

## APPLE TREE GROWTH AND MINERAL ELEMENTS CONTENT FROM THE LEAVES OF GRAFTED APPLE TREES, CULTIVATED IN A NURSERY, AND THE INFLUENCE OF CHEMICAL TREATMENTS

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**ABSTRACT** – We have compared the effect of four chemical treatments on fruit tree growth and mineral elements content from the leaves of two cultivars of grafted apple trees. The used foliar fertilizers have not significantly influenced the results of the growth of grafted fruit trees. However, they have considerably increased the number of flower buds and dwarf shoots of “Idared” cultivar. The Paturyl product has significantly increased the number of long shoots of “Jonagold” cultivar and the dwarf shoots of “Idared”, compared to the control. At the same time, it did not initiate the formation of flower buds. The effect of chemical treatments, applied through the foliage, on the content of mineral elements in the leaves of grafted apple trees was diverse.

**Key Words:** grafted apple trees, Paturyl, leaf fertilization, content of mineral elements in leaves

**REZUMAT** – Creșterea pomilor și conținutul de elemente minerale din frunzele merilor altoiți, cultivați în pepinieră, și influența tratamentelor chimice. În prezenta lucrare s-au comparat efectele a patru tratamente chimice asupra creșterii merilor și a conținutului de elemente minerale din frunzele a două cultivare de meri altoiți. Ingrășămintele foliare folosite nu au influențat semnificativ rezultatele creșterii pomilor altoiți. Totuși, ele au sporit considerabil numărul de muguri florali și de lăstari mici la cultivarul „Idared”. Preparatul Paturyl a crescut semnificativ numărul de lăstari lungi la cultivarul „Jonagold” și de lăstari mici la „Idared”, în comparație cu varianta martor. Acest preparat nu a dus la formarea de muguri florali. Tratamentele chimice, aplicate pe frunze, au avut un efect diferit asupra conținutului de elemente minerale din frunzele pomilor altoiți.

**Cuvinte cheie:** meri altoiți, Paturyl, fertilizare foliară, conținutul de elemente minerale din frunze

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## INTRODUCTION

The yield of apple trees is affected by the quality of nursery stock. The most important traits of the nursery stock are trunk diameter, tree height, number and length of lateral shoots of grafted apple trees. These traits strongly affect the fruit tree growth and the early stage of fruit bearing. Unfortunately, the grafted apple trees from many cultivars form a small number of lateral shoots or did not form them at all. The superiority of branched grafted apple trees over unbranched ones was confirmed by many researchers (Van Oosten 1978; Vittrup 1978, Shepherd 1979; Bootsma and Bart 1990, Poniedziałek et al. 1993; Poniedziałek et al. 1996; Czynczyk 1998). Nowadays, apple tree orchards are established by using mainly fruit trees on dwarf rootstocks. M.9 is one of them, and is commonly used in apple tree growing regions from Europe (Wertheim 1998). Many researchers have been used different kinds of chemicals for branching grafted apple trees (Quinlan and Tobutt 1990, Jaumień et al. 1992, Poniedziałek and Porębski 1992, Basak et al. 1993, Wertheim and Estabrooks 1994, Jaumień and Dziuban 1998).

In this experiment, we have compared the effects of Paturyl 10WSC and the three leaf fertilizers on the apple tree growth and mineral elements content from the leaves of grafted apple trees (two cultivars) in a nursery.

## MATERIALS AND METHODS

The experimental plant material consisted of one-year apple trees (“Idared” and “Jonagold” cultivars), grafted on the M.9 rootstock. The trial was set up in four replications, with 25 apple trees per plot. The experiment was conducted in the experimental farms of the August Cieszkowski Agricultural University of Poznan and the “Ion Ionescu de la Brad” University of Agricultural Sciences and Veterinary Medicine of Iași. During the 2005 and 2006 growth season, the fruit trees were treated with Paturyl and fertilized through the foliage with urea, at a rate of 0.5-1.0%, Florovit at 0.5%, and lime and magnesium saltpetre at 1.0%. Sprays of Paturyl at a rate of 100 ml per 10 litres of water was carried out once in the third decade of June, when the grafted apple trees were about 60 cm high. The grafted apple trees were treated with leaf fertilizers for five times in two-week intervals, from mid-June to mid-August. In the second decade of August, the leaves in the middle part of long shoots were sampled for chemical analyses of the content in macroelements. All the observations and measurements were performed on 15 grafted apple trees from each variant. The height and thickness of the trunk (30 cm above the ground) were measured. Long shoots, dwarf shoots and flower buds were counted. The statistical analysis of data obtained was carried out by using a two-factorial analysis of variance, followed by Duncan’s test at the probability level  $\alpha = 0.05$ .

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**RESULTS AND DISCUSSION**

The results on the thickness of “Jonagold” and “Idared” grafted apple trees were not significantly different, depending on their treatment with Paturyl and fertilizers applied through the foliage, as compared to the control. “Jonagold” apple trees, which were sprayed with lime and magnesium saltpetre, were significantly thicker than the “Idared” control. The thickness of grafted apple trees depended to a larger degree on the apple tree cultivar (*Table 1*).

**Table 1**  
**Thickness and height of grafted apple trees depending on chemical treatments**

Chemical treatments	Cultivar			
	Thickness (mm)		Height (cm)	
	Jonagold	Idared	Jonagold	Idared
Paturyl	13.4 bc *	12.3 ab	160.4 c	125.3 a
Urea	13.6 bc	12.7 ab	154.8 bc	123.9 a
Florovit	13.1 bc	12.8 ab	148.9 bc	123.1 a
Lime and magnesium saltpetre	14.4 c	12.8 ab	147.7 bc	124.0 a
Control	13.0 bc	11.4 a	142.0 b	119.5 a

\* Means followed by the same letters within the characteristic do not differ significantly at  $\alpha = 0.05$

A similar relation was observed at the height of grafted trees. “Jonagold” apple trees, affected by the Paturyl product, were significantly higher than the untreated ones. For “Idared”, the results of the height did not differ according to the treatment. The “Jonagold” apple trees were significantly higher than the “Idared” ones. The cultivar has significantly influenced the height of grafted trees (*Table 1*).

