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IMPROVING THE FEATHERING OF YOUNG APPLE TREES IN ENVIRONMENT FRIENDLY WAY BY MODIFIED BENZYLADENINE APPLICATION

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ABSTRACT

The inadequate feathering of some apple cultivars can seriously hinder the early formation of the canopy with sufficiently high cropping potential. Feathering in 1-4 year old apple trees can be improved by repeated spraying of Paturyl 10 SL (10% benzyladenine). While carrying out such treatments early in the season on trees with hardly any leaf surface, there are very high losses of spray solution. In order to cut back on the product usage, we decided to apply Paturyl 10 SL as a paint on 1-year-old shoots of young apple trees 'Pinova', 'Gala Must' and 'Golden Reinders'/M.9 in 2001 (2-year-old trees); and 'Akane' and 'Pinova'/MM.106 in 2002 (1-year-old trees).

We prepared various paints (marked as A5, A10, B5, B10 and C10) as mixtures consisting of water, Paturyl 10 SL, Tween-20 (surfactant) and commercially available spraying additives to accelerate the uptake of benzyladenine.

All the treatments effectively enhanced the feathering of young apple trees: significantly more spurs and shoots formed than on the control. As a useful consequence, flowering was also improved a year after treatments.

Key words: apple, benzyladenine, feathering, paint formulation, Paturyl 10 SL

Abbreviations: BA – benzyladenine, GA – gibberellic acid

INTRODUCTION

Early lateral branching of young apple trees is an important factor in selecting properly spaced scaffold limbs, inducing early fruit production, increasing the tree's fruiting surface and early cropping potential and in

reducing the time required to reach full bearing (Unrath and Shaltout, 1985). Several commercially grown apple cultivars produce laterals in insufficient number (e.g. ‘Akane’, ‘Gloster’, ‘Red Rome van Well’, ‘Gala’, ‘Elstar’, ‘Paulared’). Using traditional techniques to promote branching (pruning, tying down shoots, etc.) not always carry satisfactory results, so applying bioregulators that promote feathering may be necessary. Synthetic compounds of cytokinin activity, like benzyladenine (BA) can be effectively used for this purpose. Benzyladenine is applied most often for training canopies of nursery trees (Wertheim and Estabrooks, 1994; Hrotkó et al., 2000; Theron et al., 2000) and young trees in newly planted orchards (Bubán, 2000). Several products containing BA alone or in combinations with other plant hormones (mostly GA_{4+7}) are available on the world market (Bubán, 2000).

In Hungary, the domestic product Paturyl 10 SL (10% BA) is registered for improving the feathering of young (1-4-year-old) apple trees. Paturyl has also been registered for fruitlet thinning in Poland.

Treatments with Paturyl result in more laterals (shoots, spurs) developed from the buds both in the middle and basal section of shoots than typical of the given apple cultivar. This way the cropping potential and flower bud formation are also improved, trees reach full cropping earlier.

Repeated spraying is the traditional way to carry out Paturyl treatments. The first application is scheduled when the terminal buds develop a 3-5 cm long shoot having 3-4 already expanded leaves, followed by two additional sprayings 4-5 days apart. The usual concentration of Paturyl is 0.1-0.2%, and the use of a non-ionic surfactant, like Tween-20 (0.1%) is also necessary.

It is easy to see that while carrying out spraying early in the season on trees with hardly any leaf surface, there are very high losses of spray solution, as only its small fraction reach the target area, most of it lands on the soil surface, or drifts away in the air. In order to cut back on the product usage, we decided to apply Paturyl in an alternative way, as a paint formulation on 1-year-old shoots of young apple trees.

MATERIAL AND METHODS

Experiments were carried out in 2001 and 2002 at the Research Station of Újfehértó. In the first year we treated ‘Pinova’, ‘Gala Must’ and ‘Golden Reinders’ trees grafted on M.9 and planted in the spring of 1999 at the spacing of 3.5 x 1.4 m. For paint formulations we used two commercially available spray additives to improve the adhesion and uptake of benzyladenine. Additives were indicated with letters "A" and "B", and the paints were prepared with the following compositions:

– Treatment A5: 5% Paturyl 10 SL + 9% "A" additive + 1% Tween-20 + 85% water.

