EFFECT OF DIFFERENT CROP LOAD MANAGEMENT STRATEGIES ON FRUIT PRODUCTION AND QUALITY OF SWEET CHERRIES (*Prunus avium* L.) ‘LAPINS’ IN CENTRAL CHILE

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A B S T R A C T

A study was carried out during 2007 in the Maule Region of Chile to evaluate the effect of increasing levels of manual thinning at three intensities (15%, 30% and 50%) on fruit yield and quality (fruit size, weight, firmness and soluble solids content) of sweet cherries (*Prunus avium* L.) ‘Lapins’. The study evaluated manual removal of entire fruiting spurs (extinction training), individual fruit buds on the spur, individual blossoms on the spur and individual fruits on the spur.

Fruit size distribution was positively affected by the thinning treatments and in most cases yield was not affected by these treatments. Fruit which was not of fresh market quality (< 21 mm) was reduced by the thinning. The control had 82% non market quality fruit. A 50% removal treatment reduced small fruit to very low levels and the yield of premium fruit (diameter > 28 mm) was also promoted. Manual thinning arises as a practical approach for improving fruit size distribution.

Key words: extinction training, blossom thinning, fruit size distribution

INTRODUCTION

Chilean cherry production has been changing during the last 10 years. These changes have involved an increase in the cultivated area, orchard density, and introduction of new self-fertile varieties, semi-dwarfing or dwarfing rootstocks and the adoption of new training systems such as the “Solaxe” system, among others.

Yields have dramatically increased, but in many cases the rise in productivity without appropriate canopy and crop load management have produced trees that yield high crop loads but small fruits (Whiting and Ophardt, 2005; Whiting et al., 2006).

Fruit size is a very important quality attribute and in the export market the larger the fruit the higher the returns. Fruit size is a factor that may determine the future viability of an orchard. Traditionally cherry crop load is managed by dormant or summer pruning. This approach, however, may be insufficient for combinations of tree/rootstock that yield heavy loads with small fruits and can reduce the supply of assimilates for fruits. Alternatives like chemical blossom thinning are under investigation. Further studies are required before effective recommendations can be made. Manual thinning of different productive structures arises as an alternative to be studied.

The aim of this research was to evaluate the effect of increasing levels of manual thinning on fruit yield and quality (fruit size weight, firmness and soluble solids content) of sweet cherries (*Prunus avium* L.) 'Lapins' in Central Chile. The thinning applied involved removal of entire fruiting spurs (extinction training), individual fruit buds on the spur, individual blossoms on the spur and individual fruits on the spur.

The removal of fruiting spurs from side branches has been suggested as a training tool for improving the balance between vegetative growth and fruit load in cherry trees (Claverie and Lauri, 2005). Extinction has proven to have a more interesting effect on crop load and fruit size than conventional renewal pruning on various cultivars, such as 'Summit'. Conventional renewal pruning offers a persistent effect in the year following treatment. As a general trend, the spacing between spurs brought about by spur thinning leads to an increase in fruit size and colour and a decrease in brown rot incidence (Lauri, 2005). Very little scientific testing of different crop load management strategies have been carried in Chile. No reports were found that compare the removal of buds, spurs, blossoms and fruits with non-removal.

MATERIAL AND METHODS

Plant material and experimental design

The study was carried out in 2007 in the Maule Region of Chile (34.6ºS, 71.1ºW). Plant material consisted of 'Lapins' sweet cherry trees, planted in 2004 on 'Maxma 14' rootstock and spaced 2.5 × 4.5 m in north to south rows. Trees were trained to a Solaxe system. The soil was a very fine sandy loam from the Andisol order, 80 cm depth. Soil mineral analysis showed the following results: available N, 58 ppm; K 221, ppm; P, 20 ppm; pH 6.5; O.M 4.3%; EC 1.2 dS m^{-1}. Trees were irrigated weekly from November to late March using under-tree micro-sprinklers. Standard orchard management practices (irrigation, fertilization, pest and weed control, and dormant pruning) were performed every year. Trees were selected for the experiment on the basis of uniform vigor and development and were assigned to a complete randomized design. Analysis of variance was conducted using the JMP program package and means were compared using the Tuckey´s test at p = 0.005.

Thinning treatments consisted of a control and removal at three intensities (15%, 30% and 50%) of: entire fruiting spurs (FS1, FS2, FS3), individual fruit buds on the spur (FB1, FB2, FB3), individual blossoms on the spur (B1, B2, B3) and individual fruits on the spur (F1, F2, F3). Time of removal was decided according to the growth stages of the cherry fruit trees and is given as BBCH codes (Meier et al., 1994). The removal of entire fruiting spurs was carried out at BBCH 51 stage, individual fruit buds on the spur (BBCH 51 stage), blossoms at the full bloom stage (BBCH stage 65) and fruits (BBCH 72). Removal of different organs was done on three selected scaffold branches for each tree. Branches were selected on the basis of uniform length, diameter and spur number.

