

EFFECT OF THE CO-APPLICATION OF PROMALIN® AT DIFFERENT BUD PHENOLOGICAL STAGES AND NOTCHING AT DIFFERENT DISTANCES ON LATERAL BRANCHING OF THREE SWEET CHERRY CULTIVARS (*Prunus Avium* L.) IN CENTRAL CHILE

E. von Bennewitz, C. Fredes, L. Gutierrez, T. Lošák

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Abstract

BENNEWITZ, E., FREDDES, C., GUTIERREZ, L., LOŠÁK, T.: *Effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on lateral branching of three sweet cherry cultivars (Prunus Avium L.) in central Chile*. Acta univ. agric. et silvic. Mendel. Brun., 2010, LVIII, No. 2, pp. 45–50

A study was carried out during 2005 in the Maule Region of Chile (34.56°S, 71.5°W) to evaluate the effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on lateral branching of three sweet cherry cultivars. Treatments significantly increased total feather length in comparison to the untreated control only in the case of 'Bing'. Total feather growth in these cases was more than double that of control trees. On 'Lapins' treated trees, total number of lateral shoots was in most cases significantly increased. In 'Stella' trees, total feather length and total number of lateral shoots were not affected by treatments.

cherry, branching agents, feather production, plant growth regulator

Chilean cherry production has been changing during the last period of 10 years. These changes have involved an increase in the cultivated area, orchard density, introduction of new self-fertile varieties, semi-dwarfing or dwarfing rootstocks and the adoption of new training system such as the "Solaxe" system (Lauri and Lespinasse, 1998) among others. Canopy formation is very important in fruit trees because the preconditions of early productivity in young trees are a reasonable lateral branching for training scaffold limbs, and a proper balance between elongated and short shoots (e.g. spurs) which have high flowering potential (Buban, 2000). Growers require well-branched maiden trees for planting intensive orchards as feathered trees with wide angled secondary laterals provide earlier and higher yields (Hrotkó et al., 1999). Most of the sweet cherry cultivars exhibit strong apical dominance, particularly in young trees (Elfvig and Visser, 2007). If not

properly managed, scaffold branches and leaders of young trees produce hardly any laterals (Jacyna and Puchała, 2004). Different methods to increase branching have been examined. These methods included disbudding, deblading and notching among others (Neri et al., 2002; Zucconi, 2000; Elfvig and Visser, 2007). Yet branching responses brought by these procedures are often inconsistent (Elfvig and Visser, 2007). The mixture of Benzyladenine (BA) and gibberellic acid isomers (Promalin®) has been used as a branching agent in nurseries and in young cherry tree orchards. Veinbrants and Miller (1981) and Jacyna and Puchała, (2004) reported that Promalin® mixed with latex paint promoted abundant branching in young sweet cherry trees.

Important aspects to be considered at the moment of application are the phenological stage, the correct composition, concentration and timing of spray (Abbott, 1986).

Research has been carried out in Chile to assess the effect of combined cultural and chemical methods to improve the branching effect in cherry trees. The objective of this research was to evaluate the effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on lateral branching of three sweet cherry cultivars.

MATERIALS AND METHODS

Plant material and experimental design

The study was carried out during 2005 in the Maule Region of Chile (34.56°S, 71.5°W). Plant material consisted of 'Lapins', 'Bing' and 'Stella' cherry trees, planted in 2004 on 'Maxma 14' rootstock and spaced 3 × 5 m in north to south rows. Trees were trained to a Solaxe system (Lauri and Lespinasse, 1998). The soil was a very fine sandy loam from the Andisol order, 80 cm depth, pH (6.3), O.M (2.0%), EC (0.3 dS m⁻¹). Trees were irrigated with under-tree microsprinklers weekly from November to late March. Standard orchard management practices (irrigation, fertilization, pest and weed control, and dormant pruning) were followed every year. For each cherry cultivar nine treatments were conducted. Trees were selected on the basis of uniform vigor and development and were assigned to a complete randomized design with 5 tree replicates.

Treatments consisted of a control and the combined application of Promalin® (1,8% w/w of each BA and GA₄₊₇), at three different bud phenological stages and notching at three different regular distances of the middle part of one year old central leader shoots. Notching was carried out with epidermal cuts (1.5 cm long) located 1 cm above buds. Cuts were done at three different bud phenological stages: A, B and C according to Baggiolini (1952) and at three different regular distances (5 cm, 10 cm, 15 cm) of the middle part of one year old central leader shoots (Fig. 1). Promalin® was applied on the cuts as a solution (20 ml l⁻¹) with a brush. After

the application, cuts were covered with a fungicidal wound paint. Control trees were left intact.

