

Tolerance of apple propagation material to herbicides

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Investigations were conducted in the commercial nursery of the Lithuanian Institute of Horticulture. In 2001–2003 herbicides Stomp (pendimethalin, 4 l ha⁻¹), Goltix (metamitron, 3.0 l ha⁻¹), Lontrel 300 (0.3 l ha⁻¹), Agil (propikvizafop, 1.5 l ha⁻¹), Focus Ultra (cycloxydim, 4.0 l ha⁻¹), Fuzilade Super (fluazifop, 3.0 l ha⁻¹) and combination Fuzilade Super (2.0 l ha⁻¹) and Betanal Progress (phenmedipham, desmedipham and ethofumesate, 2.0 l ha⁻¹) were tested in apple nursery during the first and second growing season. Herbicides were sprayed directly on plants without mechanical protection. Herbicides Stomp (4 l ha⁻¹), Agil (1.5 l ha⁻¹), Focus Ultra (4.0 l ha⁻¹) and Betanal Progress (2.0 l ha⁻¹) are safe to use in apple tree nursery. Herbicide Goltix (3 l ha⁻¹) should be used during the second year of apple growth. Fuzilade Super (3.0 l ha⁻¹) and Lontrel 300 (0.3 l ha⁻¹) caused leaf damages of one-year-old apple trees, but did not interfere to the final growth. Interaction between herbicides and cultivars were noticed in the experiment with one-year-old plants.

Key words: apple propagation material, herbicide, vegetative growth, weed control.

Introduction. Weed control in fruit tree nurseries is performed by mechanical means and herbicides. Application of soil herbicides have been the most common practice for many years, though many of used soil herbicides were hazardous pollutant. Nevertheless until recent years such herbicides like simazin, devrinol are still used in commercial nurseries legally in some countries or not legally in others (Strandberg, Scott-Fordsmann, 2002; Kopytowski et al., 1999; Wycior et al., 1999). Use of methyl bromide was wide spread soil preparation practice both for soil disinfection and weed control, but it is forbidden because of environmental concerns (Shrestha et al., 2008; Duniway, 2002). New knowledge on chemical degradation of chemicals in soil and water is gained and some of previously safe substances appear to be more aggressive than it is declared (Saratovskikh et al., 2007).

Application of non-selective or broad-spectrum herbicides in the nursery requires special technique and sometimes it is risky since these herbicides can negatively affect or kill nursery plants. Growing bud and trees during the first season in the nursery are especially sensitive to herbicides.

Use of more nature friendly selective herbicides is wide spread practice in growing of different agriculture crops (Kavaliauskaitė et al., 2008). Application of them in fruit tree nursery is very limited. Therefore, larger experiments were planned aiming on suitability to use various herbicides in apple tree nursery.

Object, methods and conditions. Investigations were conducted in the commercial nursery of the Lithuanian Institute of Horticulture. In 2001–2002 following herbicides were tested on one-year-old apple propagation material (budded in summer 2000): Stomp (active substance pendimethalin at the rate 4.0 l ha⁻¹), Goltix (active substance metamitron, 3.0 l ha⁻¹), Lontrel 300 (active substance clopyralid, 0.3 l ha⁻¹), Agil (active substance propikvizafop, 1.5 l ha⁻¹), Focus Ultra (active substance cycloxydim, 4.0 l ha⁻¹), Fusilade Super (active substance fluazifop, 3.0 l ha⁻¹) and combination Fusilade Super (2.0 l ha⁻¹) and Betanal Progress (active substances phenmedipham, desmedipham and ethofumesate, 2.0 l ha⁻¹). In 2002–2003 the same herbicides were tested on two-year-old apples. Manual weeding was control treatment. Two apple cultivars ‘Auksis’ and ‘Shampion’ on B.396 rootstock were tested.

Herbicides were applied two times during the early season: in the middle of May and at the end of June. Herbicides were sprayed by manual sprayer directly on plants without mechanical protection. Manual weeding was performed at the same time as application of herbicides and additionally in July.

Trial consisted of four replications with 15–20 plants in each.

Plant height (cm) was measured in May before application of herbicides, at the beginning of July and at the end of vegetation season. Trunk diameter (mm) was measured at the end of experiment. Stem and leaf damages were monitored and described in two weeks after application of herbicides.

Growth characteristics of the planting materials were different and depended on climatic conditions of the vegetative period and cultivar. Since there were no interactions between year and used herbicides in the experiment with one-year-old apple planting material, the results are presented as an average of two years. No interactions were recorded between year, herbicides and cultivar in the experiment with two-year-old apple planting material; therefore, the results are presented as an average of two years and two cultivars.

Variance analysis of tree growth characters was done using Fischer least significant difference test at $P < 0.05$.

Results. No one of applied herbicides reduced growth of one-year-old apple material of cv. ‘Auksis’ (Table 1). Neither tree growth dynamics, nor final stem diameter significantly differed between herbicide treated and control plants.