– Treatment A10: 10% Paturyl 10 SL + 9% "A" additive + 1% Tween-20 + 80% water.
– Treatment B5: 5% Paturyl 10 SL + 9% "B" additive + 1% Tween-20 + 85% water.
– Treatment B10: 10% Paturyl 10 SL + 9% "B" additive + 1% Tween-20 + 80% water.

Paints were applied with a 1-inch wide paintbrush on both the leader and terminal shoots of lateral branches (2-3 per tree), on April 19, 2001 (at budburst). Untreated 1-year-old shoots were labelled as control. Five trees per plot were treated, each with 4 replicates.

In the second year (2002) we treated 'Akane' and 'Pinova' trees grafted on MM.106 and planted in the spring of 2001 at the spacing of 5.5 x 3 m. For paint formulations we used a third additive (marked „C") to improve the adhesion and uptake of benzyladenine, and prepared the paints with the following composition:

– Treatment A10: 10% Paturyl 10 SL + 9% "A" additive + 1% Tween-20 + 80% water.
– Treatment B10: 10% Paturyl 10 SL + 9% "B" additive + 1% Tween-20 + 80% water.
– Treatment C10: 10% Paturyl 10 SL + 9% "C" additive + 1% Tween-20 + 80% water.

Paints were applied as previously described, on both the leader and terminal shoots of lateral branches (3-4 per tree), on April 5, 2002 (at budburst). Untreated 1-year-old shoots were the control. Five trees per plot were treaded, each with 6 replicates.

To evaluate the effect of treatments the formed laterals were classified in different sections according to their length (leafrosette, short spur: 1-5 cm, long spur: 6-10 cm, new shoots: above 10 cm), counted and their number was calculated per 1 m of treated shoot. Return bloom was also evaluated.

Recorded data were statistically processed with the SPSS 9.0 software by ANOVA, means` separation by Tukey's test.

RESULTS

The cropping potential in apple trees of insufficiently branching cultivars can be significantly enhanced by applying a paint formulation of the branching agent Paturyl. The treatments were effective for all the cultivars tested, which improved the proportion of laterals to the advantage of those longer, more valuable (short and long spurs, shoots) (Tabs 1 and 2, and Figs 1-4).

Table 1. Feathering in trees of three apple cultivars treated with Paturyl paints (Újfehértó, 2001)

Cultivar/ treatment	Number of laterals on 1 m of 2-year-old wood			
	leafrosette	short spur [< 5 cm]	long spur [5-10 cm]	shoot [> 10 cm]
'Golden Reinders' lateral shoot				
A5	0.00 a	9.93	6.25	12.73 bc
A10	0.22 ab	10.82	6.38	11.54 b
B5	0.06 a	11.16	5.11	15.89 c
B10	1.22 b	10.04	4.34	10.51 b
Control	0.80 b	11.64	3.41	9.04 a
	***	n.s.	n.s.	**
'Golden Reinders' leader shoot				
A5	0.30	9.02	4.75	8.31
A10	0.00	10.65	6.88	10.28
B5	0.00	7.88	5.00	11.85
B10	0.11	7.74	4.74	11.26
Control	0.26	11.87	4.46	7.68
	n.s.	n.s.	n.s.	n.s.
'Pinova' lateral shoot				
A5	1.43	10.69 b	5.68 b	14.34 c
A10	1.83	10.49 b	8.58 c	15.87 c
B5	2.22	9.87 b	7.03 bc	13.81 bc
B10	2.65	10.49 b	5.97 b	12.31 ab
Control	2.22	5.86 a	3.82 a	11.01 a
	n.s.	***	***	**
'Pinova' leader shoot				
A5	0.96 ab	9.94 b	6.16 ab	18.74
A10	1.59 b	9.25 b	6.31 ab	19.84
B5	3.52 c	9.94 b	7.26 b	14.41
B10	2.22 b	17.09 c	5.56 ab	19.82
Control	0.84 a	4.52 a	3.37 a	15.52
	**	**	*	n.s.
'Gala Must' lateral shoot				
A5	0.32	15.13 b	3.26 a	14.19 b
A10	0.00	10.04 ab	7.62 b	9.47 b
B5	0.17	14.03 b	5.86 ab	5.61 a
B10	0.12	13.76 b	9.75 c	6.22 ab
Control	0.20	7.51 a	5.47 ab	9.41 b
	n.s.	*	**	**
'Gala Must' leader shoot				
A5	0.00	12.32 ab	5.92	8.53
A10	0.49	12.20 ab	5.13	9.99
B5	0.00	8.54 ab	6.81	12.00
B10	0.46	15.25 b	6.42	6.55
Control	0.16	6.76 a	4.92	8.89
	n.s.	*	n.s.	n.s.