Yield and fruit quality

Fruit were harvested on 12 December 2006 (82 DAFB) from three selected productive branches per a tree. Fruit number and yield were recorded and results were expressed as kg of fruit per linear meter of a branch. From each tree, 100 randomly sampled fruit were evaluated at room temperature for mass, diameter (fruit size and fruit size distribution), firmness (electronic durofel), soluble solids content and titratable acidity.

RESULTS AND DISCUSSION

Fruit yield. In most cases yield was not affected by the treatments (Tab. 1). These results do not agree with those reported by Whiting et al. (2005). They found that removal of blossoms and fruiting spurs at an intensity of 50% reduced the fruit number and fruit yield in ‘Bing’ sweet cherry trees on Gisela 5 and Gisela 6. The results of Whiting et al. (2005) suggest that at a thinning target of 50% or less (in the case of removal of entire fruiting spurs, individual fruit buds on the spur, individual blossoms on the spur) fruit set and drop were not affected significantly by thinning, despite altered source-sink relations.

Fruit weight was increased in all treatments with 30 and 50% intensity of removal but not in the case of 15% of removal. These data partly confirm the results of Whiting et al. (2005) concerning the increase in fruit weight of manually thinned trees. Our data disagree with the report of negative effects on fruit weight by Lenahan and Whiting (2006).

Fruit size. Results are presented in Table 1 and in Figures 1 and 2. Average fruit size was affected in most cases only at the 50% of removal intensity. Compared to the control, there was an increase in fruit diameter of FS3: 17%, FB3: 24.7%, B3: 20.2% and F3 13.4%. These results agree with

Table 1. Fruit yield and quality parameters of sweet cherries 'Lapins'

Treatment	Yield [kg fruit m^{-1} branch linear meter]	Fruit diameter [mm]	Fruit weight [g]	Fruit size [mm]
Control	1.24 a*	22.3 g	6.7 h	22.3 g
FS1	1.11 abc	22.5 fg	7.4 gh	22.5 fg
FS2	0.98 bc	23.8 efg	8.2 efg	23.8 efg
FS3	1.00 abc	26.1 bc	10.0 bc	26.1 bc
FB1	1.06 abc	22.4 g	7.1 h	22.4 g
FB2	1.22 a	24.6 de	8.8 de	24.6 de
FB3	1.05 abc	27.8 a	11.1 a	27.8 a
B1	1.24 a	22.9 fg	7.4 gh	22.9 fg
B2	1.22 a	23.7 efg	8.4 def	23.7 efg
B3	1.09 abc	26.8 ab	10.3 ab	26.8 ab
F1	1.02 abc	22.4 fg	7.4 fgh	22.4 fg
F2	0.95 c	24.0 efg	8.2 efg	24.0 efg
F3	1.05 abc	25.3 cd	9.3 cd	25.3 cd

*Means followed by the same letter do not differ at p = 0.05 according to Duncan's multiple range t-test

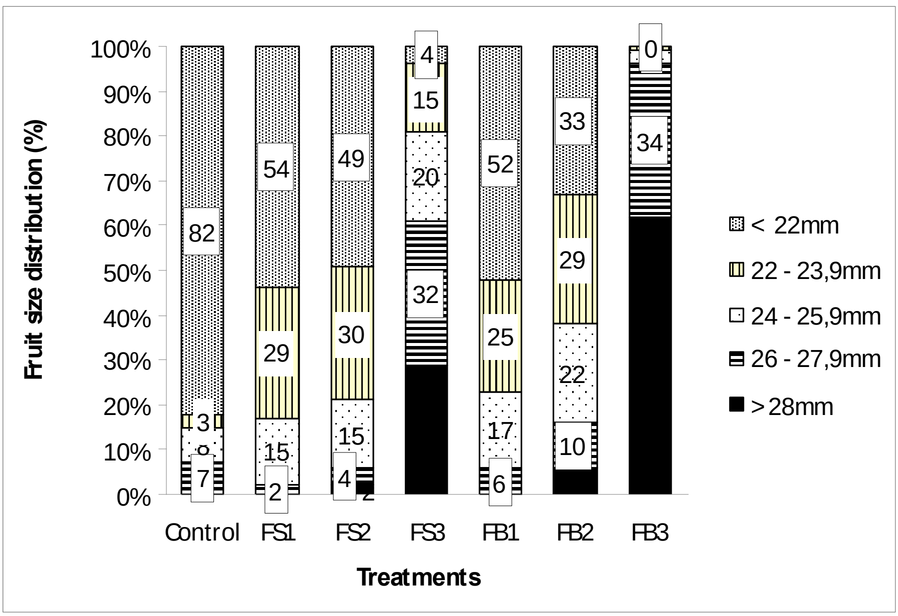

Figure 1. Fruit size distribution of sweet cherries 'Lapins'