Herbicides Goltix, Fusilade Super and Lontrel 300 had negative effect on the height of cv. ‘Shampion’ during the earliest application date (Table 2). More pronounced tendencies of reduced tree height and stem diameter remained in plots sprayed by Goltix.

Table 1. Herbicide effect on vegetative growth dynamics of one-year-old ‘Auksis’ planting material

1 lentelė. Herbicidų įtaka vienerių metų dauginamosios medžiagos ‘Auksis’ vegetatyvinio augimo dinamikai

Herbicide Herbidas	Height Aukštis (cm)			Stem diameter Kamieno skersmuo (mm)
	06.01	07.15	09.20	09.20
Control Kontrolė	39.8	85.6	139.0	13.2
Goltix	41.0	82,1	137.2	12.7
Stomp	38.9	84.2	139.7	13.0
Fusilade Super	37.7	83.2	138.9	13.2
Agil	41.0	86.5	142.3	13.3
Focus Ultra	38.9	86.0	141.5	13.4
Fuzilade Super + Betanal Progres AM	39.7	85.4	141.6	13.4
Lontrel 300	38.4	84.2	143.0	13.7
LSD ₀₅ / R ₀₅	3.04	4.31	5.28	0.62

Table 2. Herbicide effect on vegetative growth dynamics of one-year-old ‘Shampion’ planting material

2 lentelė. Herbicidų įtaka vienerių metų dauginamosios medžiagos ‘Shampion’ vegetatyvinio augimo dinamikai

Herbicide Herbidas	Height Aukštis (cm)			Stem diameter Kamieno skersmuo (mm)
	06.01	07.15	09.20	09.20
Control Kontrolė	34.5	70.7	128.7	12.7
Goltix	30.2	65.9	125.2	12.2
Stomp	33.2	68.9	127.8	12.6
Fusilade Super	31.1	66.8	126.3	12.8
Agil	34.2	71.2	128.2	12.5
Focus Ultra	34.8	70.5	129.3	12.9
Fuzilade Super + Betanal Progres AM	33.2	69.2	128.1	12.3
Lontrel 300	30.4	67.2	129.7	12.8
LSD ₀₅ / R ₀₅	3.05	4.92	6.2	0.61

No one of used herbicides had negative effect on the vegetative characteristics of two-year-old apple planting material (Table 3). Only tendency of slightly reduced tree height was noticed in Goltix treatment.

Cv. ‘Shampion’ was somewhat more sensitive than cv. ‘Auksis’. Lontrel 300 caused leaf damages during both applications. Fuzilade Super damaged leaves of cv. ‘Auksis’ during first application, and leaves of cv. ‘Shampion’ during early and late applications. Herbicide Goltix was a reason of leaf chlorosis of cv. ‘Shampion’. Herbicides Agil, Focus Ultra and Stomp did not damaged leaves of any cultivar during both times of application. No leaf damages were recorded on 2-year-old apple propagation material.

Table 3. Herbicide effect on vegetative growth dynamics of two-year-old apple planting material (average of two cultivars and two years)

3 lentelė. Herbicidų įtaka dvejų metų dauginamosios medžiagos vegetatyvinio augimo dinamikai (dviejų veislių ir dvejų metų vidurkiai)

Herbicide Herbidas	Height Aukštis (cm)			Stem diameter Kamieno skersmuo (mm)
	06.01	07.15	09.20	09.20
Control Kontrolė	116.2	145.3	188.3	18.1
Goltix	112.3	140.6	180.0	18.3
Stomp	114.2	142.4	184.2	17.9
Fusilade Super	115.6	143.1	185.3	18.8
Agil	115.4	144.9	187.4	18.2
Focus Ultra	115.9	144.2	187.1	17.7
Fuzilade Super + Betanal Progress AM	115.6	144.8	187.3	17.9
Lontrel 300	116.2	145.1	189.8	18.0
LSD ₀₅ / R ₀₅	4.01	5.33	9.19	1.13

Leaf damages by some herbicides were recorded on one-year-old planting material (Table 4).

Table 4. Herbicide caused damages on apple propagation material

4 lentelė. Herbicidų žala obelių dauginamajai medžiagai

Herbicide Herbidas	1-year-old cv. 'Auksis' 'Auksis' vienmečiai sodinukai		1-year-old cv. 'Šampion' 'Šampion' vienmečiai sodinukai		2-year-old apple propagation material Obelių dvimečiai sodinukai	
	06.01	07.15	06.01	07.15	06.01	07.15
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
Control Kontrolė	- *	-	-	-	-	-
Goltix	-	-	light chlorosis lengva chlorozė	-	-	-
Stomp	-	-	-	-	-	-
Fusilade Super	scorched 1 to 3 leaves nudeginti 1–3 lapai	-	scorched 1 to 5 leaves nudeginti 1–5 lapai	scorched 1 to 2 leaves nudeginti 1–2 lapai	-	-
Agil	-	-	-	-	-	-
Focus Ultra	-	-	-	-	-	-
Fuzilade Super + Betanal Progress AM	-	-	scorched 1 to 3 leaves nudeginti 1–3 lapai	-	-	-

