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EVALUATION RESULTS OF FINNISH APPLE ROOTSTOCKS IN LATVIA

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Introduction

- **Winterhardiness of rootstocks is an essential problem in Latvia**, as snowless winters soil temperatures may reach over -15 C and freeze to >1m depth.
- M.9 is very risky; MM106 is injured when soil temperature is below -16 C.
- B-series rootstocks are more hardy (to -18 C), but only B.118 is medium vigour.
- **Search for new hardy rootstocks is essential, especially for medium vigour trees.**
- **For this reason a trial with new Finnish rootstocks was established.**

Trial establishment

- A trial was established in 2011 with 5 rootstocks:
 - **MTT 1, MTT 4 and control B9** (1.5 x 4 m, 5 replications with 2 trees each), total – 10 trees per combination;
 - **MTT 5 and control MM106** (2.5 x 5 m, 6 replications with 2 trees each), total – 12 trees per combination.
- 2 cultivars - 'Auksis' and 'Gita'.
- Rootstocks were grouped at planting by vigour, using data from MTT Finland.
- Growing techniques – standard integrated growing.
- All trees individually staked.
- Evaluation done in 2012-2015, to be continued.

Characterization of rootstocks

(originator data for MTT series)

- **MTT 1** – YP (*M.baccata* o.p.) x M26 (1997):
 - vigour like B9 (40% of 'Antonovka' sdlg.),
 - stronger roots and less suckers than B.9,
 - trees need support,
 - very winter and cold-hardy, easily propagated.
- **MTT 4** - YP (*M.baccata* o.p.) x M27 (2006):
 - vigour like M26 (50-60 % of 'Antonovka' sdlg.),
 - young trees need support, older – without,
 - very winter and cold-hardy, easily propagated,
 - tolerant to specific apple replant disease (SARD).
- **MTT 5** – YP (*M.baccata* o.p.) x M26 (2006):
 - vigour almost like A2 (60-80% of 'Antonovka' sdlg.),
 - young trees need support, older – without,
 - very winter and cold-hardy, easily propagated.

Characterization of rootstocks (control)

- **B.9** (control):
 - weak vigour, but larger than M.9 (30-40 % of 'Antonovka' sdlg.),
 - trees need support,
 - often root suckers,
 - root cold tolerance -12 to -14 C,
 - early and good yields,
 - propagation in stoolbed poorer than M.9,
 - negative influence on fruit colour possible.
- **MM106** (control):
 - medium vigour (60-75 % of sdlg.rootstocks), in young age vigorous,
 - does not need support,
 - very few root suckers,
 - root cold tolerance -12 C or lower, susceptible to early cold,
 - medium early production, good yields,
 - drought susceptible,
 - good fruit colour.

Characterization of cultivars



'Auksis' - medium vigour, tendency to bienniality;
medium to large fruits, stable good flavour;
September to March;
most commercially important cv. in Latvia

'Gita' (Vf/Rvi6) - vigorous, annual yields;
large fruits, little need for thinning;
September to February;
new scab resistant cultivar of Latvian breeding



Evaluated parameters

- Tree general condition, flowering and yielding intensity (points);
- Tree and fruit diseases (if any);
- Number of root suckers;
- Trunk diameter (cm) at 20 cm height;
- Average yield (kg/tree);
- Yield per trunk cross section area - TCSA (kg cm^{-2});
- Average fruit mass (g);
- Amount of non-standard fruits (%) and their type;
- Randomized sample (15-30 kg) from each put into storage;
- Taste panel 1 time a season for fully ripe fruits, 10 untrained members.