The following measurements were carried out at the central segment of the leader (1 m length) – Number of lateral shoots (feather). Feathers were defined as sylleptic shoots. All feathers meeting this criterion were measured. – Total length of feathers (length of feathers per meter of central leader). By length shoots were divided into two groups, above and below 10 cm. Secondary laterals longer than 10 cm are suitable for canopy formation.

The data were processed and analyzed by one-way analysis of variance using the JMP program Package. Means were compared using the Tuckey's test at 0.05.

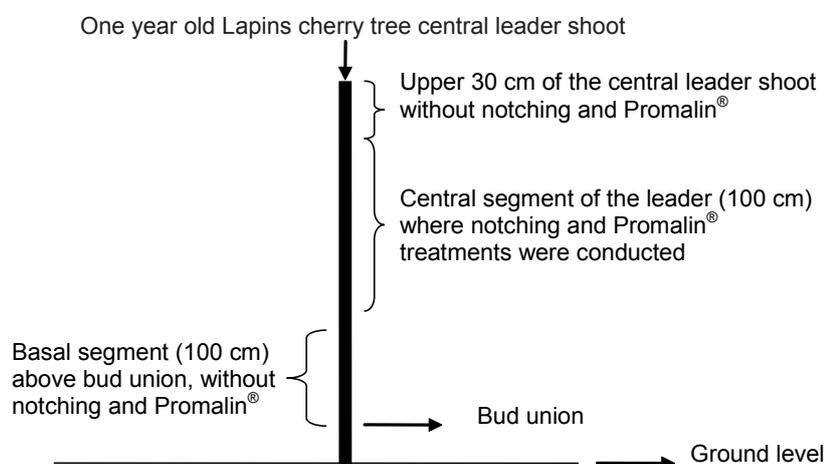
RESULTS AND DISCUSSION

a) Number of lateral shoots (feather)

On 'Bing' trees, the number of lateral shoots was significantly increased in comparison to the untreated control in the case of B5, C5 and C15 (Tab. I). On 'Lapins' treated trees, total number of lateral shoots was in most cases significantly greater in comparison to the control. The phenological stage and the different distances at which notching was carried out didn't seem to play a role for this evaluation. The increase in the number of shoots induced by the application of Promalin® in 'Bing' and 'Lapins' agrees with works by Elfving and Visser (2007) who obtained good results of BA + GA₄₊₇ treatments when the bark of the central leader was purposely injured by notching.

b) Total length of feathers and number of short and long laterals

Treatments significantly increased total feather length in comparison to the untreated control only in the case of C5 and C15 on 'Bing' (Tab. II). Total feather growth in these cases was more than double that of control trees. In 'Stella' and 'Lapins' trees, total feather length was not affected by treatment.



1: High above bud union of 1 year old cherry tree central leader shoots at which treatment with notching and Promalin® were carried out

I: Effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on number of lateral shoots (feather)

Treatments	Cultivar/Rootstock combinations		
	'Bing'/Maxma 14	'Stella'/Maxma 14	'Lapins'/Maxma 14
Control	4.4 c	3.8 a	3.4 c
A*5**	6.6 bc	7.2 a	5.4 abc
A10	8.4 abc	6.2 a	6.0 abc
A15	6.4 bc	6.0 a	7.4 ab
B5	11.6 a	8.8 a	9.2 a
B10	8.6 abc	6.0 a	7.2 ab
B15	7.6 abc	5.0 a	6.0 abc
C5	11.8 a	9.6 a	8.0 ab
C10	8.6 abc	5.6 a	7.2 ab
C15	10.4 ab	7.6 a	4.2 bc

*: A,B,C: Phenological stages (Baggiolini, 1952)

**: 5, 10, 15: Notching at different regular distances (5 cm, 10 cm, 15 cm) of the middle part (1 m) of one year old central leader shoots.

Values marked by the same letters in column are not statistically different ($P \leq 0.05$) according to Tukey's test.

