Effect of Prohexadione Calcium on Vegetative and Reproductive Development in Sweet Cherry Trees

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Abstract

Cherry trees display vigorous upright growth, which tends to reduce precocity, flower bud formation and fruit quality. Three trials were performed in the 2010-2011 season on mature 'Lapins' and 'Sweetheart' sweet cherry trees in the Angol area (37°48'50"S, 72°37'36"W). The effects of prohexadione calcium (P-Ca) on shoot growth, leaf area, yield, fruit quality and flower differentiation were assessed. Two rates were evaluated (150 mg L^{-1} and 250 mg L^{-1}), which were sprayed when shoots were 15 cm long and 15 days later or after harvest. The P-Ca treatment reduced the elongation of terminal shoot in both cultivars, which was due to reducing both length and number of internodes, resulting in a reduction in total leaf area. This led to better light penetration and distribution in tree canopies. Applications of P-Ca to shoots 13 to 15 cm in length controlled shoot growth adequately, while the effect was excessive when the spray was repeated after 15 days. No additional effect was detected when the second application was applied after harvest. P-Ca treatments increased the number and size of reproductive buds and the number of floral primordia per bud. The development of floral structures in the buds was more advanced compared to the control. Regarding fruit quality, soluble solids concentration and fruit size there were no significant effect from P-Ca application, while the fruit firmness increased. One single application of P-Ca at 250 mg L^{-1} in spring appears to be the most effective treatment to control vegetative growth, to increase the number of flower buds and to improve fruit firmness.

INTRODUCTION

The use of inhibitors of gibberellin (GA) biosynthesis such as paclobutrazol and daminozide, was effective in controlling shoot growth (Proebsting and Mills, 1976; Ogata et al., 1989). However, due to residues in fruit their use was discontinued. Prohexadione-Ca (P-Ca) primarily inhibits deoxygenases that catalyze distinct steps in the biosynthesis of GAs, while showing also very benign toxicological and ecotoxicological features (Rademacher, 2004). It has been used mainly in apple trees, but for sweet cherry trees it also controls growth (Elfving et al., 2005; Zhang and Whiting, 2011). Its efficacy depends on the application time and rate. Due to low tissue persistence, P-Ca is spray-applied to growing shoots, from where it is translocated primarily acropetally, (Rademacher, 2004) with a short-time effect only when shoot growth is active (Elfving et al., 2005). However, when the application is repeated after 15 days the effect is prolonged (Oróstica, 2003). Another effect of P-Ca is the increase in flower bud density (Ogata et al., 1989; Elfving et al., 2005). In terms of fruit quality the effect is inconsistent (Oróstica, 2003; Guak et al., 2005), although no negative effects were reported.

In this paper we report on the effects of rate and timing of P-Ca application in shoot growth, leaf area, yield, fruit quality and flower differentiation.

MATERIALS AND METHODS

The study was carried out on eight-year-old 'Lapins' and 'Sweetheart' sweet cherry trees grafted onto CAB-6P rootstock and planted at a 3 x 4.5 m spacing, in a