

# Knowledge-driven Baltic Cider Production and Branding for Growth and Competitiveness of SMEs

Project ID: EE-LV00145

## Baltic Cider

### WP1: Solution development - current state: first results of soil analysis and data relations to juice yield of apple cultivars and it's composition

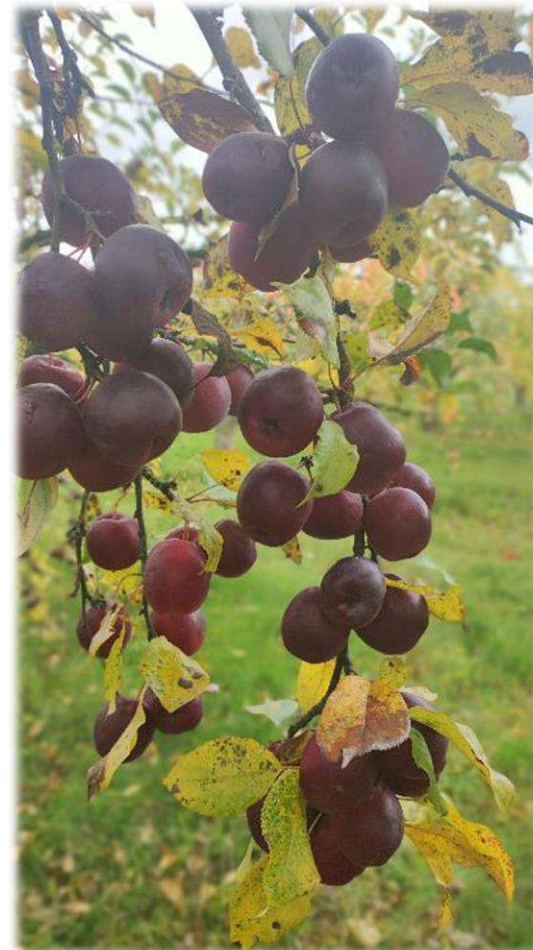


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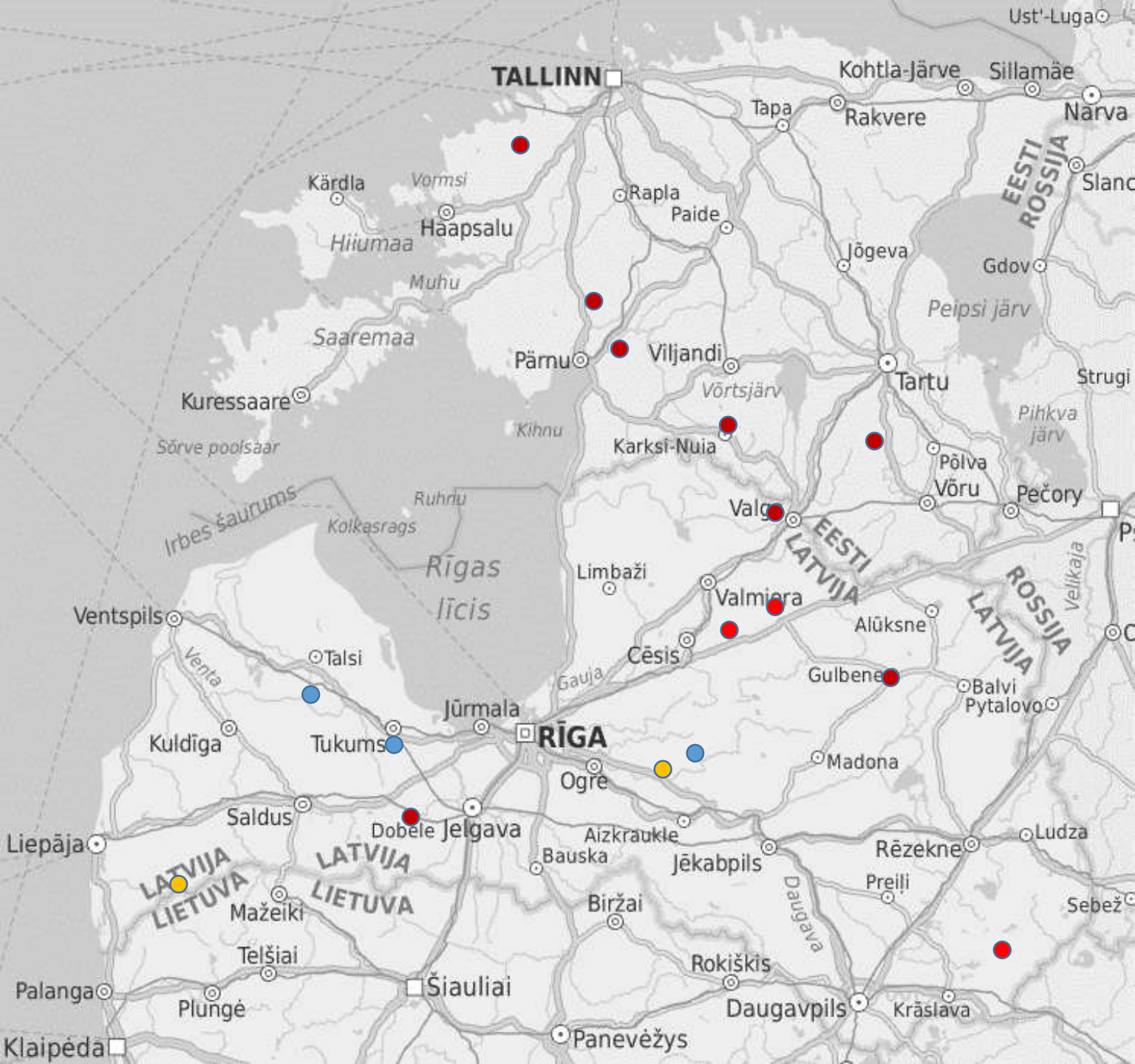