II: Effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on total length of feathers (length of feather (m) per meter of central leader)

Treatments	Cultivar/Rootstock combinations		
	'Bing'/Maxma 14	'Stella'/Maxma 14	'Lapins'/Maxma 14
Control	3.38 b	3.30 a	1.23 a
A5	4.01 b	4.17 a	2.55 a
A10	5.47 ab	5.02 a	3.57 a
A15	5.71 ab	4.81 a	3.43 a
B5	5.98 ab	5.61 a	3.83 a
B10	5.10 ab	3.83 a	4.27 a
B15	6.05 ab	2.82 a	5.12 a
C5	8.13 a	4.53 a	4.96 a
C10	4.61 b	3.71 a	4.54 a
C15	7.81 a	5.63 a	3.31 a

A,B,C: Phenological stages (Baggiolini, 1952)

5, 10, 15: Notching at different regular distances (5 cm, 10 cm, 15 cm) of the middle part (1 m) of one year old central leader shoots.

Values marked by the same letters in column are not statistically different ($P \leq 0.05$) according to Tukey's test.

These data partly confirm the results of Hrotkó *et al.* (1999) concerning the combined application of BA + GA₄₊₇. These authors found out that the combined application of BA + GA₄₊₇ worked well in stimulating total lateral length on one-year-old 'Germersdorfi FL 45' sweet cherry trees in the nursery.

According to these results, the phenological stage C seems to be the most adequate stage for the applications of BA + GA₄₊₇ in order to stimulate total length of feathers.

In most cases no significant differences were detected for the evaluation of number of short laterals (≤ 10 cm) per tree (Tab. III). These results agree with those obtained by Jacyna and Lipa (2008) who didn't found out differences between the treatments

in this shoot length class after the application of BA + GA₄₊₇.

In most cases no significant differences were detected for the evaluation of number of long laterals (> 10 cm) (Tab. IV). Treatment C5 on 'Bing' and 'Lapins' significantly increased the number of long laterals. Again as in the evaluations of total length of feathers, the phenological stage C seems to be the most adequate stage for the applications of BA + GA₄₊₇ in order to stimulate the formation of long laterals.

CONCLUSIONS

Based on results of our trial it is proved that the application of Promalin® is successful in stimulating the number of lateral shoots feathering

III: Effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on number of short laterals (≤ 10 cm) per tree

Treatments	Cultivar/Rootstock combinations		
	'Bing'/Maxma14	'Stella'/Maxma 14	'Lapins'/Maxma 14
Control	1.0 a	0.2 a	0 b
A*5**	1.8 a	1.6 a	1.2 ab
A10	1.6 a	1.2 a	0.6 ab
A15	1.6 a	0.2 a	1.6 ab
B5	1.8 a	1.2 a	2.4 a
B10	1.2 a	1.6 a	1.2 ab
B15	0.6 a	0.4 a	0 b
C5	1.8 a	0.8 a	1 ab
C10	1.0 a	0.6 a	0.6 ab
C15	1.6 a	1.4 a	0 b

*: A,B,C: Phenological stages (Baggiolini, 1952)

** : 5, 10, 15: Notching at different regular distances (5 cm, 10 cm, 15 cm) of the middle part (1 m) of one year old central leader shoots.

Values marked by the same letters in column are not statistically different ($P \leq 0.05$) according to Tukey's test.

IV: Effect of the co-application of Promalin® at different bud phenological stages and notching at different distances on number of long laterals (> 10 cm) per tree

Treatments	Cultivar/Rootstock combinations		
	'Bing'/Maxma14	'Stella'/Maxma 14	'Lapins'/Maxma 14
Control	3.4 b	3.6 a	3.4 b
A*5**	4.8 ab	5.6 a	4.2 ab
A10	6.8 ab	5.0 a	5.4 ab
A15	5.8 ab	5.8 a	5.8 ab
B5	9.8 ab	7.6 a	6.8 ab
B10	7.4 ab	4.4 a	6.0 ab
B15	7.0 ab	4.6 a	6.0 ab
C5	10.0 a	8.8 a	7.0 a
C10	7.6 ab	5.0 a	6.6 ab
C15	8.8 ab	6.2 a	4.2 ab

*: A,B,C: Phenological stages (Baggiolini, 1952)

** : 5, 10, 15: Notching at different regular distances (5 cm, 10 cm, 15 cm) of the middle part (1 m) of one year old central leader shoots.

Values marked by the same letters in column are not statistically different ($P \leq 0.05$) according to Tukey's test.

in the case of 'Lapins' and 'Bing' but not in the case of 'Stella'. Total feather length was stimulated in the case of C5 and C15 on 'Bing' and C5 significantly increased the number of long laterals on 'Bing' and 'Lapins'. Therefore the phenological stage C seems to be the most adequate stage for the applications

of BA + GA₄₊₇ in order to stimulate feathering and feather length.