Influence of winter conditions

- **Winter of 2013/2014 was snowless and so very unfavourable for rootstock over-wintering:**
 - Cold started in January and lasted till March, soil already in January froze to 1...1.5 m depth.
 - temperature at 20 cm depth in January gradually fell to -7...-9°C and later below 10°C, **which is critical to MM106.**
 - Injury was stronger as root zone was not covered with mulch.
 - **Visual observations - part of trees on MM 106 had lower yield and smaller fruits, chlorosis, reduced new growth.**
 - Roots not extracted for analysis, to avoid further tree damage.
 - Injuries depended on the tree place in field, higher on exposed trees (e.g. row ends).
- **After-effect observed also in 2015**, as chlorosis and poorer growth of some trees on MM106.
- **Root winter hardiness of all other rootstocks was better than MM106.**

After-effect of 2013/2014 winter injury (photos in 2015)



‘Gita’ on MM106 – weaker new growth, smaller fruits



‘Gita’ on MTT 4 (no injury)

Start of production

- The trees started flowering in 2012, part of flowers were removed to improve tree growth.
- In average, significantly highest amount of flowers was observed **on B9**.
- **The earliest start of bearing had 'Gita' on MTT 4; the latest – 'Auksis' on MM106.**
- Cultivar 'Gita' had earlier start of bearing than 'Auksis'.