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**2nd PROJECT PARTNER MEETING**  
November, 12-13, 2024,  
Polli Horticultural Research Centre, Estonia



# Cider apple orchards, sites and cidery location



## The activities performed

- ❖ A unified methodology was developed for collecting and preparing fresh fruit, apple juice, and soil samples for analysis in cooperation with Polli (EMU) colleagues.
- ❖ Apple, juice and soil samples were collected.
- ❖ The amount of juice for apple samples was determined, and standard analyses were performed (SSC, pH, Titratable acidity)
- ❖ The samples (collected until 09.10.) were analysed for soil, and the analysis of aromatic compounds started.



# Preliminary results of cider apple juice

Date of analysis	ID	Location	Cultivar/ sample	Titrateable acidity, %	pH	Soluble solids, °Brix	Juice yield, %
17/10/2024	1083	Tori	Auksis	0.57	3.29	10.80	65.32
14/10/2024	1084	Polli	Šampanjer	1.03	3.10	10.97	66.65
14/10/2024	1085	Polli	Veiniõun	0.99	3.09	11.57	63.53
14/10/2024	1086	Polli	Vambola	0.70	3.25	11.67	62.89
14/10/2024	1087	Polli	Liivika	0.65	3.26	10.83	65.86
14/10/2024	1088	Polli	Sandra	0.33	3.62	11.67	62.22
16/10/2024	1089	Kodas	Melba	0.83	3.26	12.50	55.73
17/10/2024	1090	Jaanihanso	Auksis	0.69	3.27	12.90	67.20
17/10/2024	1091	Kodas	Auksis	0.53	3.24	11.47	70.61
17/10/2024	1092	Polli	Auksis	0.65	3.24	11.07	68.17
17/10/2024	1093	Kloostrimetsa	Auksis	0.77	3.18	12.80	66.59
24/10/2024	1094	Polli (a)	73-15-155 (a)	0.87	3.14	9.07	67.58
16/10/2024	1095	Polli	Maimu	0.66	3.24	11.50	69.86
16/10/2024	1096	Polli	Sidrunkollane taliõun	0.61	3.27	10.40	65.89
16/10/2024	1097	Polli	Sügisjoonik	0.57	3.33	11.27	59.09
16/10/2024	1098	Kloostimetsa	Pig's Orchard	0.64	3.32	13.40	67.95
16/10/2024	1099	Polli	Kerr	1.04	3.09	11.23	75.91
17/10/2024	1100	Kloostrimetsa (own juice)	Auksis	0.51	3.40	13.70	
16/10/2024	1101	Kloostrimetsa	Segu	0.43	3.48	12.13	
17/10/2024	1102	Jaanihanso (own juice)	Auksis	0.48	3.30	12.20	
14/10/2024	1103	Jaanihanso	Liivika	0.60	3.26	12.37	
18/10/2024	1104	Tori (own juice)	Auksis	0.56	3.30	10.77	
24/10/2024	1105	Jaanihanso	Orlovski sinap	0.85	3.21	13.57	65.69
29/10/2024	1106	Kloostrimetsa	Dabinett	0.27	3.83	13.30	63.65
29/10/2024	1107	Kloostrimetsa	Yarlington Mill	0.30	3.83	14.10	44.78
24/10/2024	1108	Kodas	Orlovski sinap	0.77	3.24	11.90	66.79