Results presented here are not consistent enough to suggest any effect of the bud phenological stages and distances of notching on feathering and total length of feathers on 'Stella'.

SOUHRN

Vliv společné aplikace Promalinu® v různých fenologických fázích pupenů a řezu v diferencovaných vzdálenostech na postranní větvení u tří odrůd třešně (*Prunus avium* L.) pěstovaných v centrální Chile

V roce 2005 byl realizován pokus v regionu Maule v Chile (34.56°j.š, 71.5°z.d.) za účelem posouzení společného použití přípravku Promalin® v různých fenologických fázích pupenů a řezu v diferencovaných vzdálenostech na postranní větvení tří různých odrůd třešně. Promalin® je rostlinný sti-

mulátor obsahující gibbereliny ($GA_{4,7}$) a cytokininy (6BA). Signifikantní celkový nárůst postranních větví byl pozorován pouze u kultivaru 'Bing' v porovnání s neošetřenou kontrolní variantou. Celkový vzrůst postranních větví byl v tomto případě více než dvojnásobný v porovnání s kontrolním stromem. Celkový počet laterálních výhonů u ošetřených stromů kultivaru 'Lapins' byl signifikantně zvýšen ve většině případů. V případě kultivaru 'Stella' nebyla celková délka ani počet postranních výhonů ošetřením ovlivněn.

třešeň, větvičí agens, tvorba postranních větví, rostlinné regulátory

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REFERENCES

- ABBOTT, D. L., 1986: A tree physiologist's view of growth regulators. *Acta Hort.*, 179: 293–299.
- BAGGIOLINI, M., 1952: Stade repères du pecher. *Revue Romande d'Agriculture, Viticulture et Arboriculture*, 4, 29 p.
- BUBAN, T., 2000: The use of benzyladenine in orchard fruit growing: a mini review. *Plant Growth Regul.*, 32: 381–390. ISSN 0167-6903.
- ELFVING, D. and VISSER, D., 2007: Improving the efficacy of cytokinin applications for stimulation of lateral branch development in young sweet cherry trees in the orchard. *Hortscience*, 42: 251–256. ISSN 0018-5345.
- HROTKÓ, K., MAGYAR, L. and ÖRI, B., 1999: Improved Feathering on One-Year-Old 'Germersdorfi FL 45' Sweet Cherry Trees in the Nursery. *Gartenbauwissenschaft*, 64: 75–78. ISSN 0016-478X.
- JACYNA, T. and LIPA, T., 2008: Induction of lateral shoots in unpruned leaders of young sweet cherry trees. *Journal of Fruit and Ornamental Plant Research*, 16: 65–73. ISSN 1231-0948.
- JACYNA, T. and PUCHAŁA, A., 2004: Application of environment friendly branch promoting substances to advance sweet cherry tree canopy development in the orchard. *Journal of Fruit and Ornamental Plant Research*, 12: 177–182. ISSN 1231-0948.
- LAURI, P. and LESPINASSE, J. M., 1998: The Vertical Axis and Solaxe Systems in France. *Acta Hort. (ISHS)*, 513: 287–296. ISSN 0567-7572.
- NERI, D., MAZZONI, M., ZUCCONI, F. and DRADI, G., 2004: Feathering control in Sweet Cherry (*Prunus Avium* L.) Nursery, by Deblading and Cytokinin. *Acta Hort. (ISHS)*, 636: 119–127. ISSN 0567-7572.
- VEINBRANTS, N. and MILLER, P., 1981: Promalin promotes lateral shoot development of young cherry trees. *Austral. J. Exp. Agr. A. Husb.*, 21: 618–622.
- ZUCCONI, F., 2000: Selective disbudding for Training dwarfed, early bearing Fruit Trees. *Acta Hort. (ISHS)*, 527: 185–192. ISSN 0567-7572.

Address

Ing. Eduardo von Bennewitz, Ph.D., Ing. Claudio Fredes, M.Sc., Ing. Luisa Gutierrez, Universidad Católica del Maule, Facultad de Ciencias Agrarias y Forestales. Casilla 684, Curicó-Chile. e-mail: evon@ucm.cl, e-mail: cfredes@ucm.cl, doc. Ing. Tomáš Lošák, Ph.D., Ústav agrochemie, půdoznalství, mikrobiologie a výživy rostlin, Mendelova univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, e-mail: losak@mendelu.cz