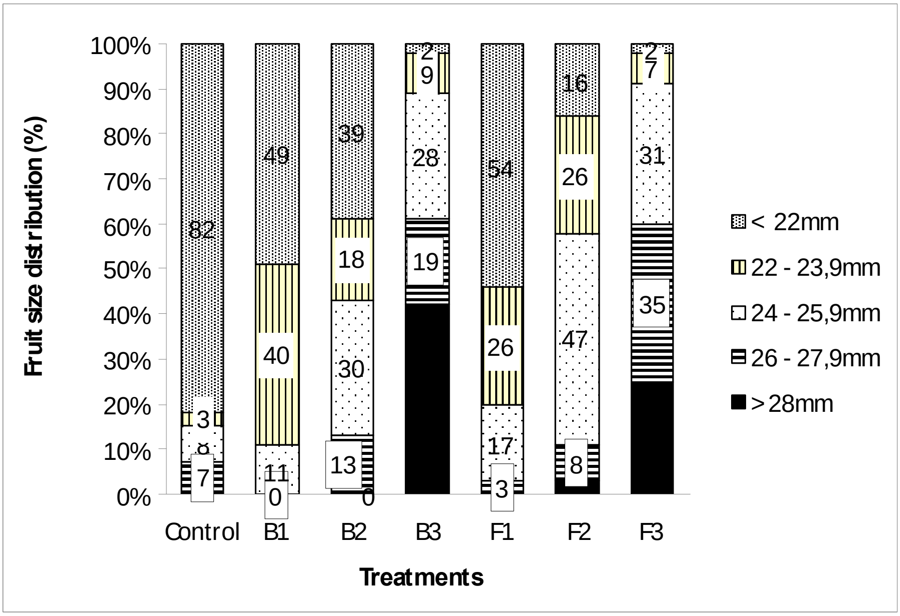

Figure 2. Fruit size distribution of sweet cherries 'Lapins'

those of Lauri (2005) and Whiting and Ophardt (2005) who recorded an increase of 2% to 10% of fruit diameter in thinned trees (50% of blossoms and 50% of fruiting spurs).

Fruit size distribution was markedly affected by treatments (Figs 1 and 2). Fruit which was not of fresh market quality (21 mm) was reduced in all treatments. Eighty two per cent of the fruit of the control was not of fresh market quality. Treatments of a 50% removal intensity greatly reduced the amount of small fruit. At the 50% of removal intensity, the yield of premium fruit (diameter 28 mm) was also promoted (29% in FS3, 62% in FB3, 42% in B3 and 25% in F3). It was only in treatments FS2 and F2 that the increase in fruit size distribution was accompanied by a slight decrease in fruit yield.

Firmness and titratable acidity were not affected in most cases. Soluble solids content was reduced when entire fruiting spurs and individual fruit buds on the spur were removed (Tab. 2).

CONCLUSIONS

Manual removal arises as a practical approach for improving fruit size distribution.

Fruit size distribution was positively affected by treatments with removal and in most cases yield was not affected by these treatments. Treatments at the 50% of removal intensity greatly reduced small fruit and the yield of premium fruit was greatly improved.

Table 2. Fruit quality parameters of sweet cherries 'Lapins'

Treatments	Firmness [0-100 Durofel units]	Soluble solids [°Brix]	Tritable acidity [%]
Control	76.9 ab*	19.0 a	0.7 a
FS1	79.5 a	17.2 bc	0.8 a
FS2	77.1 ab	17.6 bc	0.8 a
FS3	78.0 a	17.9 bc	0.7 a
FB1	78.7 a	17.5 bc	0.8 a
FB2	78.6 a	17.7 bc	0.8 a
FB3	70.5 a	18.5 ab	0.7 a
B1	76.1 c	18.1 abc	0.7 a
B2	75.2 ab	18.0 abc	0.8 a
B3	71.8 abc	18.4 ab	0.7 a
F1	75.1 bc	18.3 abc	0.8 a
F2	76.3 abc	17.9 bc	0.7 a
F3	72.5 bc	18.5 ab	0.7 a

*Explanations: see Table 1

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WPŁYW RÓŻNYCH SPOSOBÓW PRZERZEDZANIA NA PRODUKCJĘ I JAKOŚĆ CZEREŚNI (*Prunus avium* L.) 'LAPINS' W REGIONIE ŚRODKOWYM CHILE

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S T R E S Z C Z E N I E

W roku 2007 wykonano badania w regionie Chile – Maule w celu określenia wpływu trzech intensywności przerzedzania (15%, 30% and 50%) na plon czereśni (*Prunus avium* L.) odmiany 'Lapins' oraz na jakość owoców (ich rozmiar, ciężar i jędrność oraz rozpuszczalność substancji stałych). Oceniane były cztery sposoby przerzedzania: przerzedzanie krótkopędów przed kwitnieniem oraz przerzedzanie pąków kwiatowych, kwiatów i owoców na krótkopędach.

Przerzedzanie miało pozytywny wpływ na średnicę owoców, natomiast w większości przypadków nie miało wpływu na plon. Zabiegi te zmniejszały liczbę owoców o średnicy poniżej 21 mm nienadających się do celów handlowych, które w kontroli stanowiły aż 82%. Przerzedzanie o intensywności 50% zmniejszało liczbę małych owoców, natomiast zwiększało plon owoców wysokiej jakości o średnicy powyżej 28 mm. Ręczne przerzedzanie może być stosowanie w praktyce w celu zwiększenia średnicy owoców czereśni.

Słowa kluczowe: przerzedzanie, średnica owoców