1	2	3	4	5	6	7
Lontrel 300	scorched 1 to 3 leaves nudeginti 1–3 lapai	scorched 1 to 2 leaves nudeginti 1–2 lapai	scorched 1 to 5 leaves nudeginti 1–5 lapai	scorched 1 to 3 leaves nudeginti 1–3 lapai	-	-

* no damages recorded / pažeidimų nenustatyta

Discussions. Weed control in fruit tree nurseries continues to be a major problem. Weeds can decrease nursery plant development, interfere with field and harvest operations. Still extensive hand labour and tillage are used for weed control during the growing season. Since the costs of both fuel and labour continue to rise, herbicides are likely to become a more important weed management tool in the tree nursery industry (Hanson, Schneider, 2008).

Herbicides availability is different throughout the world. European Commission continuously revises list of substances allowed to use for crop protection and many of them are banned or suggested to remove from the list in coming years. In some countries still widely used simazin appears to be phytotoxic to many species even at rates below recommended (Strandberg, Scott-Fordsmann, 2002). Proper replacement of simazin is an urgent task for fruit and nurseries growers. In our trial two soil herbicides Goltix and Stomp were tested. Both of them protect weed infestation for shorter time compared with simazin (Rankova et al., 2009 a). Negative apple tree reaction to Goltix was noticed immediately after its application. Tendency of reduced tree height was established both in one-year-old and two-year-old plantings.

Another soil herbicide Stomp was not toxic for apple propagation material, what is confirmed in other trials too (Gercheva et al., 2002, Rankova et al., 2009 b), though there is data on its negative effect on apple stem diameter (Wycior et al., 1999).

Herbicides Agil, Focus and Fusilade Super are used to control graminaceous weeds. Nevertheless, at early stage of plant development higher dose of Fusilade Super (3.0 l ha⁻¹) caused damages when it was applied directly on growing one-year-old shoots. Other herbicides Agil and Focus were safe to use at any plant development stage.

Lontrel 300, which is used for control of a wide range of broadleaf weeds, damaged young apple leaves. In spite of visual damages it did not course any growth suppression for cv. ‘Auksis’ and final characteristics of one-year-old plants of both tested cultivars.

Interactions between herbicides and cultivars were noticed in the experiment with one-year-old plants during the earliest application date. Vegetative growth of apple trees of cv. ‘Shampion’ is less luxuriant than cv. ‘Auksis’ and it could be a reason of its somewhat higher sensitivity to some herbicides. If there were no significant differences between herbicide treatments and not sprayed plots for cv. ‘Auksis’, some herbicides as Goltix, Fusilade Super and Lontrel 300 reduced significantly the height of cv. ‘Shampion’ during the first application.

Conclusions. Preemergence herbicide Stomp (4.0 l ha⁻¹) is safe to control weeds in apple nursery during the first and second year of plant growth. Herbicide Goltix (3.0 l ha⁻¹) should be used during the second year of apple growth.

Fusilade Super (3.0 l ha⁻¹) and Lontrel 300 (0.3 l ha⁻¹) damaged leaves of one-

year-old apple trees when they were applied directly. This did not interfere to the final characteristics of propagation material.

Herbicides Agil (1.5 l ha⁻¹), Focus Ultra (4.0 l ha⁻¹) and Betanal Progress (2.0 l ha⁻¹) are safe to use in apple tree nursery.

Tolerance to herbicides is determined by apple cultivar.

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Obelių dauginamosios medžiagos tolerantiškumas herbicidams

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Santrauka

2001–2003 m. Lietuvos sodininkystės ir daržininkystės instituto medelyne atlikti herbicidų stomp (pendimethalin, 4,0 l ha⁻¹), goltix (metamitron, 3,0 l ha⁻¹), lontrel 300 (0,3 l ha⁻¹), agil (propikvizafop, 1,5 l ha⁻¹), focus ultra (cycloxydim, 4,0 l ha⁻¹), fuzilade super (fluazifop, 3,0 l ha⁻¹) ir herbicidų derinio fuzilade super (2,0 l ha⁻¹) ir betanal progress (phenmedipham, desmedipham ir ethofumesate, 2,0 l ha⁻¹) tyrimai su vienmečiais ir dvimečiais obelių sodinukais. Visi herbicidai buvo purškiami nenaudojant apsaugos. Herbicidai stomp, agil, focus ir betanal progress tinkami naudoti obelių medelyne. Herbicidą goltix rekomanduojama naudoti dauginant dvimetes obelis. Didesnės normos fuzilade super (3,0 l ha⁻¹) ir lontrel apdegina vienmečių obelaičių lapus, tačiau neturi neigiamos įtakos galutiniam obelaičių dydžiui. Pirmamečiame medelyne nustatytos obelių veislės ir herbicidų sąveika.

Reikšminiai žodžiai: herbicidai, kova su piktžolėmis, obelių dauginamoji medžiaga, vegetatyvinis augimas.