“Jonagold” apple trees, treated with Paturyl, have produced less flower buds. A similar relation was observed in “Idared” cultivars. The number of flower buds did not differ according to a cultivar within the same treatments. Leaf fertilization of grafted apple trees has beneficially affected the number of formed flower buds (*Table 2*). One could conclude that apple trees fertilized through the foliage in a nursery, planted in an orchard, have begun earlier to bear fruits. This is the basic requirement of nowadays established intensive orchards.

After sprays of Paturyl, the “Jonagold” cultivar has produced a significantly higher number of long shoots than the control. The result of the last treatment was not significantly different from the one obtained in case of apple trees treated with urea, Florovit and lime and magnesium saltpetre. The number of long shoots of “Idared” cultivar did not differ significantly, according to the presence of sprays or their lack. The cultivar has significantly affected the number of long shoots (*Table 2*). A stronger growth of a certain cultivar was positively correlated to the

branching of grafted apple trees. This correlation was strict for a strongly branching cultivar, in this case for “Jonagold”. A similar conclusion based on research was drawn by Słowiński and Sadowski (1996) and Lipecki and Janisz (1999).

**Table 2**

**Average number of flower buds, long and dwarf shoots, depending on chemical treatments**

Chemical treatments	Cultivar					
	Number of flower buds		Number of long shoots		Number of dwarf shoots	
	Jonagold	Idared	Jonagold	Idared	Jonagold	Idared
Paturyl	0.0 a *	0.1 a	7.0 c	2.7 a	12.6 c	3.0 b
Urea	3.8 c	2.0 bc	5.9 bc	2.5 a	12.0 c	2.4 b
Florovit	3.5 c	2.7 c	5.6 bc	2.0 a	11.7 c	2.3 b
Lime and magnesium saltpetre	2.9 c	2.7 c	5.8 bc	2.3 a	12.3 c	2.8 b
Control	1.2 ab	0.6 a	4.5 b	1.8 a	11.1 c	0.8 a

\* Means followed by the same letters within the characteristic do not differ significantly at  $\alpha = 0.05$

Different agents applied through foliage did not affect the number of dwarf shoots of “Jonagold” cultivar in comparison with the control. More dwarf shoots were obtained for “Jonagold” cultivars than for “Idared” (*Table 2*).

According to the chemical analyses of the content in macroelements from leaves, no unambiguous impact of grafted apple trees, sprayed with Paturyl and leaf fertilizers, was observed. A lower content of nitrogen was noticed for “Idared” treated with Florovit, as compared to the other treatments. The content of phosphorus in the leaves of “Jonagold” was significantly lower if the fertilizer was applied. Higher contents of potassium in the leaves of “Jonagold” control, lower contents of magnesium in grafted apple trees of both cultivars and calcium in the “Jonagold” cultivar were noticed (*Table 3*).

The results of chemical analysis on the leaves of grafted apple trees presented in *Table 3* did not confirm the results obtained by Szwedo and Murawska (1999). The above-mentioned authors have noticed in the leaves of “Jonagold” cultivar higher nitrogen (on average, 2.5% dry matter), lower phosphorus (0.15-0.20% dry matter) and magnesium contents (0.23–0.28% dry matter), depending on the year and time of leaf sampling. The most similar results were obtained in the case of potassium content (on average, 2.0% dry matter). According to the observations, one might state that the leaf fertilization did not always have a direct impact on the mineral elements content in the leaves of grafted apple trees in a nursery. Many factors were involved, among others: cultivar, time of leaf sampling and climatic conditions in a certain year.

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**Table 3**

**Content of mineral elements in the leaves of grafted apple trees, depending on chemical treatments (% dry matter)**

Cultivar	Chemical treatments	Nitrogen	Phosphorus	Potassium	Magnesium	Calcium
Jonagold	Paturyl	2.13 ab *	0.46 abc	1.97 cd	0.39 ab	2.78 de
	Urea	2.17 ab	0.49 cd	2.19 e	0.43 bc	2.65 bcd
	Florovit	2.21 b	0.40 a	2,05 de	0.43 bc	2.61 bc
	Lime and magnesium saltpetre	2.19 ab	0.48 bcd	1.98 cd	0.44 bc	2.74 cd
	Control	2.10 a	0.43 ab	2.23 f	0.36 a	2.40 a
Idared	Paturyl	2.74 e	0.54 e	1.91 bc	0.41 abc	2.35 a
	Urea	2.62 de	0.51 d	1.86 ab	0.41 abc	2.86 e
	Florovit	2.40 c	0.51 d	1.86 ab	0.44 bc	2.54 b
	Lime and magnesium saltpetre	2.60 de	0.55 e	1.92 bc	0.48 c	2.35 a
	Control	2.50 d	0.54 e	1.83 a	0.39 ab	2.36 a

\* Means followed by the same letters within the characteristic do not differ significantly at  $\alpha = 0.05$

### CONCLUSIONS

Paturyl has produced the most intensive branching of grafted trees, but at the same time, has reduced to a greater extent the number of flower buds. It did not affect the thickness and height of grafted trees.

Among the leaf fertilizers applied, no one has significantly affected the growth and formation of side shoots. However, all of them have increased the number of flower buds, in comparison with the control.

The grafted apple trees treated with Paturyl and leaf fertilizers did not affect unambiguously the content of macroelements in leaves.

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