*** P < 1% ** P < 5 % * P < 10% n.s. – not significant

Table 2. Feathering in trees of two apple cultivars treated with Paturyl paints (Újfehértó, 2002)

Cultivar/ treatment	Number of laterals on 1 m of 2-year-old wood			
	leafrosette	short spur [< 5 cm]	long spur [5-10 cm]	shoot [> 10 cm]
'Akane' lateral shoot				
A10	4.92 a	6.23 ab	4.40 b	8.30
B10	5.80 ab	7.80 b	5.08 b	8.15
C10	4.41 a	15.46 c	1.85 a	8.13
Control	7.24 b	4.08 a	2.93 a	7.83
	***	***	***	n.s.
'Akane' leader shoot				
A10	4.72 a	4.56 ab	4.27 b	11.61 b
B10	5.37 a	7.32 b	4.33 b	12.59 b
C10	3.72 a	14.10 c	2.53 a	10.24 ab
Control	9.83 b	3.75 a	2.21 a	7.94 a
	***	***	***	***
'Pinova' lateral shoot				
A10	3.47 bc	7.59 b	7.89 b	12.65 b
B10	2.57 ab	6.56 b	7.37 b	16.51 c
C10	1.89 a	3.99 a	10.19 c	16.39 c
Control	4.63 c	3.78 a	1.63 a	10.25 a
	***	***	***	***
'Pinova' leader shoot				
A10	2.81 b	6.95 ab	5.09 ab	17.19 b
B10	2.19 ab	8.97 b	5.52 b	17.66 b
C10	1.31 a	5.43 a	9.33 c	21.63 c
Control	3.36 b	4.53 a	2.20 a	12.36 a
	***	*	***	***

*** P < 1% * P < 10% n.s. – not significant

In the first year (2001) on treated laterals in 'Pinova' trees 70-80% more short spurs were formed than on those untreated. Due to A10 paint, 125% more long spurs and 44% more new shoots developed.

On leader shoots treated with B5 paint the number of short spurs increased by 120% and long spurs by 115%, whereas for B10 the relevant gain was 278 and 65%, respectively.

Figure 1. ‘Akane’/MM.106 tree treated with A10 paint before pruning

Figure 2. ‘Akane’/MM.106 tree treated with A10 paint after pruning

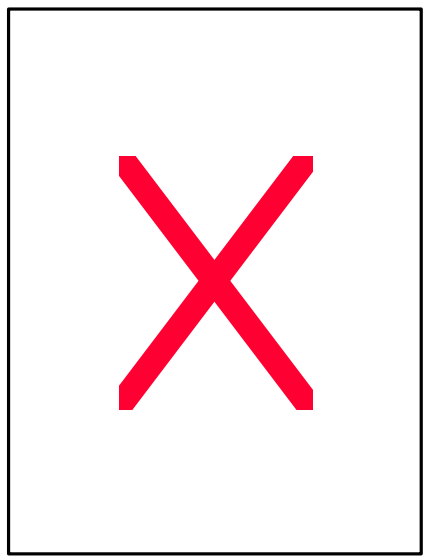

Figure 3. Untreated ‘Akane’/MM.106 tree before pruning

Figure 4. Untreated ‘Akane’/MM.106 tree after pruning

In the case of ‘Golden Reinders’ and ‘Gala Must’ the beneficial effects could be observed on lateral shoots rather than on the leaders. For the first cultivar, differences in the number of short and long spurs both on laterals and

leaders proved to be statistically insignificant. Most new shoots were formed on laterals treated with B5 paint, and they were 76% more numerous than in the control. For A5, A10 and B10 treatments, such an increase was 41, 28 and 16%, respectively.

On 'Gala Must' laterals a 102% increase in the number of short spurs was attributed to A5 paint. For B5 and B10 treatments it was 87 and 83%, respectively. Due to A5 treatment new shoots were 51% more numerous as compared to the control.