24/10/2024	1109	Polli	Orlovski sinap	0.81	3.19	11.77	67.34
24/10/2024	1110	Polli (b)	73-15-155 (b)	0.75	3.24	10.30	63.69
18/10/2024	1127	LatHort	Auksis	0.44	3.38	11.37	63.31
18/10/2024	1128	SIA Jumpravas sidrs	Pavilostas sidrabols	0.32	4.01	14.80	64.46
18/10/2024	1129	LatHort	Nr 19-97-98	0.68	3.23	12.80	59.79
22/10/2024	1130	LatHort	Malus prunifoliana	1.71	3.11	13.80	50.85
22/10/2024	1131	LatHort	Pures sidarbols	0.20	4.40	15.30	54.55
22/10/2024	1132	LatHort	Ritika	0.52	3.60	16.20	44.45
22/10/2024	1133	LatHort	H-1-03-1	0.12	4.50	12.80	52.19
18/10/2024	1134	LAUSKIS	Auksis	0.31	3.49	11.47	63.85
22/10/2024	1135	LatHort	Dzeltēnais skabais, ražīgs krebs	2.99	2.73	11.17	59.82
22/10/2024	1136	SIA Jumpravas sidrs	Jumpravas baltais	0.58	3.11	12.93	62.99
22/10/2024	1137	Mūrbūdu sidra darītava	Viltņieks	1.23	3.15	12.40	55.36
24/10/2024	1138	Mūrbūdu sidra darītava	Lidumnieku plumjaboli	1.01	3.39	15.57	36.80
18/10/2024	1139	Tālavas SIA	Auksis	0.52	3.48	13.73	48.89
24/10/2024	1140	LatHort	Sinap Orlovslīj	0.76	3.12	12.20	60.48
29/10/2024	1141	LatHort	Slinkis	0.18	3.98	13.80	59.97
29/10/2024	1142	LatHort	H-13-97-14	1.20	3.04	14.00	47.54
29/10/2024	1143	LatHort	H-7-03-47	0.16	4.23	12.70	54.87
29/10/2024	1144	LatHort	H-16-97-86	0.42	3.51	12.50	61.29
29/10/2024	1145	LatHort	H-4-03-21	0.17	4.05	10.93	56.78

## Preliminary results of cider apple juice

Cultivars (selected)	Lowest titratable acidity (frozen juice), %	Highest juice pH	Highest soluble solids content (frozen juice), °Brix	Highest juice yield, %
	<b>H-1-03-1</b> (0,12– LatHort)	<b>Pūres sidrābols</b> (4,4 – LatHort)	<b>Ritika</b> (16,2 – LatHort)	<b>Kerr</b> (75,9 – EMU)
	<b>H-7-03-47</b> (0,16– LatHort)	<b>H-1-03-1</b> (4,5 – LatHort)	<b>Lidumnieki plumapple</b> (15,6 – Mūrbūdu sidrs)	<b>Maimu</b> (69,9 – EMU)
	<b>H-4-03-21</b> (0,17– LatHort)	<b>H-7-03-47</b> (4,2 – LatHort)	<b>Pūres sidrābols</b> (15,3 – LatHort)	<b>Pig's orchard</b> (67,9 – Kloostrimetsa)
Auksis	<b>0,31</b> (Lauskis)	<b>3,5</b> (Lauskis, Tālavas cidery)	<b>13,7</b> (Kloostrimetsa, Tālavas cidery)	<b>70,6</b> (Kodas)
Dabinet	<b>0,27</b> (Kloostrimetsa)	<b>3,8</b> (Kloostrimetsa)	<b>13,3</b> (Kloostrimetsa)	<b>63,6</b> (Kloostrimetsa)
Sinap Orlovskii	<b>0,76</b> (LatHort, Koodas)	<b>3,2</b> (Koodas, EMU, Jaanihanso Cider House)	<b>13,6</b> (Jaanihanso Cider House)	<b>67,3</b> (EMU)