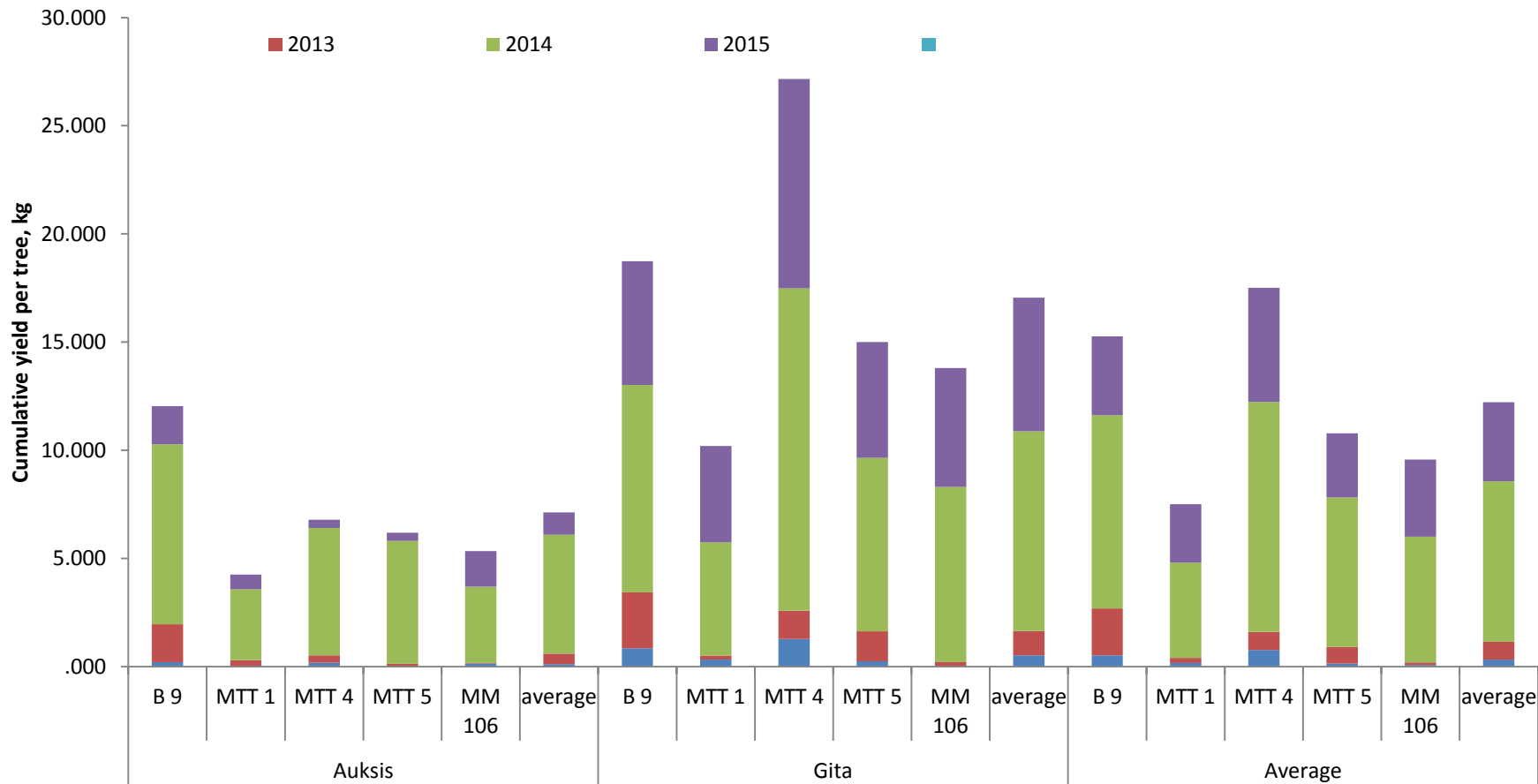


'Gita' on B9, 2nd year

Productivity

- Both rootstock and cultivar effect on yield were highly significant (0,000).
- **The highest yield in average was obtained on MTT 4 and B9,** the lowest - on MTT 1.
- **The highest yield per tree** for 'Gita' was on MTT4, but for 'Auksis' - on B9.
- **The yield per TCSA** was the highest for 'Gita' on B9 and for 'Auksis' on MTT 5.
- Cultivar 'Gita' was more productive than 'Auksis'.
- The poorest yield was observed for 'Auksis' on MTT 1, the rootstock evidently is not suitable for this cultivar.
- No bienniality was observed till 2015, when the yield of 'Auksis' was lower than in 2014.
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Cumulative yield in 2012-2015, kg/tree



Trunk cross section area and yield per TCSA

cultivar	rootstock	year	TCSA, cm ²	Yield per TCSA, kg cm ⁻²	cultivar	rootstock	year	TCSA, cm ²	Yield per TCSA, kg cm ⁻²
Auksis	B 9	2012	1,7	,40	Gita	B 9	2012	1,6	,68
		2013	2,2	,85			2013	2,2	1,16
		2014	2,6	3,17			2014	2,6	3,73
		2015	3,2	,81			2015	2,9	1,89
		Total	2,5	1,62			Total	2,3	1,96
	MTT 1	2012	1,1	,00		MTT 1	2012	1,3	,59
		2013	1,5	,52			2013	1,8	,27
		2014	2,0	1,65			2014	2,1	2,28
		2015	2,4	1,47			2015	2,6	1,65
		Total	1,7	1,38			Total	1,9	1,50
	MTT 4	2012	1,7	,27		MTT 4	2012	2,2	,64
		2013	2,4	,29			2013	3,0	,43
		2014	2,9	1,96			2014	3,6	4,01
		2015	3,6	,15			2015	4,1	2,36
		Total	2,6	,85			Total	3,2	1,89
	MTT 5	2012	1,5	,00		MTT 5	2012	1,7	,35
		2013	2,1	,32			2013	2,3	,82
		2014	2,5	2,35			2014	2,8	2,80
		2015	3,3	,69			2015	3,6	1,47
		Total	2,3	1,86			Total	2,6	1,6
	MM 106	2012	1,8	,19		MM 106	2012	2,0	,00
		2013	2,5	,12			2013	2,8	,14
		2014	2,9	1,17			2014	3,4	2,40
		2015	3,6	,58			2015	4,0	1,37
		Total	2,7	,75			Total	3,0	1,54

Differences by yield per TCSA, kg cm⁻²

Yield per TCSA, kg cm ⁻²					
	rootstock	N	Subset		
			1	2	
Tukey HSD ^{a,,b,,c}	MM 106	58	1,16		b
	MTT 1	31	1,46	1,46	ab
	MTT 4	64	1,49	1,49	ab
	MTT 5	53		1,66	a
	B 9	68		1,80	a
	Sig.		,222	,191	

There were significant differences of yield between rootstocks:

- MM106 had the lowest yield (in first years);
- The highest average yield was obtained on MTT⁵ and B9.