In the following year (2002) we could observe slightly enhanced return bloom, as an indirect treatment effect (data not shown). In 'Gala Must' trees from 20-30% (A10, B5, B10) to 64% (A5) more spurs flowered on laterals, than in control. On leader shoots, the number of flowering spurs increased by about 40% in trees treated with A10 and B10 paints, although the differences were not significant.

On lateral shoots of 'Pinova' the number of flowering spurs was more than twice as high, following treatments A5 and A10, while for B5 and B10 and B10 they increased by 59 and 100%, respectively.

'Golden Reinders' trees showed no significant differences in the number of flowering spurs.

In the second year (2002) laterals of 'Akane' trees developed 91 and 279% more short spurs after treatments B10 and C10, respectively (Tab. 2). The number of long spurs increased by 50 (A10) and 73% (B10), but there was no significant difference between treatments concerning the number of new shoots. Similar tendencies appeared for the leaders, but in this case A10 and B10 paints caused about 50% increase in the number of new shoots.

For 'Pinova' trees we obtained even more spectacular results. In relation to the control, treated laterals formed 74 (B10) and 100% (A10) more short spurs, while for long spurs such on increase was 4.5 fold (B10) and 6 folds (C10). The number of new long shoots enhanced by 23 (A10) and by 60% (B10 and C10).

Leaders showed a moderate, but not less spectacular feathering. Trees treated with B10 paint developed 100 and 150% more short and long spurs respectively, as compared to the control. At the same time the leaders treated with C10 paint produced 324% more long spurs, where as new long shoots increased by 40% (A10 and B10), and 75% (C10).

Based on the results of these experiments we can conclude that the feathering of young apple trees can be enhanced in environment friendly ways. Paint formulations containing benzyladenine effectively increased the density of useful laterals in all the cultivars treated.

Paturyl as a paint provides the possibility to significantly cut back the product usage as compared to traditional spraying. Required manual labour may seem to be high at the first sight, but it is compensated by the negligible need for tools (paintbrush, container to hold paint) to carry out treatments,

furthermore, the work is easy to organise. Treatments are also more independent from weather conditions (often unfavourable for spraying during windy spring), as the applied spray additives provide a quicker uptake of benzyladenine and a certain resistance against rain wash-off. Last but not least, pesticide load of the environment can also be reduced.

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KORZYSTNY WPŁYW EKOLOGICZNEJ, ZMODYFIKOWANEJ METODY STOSOWANIA BENZYLOADENINY NA WYTWARZANIE PĘDÓW U DRZEWEK JABŁIONI

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

Niekorzystne wytwarzanie pędów u młodych drzew niektórych odmian jabłoni może poważnie opóźnić uformowanie korony z właściwym potencjałem owocowania. W przypadku drzewek w wieku 1-4 lat można pozytywnie wpłynąć na wytworzenie ich pędów przez kilkakrotne opryskiwanie preparatem Paturyl 10 SL, zawierającym 10% benzyloadeniny. Jednakże podczas wykonywania takiego zabiegu na początku okresu wegetacji, przed wykształceniem blaszek liściowych są znaczne straty cieczy użytkowej. Dla uniknięcia tego i zmniejszenia ilości stosowanego preparatu, postanowiono użyć go w formie roztworu do pędzlowania naniesionego na jednoroczne pędy młodych drzew jabłoni. W roku 2001 były to dwuletnie drzewka odmian 'Pinova', 'Gala Must' i 'Golden Reinders' szczepione na podkładce M.9, a w roku 2002 jednoroczne drzewka 'Akane' i 'Pinova' na MM.106.

Roztwory do pędzenia (oznaczone jako A5, A10, B5, B10 i C10) różniące się stężeniem składników, były mieszaniną wody, preparatu Paturyl 10 SL, środka powierzchniowoczynnego Tween-20 oraz dostępnych w handlu substancji dodatkowych poprawiających przyczepność i przyspieszających wchłanianie benzyloadeniny.

Wszystkie zabiegi skutecznie poprawiły formowanie się drzewek jabłoni przez istotne zwiększenie liczby krótkopędów i pędów w porównaniu z kontrolą, co miało pozytywny wpływ na kwitnienie w roku następnym.

Słowa kluczowe: jabłoń, benzyladenina, wytwarzanie pędów, pędzlowanie, Paturyl 10 SL