## Soil agrochemical properties (samples collected until October 17)

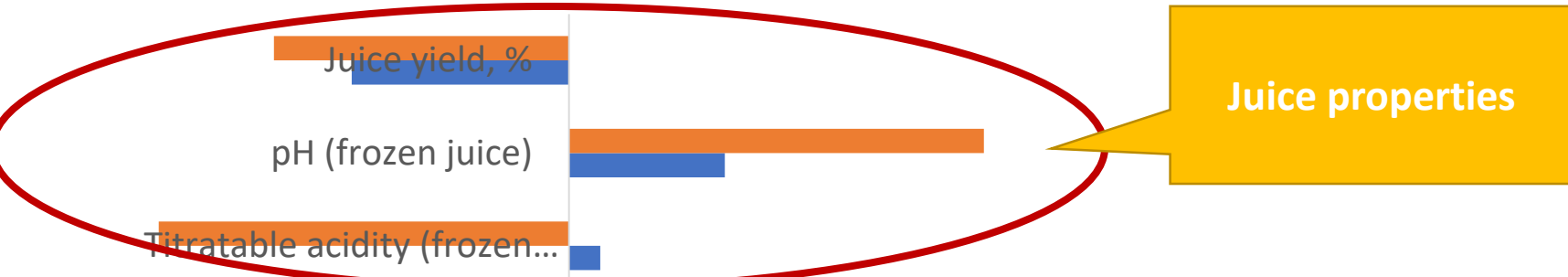
Soil parameters	Average (min – max)	Auksis	Dabinet	Sinap Orlovskii
pH	6,4 (4,9 – 7,4)	6,7 (5,4 – 7,4)	6,9 (6,6 – 7,1)	6,7 (6,3 – 7,1)
Organic matter, %	3,9 (2,1 – 9,1)	4,9 (2,1 – 9,1)	4,5 (2,6 – 6,4)	6,2 (3,6 – 8,8)
P <sub>2</sub> O <sub>5</sub> , mg/kg	151,6 (21 – 627)	233,9 (84 – 505)	130 (70 – 190)	360,5 (94 – 627)
K <sub>2</sub> O, mg/kg	160,7 (46 – 396)	165,1 (46 – 370)	120 (111 – 129)	278,5 (161 – 396)
Mg, mg/kg	572,4 (67 – 5965)	1223 (67 – 5449)	84,5 (82 – 87)	3079 (193 – 5965)
Ca, mg/kg	1721,8 (589 – 10297)	3413,1 (723 – 8718)	1215,5 (805 – 1626)	5614 (931 – 10297)
B, mg/kg	1,1 (0,4 – 2,4)	1,2 (0,5 – 2,4)	1,3 (0,9 – 1,6)	1,8 (1,1 – 2,4)
Cu, mg/kg	4,2 (1,2 – 10,5)	2,8 (1,4 – 5,5)	1,7 (1,6 – 1,7)	5,4 (5,3 – 5,5)
Mn, mg/kg	114,7 (26,5 – 250)	134,2 (26,5 – 250)	128,5 (105 – 152)	184,5 (107 – 262)
Zn, mg/kg	3,9 (1,3 – 33,5)	5,8 (1,5 – 20,2)	3,1 (2,3 – 3,8)	18 (2,5 – 33,5)
S-SO <sub>4</sub> , mg/kg	< 1,0 – 6,4	<1,0 – 5,3	<1,0 – 1,5	<1,0 – 6,4
Ratio: Ca/Mg	6,7 (1,6 – 23,1)	7,3 (1,6 – 23,1)	14,3 (9,8 – 18,7)	3,3 (1,7 – 4,8)
Ratio: Ca/K	10,3 (3,3 – 42,6)	20,3 (3,8 – 42,6)	10,4 (6,2 – 14,6)	15,9 (5,8 – 26)