Cultivar ‘Gita’ was more productive than ‘Auksis’.

Tree vigour

- Both rootstocks and cultivars had highly significant differences in vigour (0,000).
- **Cultivar 'Gita' had more vigorous growth, earlier start of bearing and less alternance than 'Auksis'.** This affected also rootstock performance.
- **The most vigorous rootstocks were MM106 and MTT4, the weakest – MTT1.**
- **MTT 5 and B9 had similar vigour.**
- **MTT 1 is not suitable for cv. 'Auksis'** - about half of the trees in nursery did not reach standard plant size, 1/3 trees in 3rd growth year had not yet developed good laterals.
- 'Gita' may be grown on MTT 1, as it is more vigorous.

Differences of tree vigour by trunk cross section area (TCSA), cm²

TCSA, cm ²					
	rootstock	N	Subset		
			1	2	3
Tukey HSD ^{a,,b,,c}	MTT 1	61	1,83		c
	B 9	82		2,40	b
	MTT 5	93		2,47	b
	MM 106	96			2,86 a
	MTT 4	76			2,95 a
	Sig.		1,000	,745	,652

Significant differences were found between rootstocks:

- MTT1 was the weakest growing;
- MTT5 and B9 were similar by vigour;
- MTT4 and MM106 were the most vigorous.

Cultivar ‘Gita’ was more vigorous than ‘Auksis’.

Rootstock influence on growth and production (1)



'Gita' on B9 in 2016



'Gita' on MTT4 in 2016

Rootstock influence on growth and production (2)



'Auksis' on B9 in 2016



'Auksis' on MTT4 in 2016

Root suckers

- The number of root suckers was significantly influenced by rootstock (0.000) and cultivar (0.019).
- **MTT 5 developed significantly higher number of root suckers.**
- B9, contrary to other data, had sucker number similar to other rootstocks.

- Fruit size variation between rootstocks was observed in some years, linked with yield amount.
- **The smallest fruits were on MM106**, which may be the result of winter injury.
- **The largest fruits were on MTT 4 and MTT 5.**
- Number of non-standard fruits did not differ significantly.
- Observations of improved fruit colour were not consistent.
- **Taste panel** showed higher evaluation for MTT1, but it may be the result of low yield (large, well ripened fruits).
- **Evaluation of fruit quality needs further observation, on mature trees.**

Rootstock grouping

- **MTT 4** has been ranged as similar to M26 in Finland.
 - In our trial, the trunk diameter data allowed ranging it as **medium vigour, similar to MM 106, while the start of bearing was very early, like B9.**
- **MTT 5** was initially grouped with the medium vigour MM106, approaching size of A2 in Finland.
 - **In our trial it had vigour similar to B9.** The first flowering was more abundant than on MM106 and was slightly lower than on B9, with lower first yield. **The rootstock has a tendency to form root suckers.**
- **MTT 1** has been ranged as similar to B9 in Finland.
 - **In our trial it had very weak vigour. In Latvia it can be recommended only for vigorous cultivars like 'Gita', and planting distances should be reduced.**
- Differences in tree growth possibly caused by **differences in climate** (day length, temperatures)?

CONCLUSIONS

- There were significant differences between rootstocks as well as cultivars, because 'Gita' is more vigorous.
- **Rootstock MTT 4** is the most promising in Latvia. Its vigour is similar to MM 106, but start of bearing - to B9. It has better root winter-hardiness than MM 106.
- **Rootstock MTT 5** has vigour similar to B9, with similar start of bearing but lower first yields; it has a tendency to form root suckers.
- **Rootstock MTT 1** is not promising in Latvia, as it has too weak vigour; it may be used only for vigorous cultivars.
- **A promising cultivar-rootstock combination is 'Gita' on MTT 4.**



Thank you!