was not apparent for July-renovated plants, which showed similar productivity in all cane sections (data not shown). The basal cane section was the most productive due to higher node number and percent budbreak (table 3). Also, branch canes arising in the basal section of the main cane had a higher percent budbreak, longer laterals and more fruit per lateral than those arising in middle or terminal sections (table 3)

4. Discussion

4.1. Primocane removal date

The effect of renovation date on cane length was consistent with the results of Lawson and Wiseman (1983), who found that early removal of primocanes had no effect on final cane length of red raspberry, but that later removal, particularly after the canes reached 60 cm, resulted in drastic reductions in total length. However, the estimates of potential yield in this study reflect the contrasting effect that mechanical primocane suppression has on red raspberries and blackberries. In the case of raspberry, cutting primocanes results in a reduction in cane production, but an increase in productivity per unit length (Lawson and Wiseman, 1983). The increase in individual productivity in raspberry is due to an increased number of nodes and a larger number of berries per lateral (Lawson and Wiseman, 1983).

In the case of blackberry, increased yield from primocane removal resulted from the production of many more canes whose individual productivity was reduced. At least in the first year of this experiment, the increase in cane number was more than sufficient, in three of the four cane removal treatments, to compensate for the significant decline in productivity per unit length. The most important reason for the decline in per-cane yield with renovation is the reduction in branch cane length. Branch canes contributed tremendously to the total fruit number in unrenovated plants, particularly in the basal cane section.

The increase in percent main cane budbreak with later renovation date is surprising given that in red raspberry large-diameter canes have a higher percent fruit set than thinner canes (Crandall et al., 1974). In 'Marion' however, large sections of cane on unrenovated plants were often found to be barren of laterals or branch canes. Failure of the buds was perhaps the result of within-cane competition between branch canes and main cane buds. This situation may also be analagous to the growth of multiple fruiting laterals at individual nodes in red raspberry, whose development tends to be accompanied by a reduction in percent budbreak (Jennings, 1979). The increase in percent budbreak with later renovation date may also have been partly due to a reduction in pest and disease pressure. A measurement of pest and disease problems was not done on the canes in this experiment, but observation alone suggested that cane disease, particularly purple blotch (*Septocyta ruborum*), was reduced on later-renovated plants.

4.2. Training time

The increased percent main cane budbreak and fruit number per main cane lateral found in summer-trained plants may be the result of two factors, the improved light exposure of canes trained on the wire versus those left on the

ground until February, and a less favorable environment for the development of fungal disease and pests. Swartz et al. (1984) attributed yield increases of V-trellised blackberries to the improved light exposure of primocanes. Studies on grapes have shown that variation in the yield from node to node along the cane can be partly explained by differences in illumination of the leaf subtending the node the previous year (Smart et al., 1982).

4.3. Cane section

The productivity of the basal cane section in 'Marion' relative to other sections for all primocane removal treatments is in contrast to studies on red raspberry which show that the number of fruiting sites increases with cane height (Crandall et al., 1974; Gundersheim and Pritts, 1991). The increased productivity of basal sections in 'Marion' was the result of a combination of higher node number and increased budbreak, and, in some cases, a higher number of fruit per lateral. The decrease in percent budbreak with increasing cane height is in contrast to the observations of Jennings (1987), who suggested that the success of buds at different levels of the red raspberry cane were due to their size differences. Buds on the terminal sections of the raspberry cane were larger than those near the base, an effect attributed to the pattern of flower bud initiation, which started at the distal end of the cane. This pattern was considered to favor bud size and consequently vigor at the terminal part of the cane. The size of buds in different cane sections was not measured in this experiment. However, basal branch canes were at least as vigorous, or more vigorous, than those in other sections of the cane, and the superior productivity of basal main cane laterals in the renovated treatments has already been noted.

4.4. Summary

Mechanical suppression of primocanes in late April or late May caused an increase in potential yield per plant of 'Marion' blackberry relative to an unrenovated control. The increased yield of April- and May-renovated plants was the result of a larger number of canes, whose individual productivity was reduced relative to that of the unrenovated plants. Individual canes of unrenovated plants were the most productive on a per-meter basis, mostly because of significantly greater branch cane production. Training canes in August resulted in a significant yield increase over February training. The increased yield was the result of longer main canes, higher percent budbreak, and more fruit per main cane lateral. The basal cane section was the most productive for all dates of primocane suppression. The most productive branch canes were located in the basal cane section, followed by the terminal cane section.

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Table 1. **Effect of primocane removal date on yield components of 'Marion' blackberry (averaged across training time and cane section).**

Treatment	Cane No.	Cane Diam. (mm)	Main Cane Length (m)	Main Cane Budbreak (%)	Branch Cane Length/Plant (m)	Yield/Cane (kg/m)	Potential Yield/Plant (kg)
Unrenovated	10.3c[y]	10.7a	4.59a	27	52.7a	0.43a	15.48c
April	19.4a	7.5b	4.44a	38	41.6b	0.31b	20.87a
May	18.8ab	7.1c	3.74b	41	27.8c	0.33b	18.51b
June	20.0a	6.4d	3.12c	52	8.5d	0.31b	15.28c
July	15.8b	5.6e	2.13d	48	0.1e	0.21c	6.57d
Sig.[z]	**	**	**	**	**	**	**

[z]Significant at $P = 0.01$.

[y]Means followed by the same letter within columns are not significantly different.

Table 2. **Effect of training time on yield components of 'Marion' blackberry (means are averaged across primocane removal treatments and cane section).**

Training Time	Yield/4 Cane Plant (kg)	Potential Yield/Plant (kg)	Main Cane Length (m)	Main Cane Budbreak (%)	Fruit/Lateral
August	6.73	20.15	4.38	46	6.8
February	4.13	14.92	3.57	33	5.7
Sig.[z]	**	**	**	**	**

[z]**, significant at $P = 0.01$.

Table 3. **Yield components of basal, middle, and terminal cane sections of 'Marion' blackberry (means are averaged across primocane removal treatments and training time).**

Cane Section	Main Cane Node No.	Main Cane Budbreak (%)	Branch Cane Budbreak (%)	Branch Cane Lateral Length (m)	Branch Cane Fruit/Lateral
Basal	24.5 ± 0.5[z]	46 ± 1.4	41 ± 1.4	0.33 ± 0.01	6.1 ± 0.2
Middle	20.4 ± 0.5	40 ± 1.4	36 ± 2.7	0.29 ± 0.01	5.5 ± 0.3
Terminal	21.8 ± 0.6	37 ± 1.4	32 ± 2.3	0.28 ± 0.01	5.2 ± 0.3

[z]Mean ± standard error.