**Locations:**

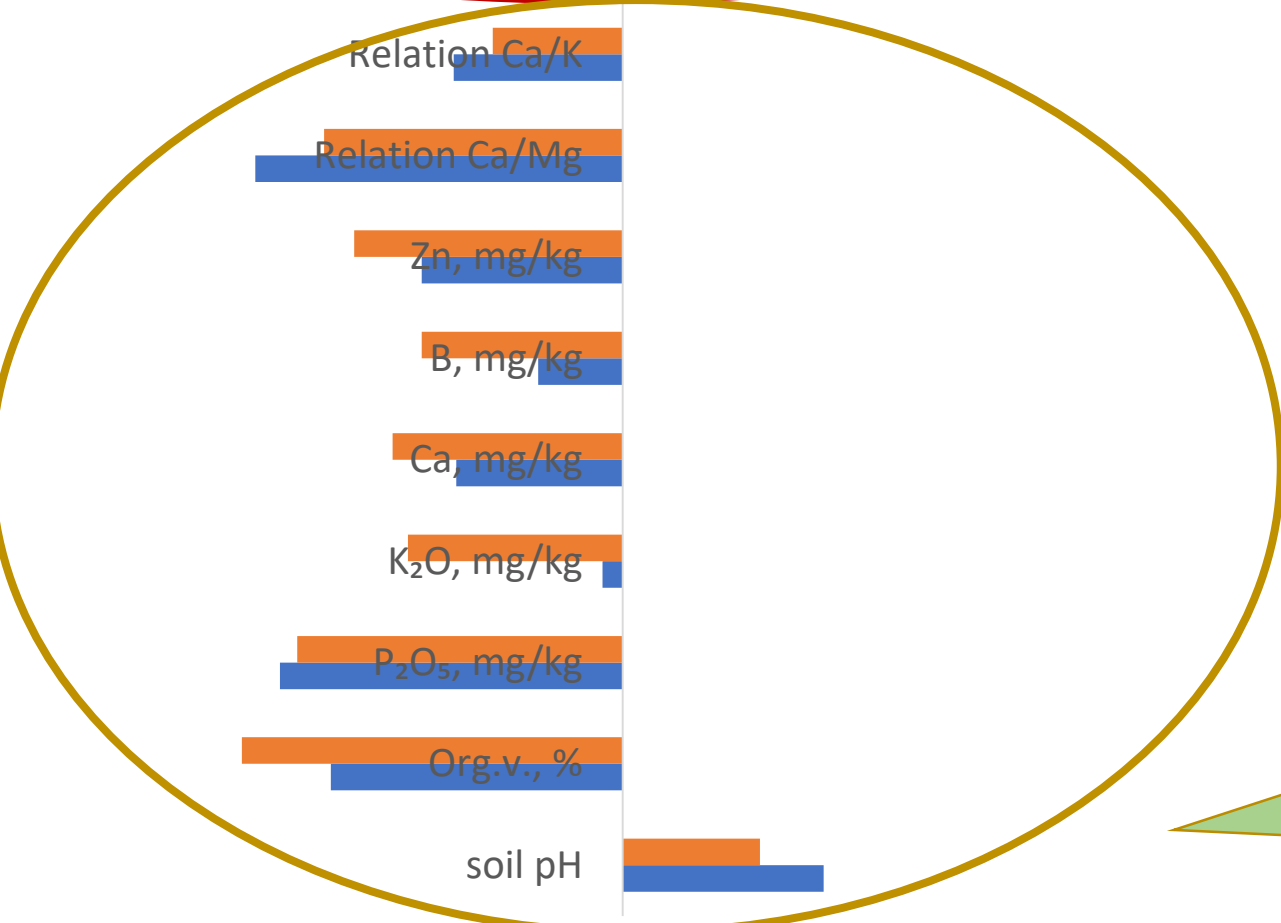
LatHort, EMU, Tālava cidery,  
Jaanihanso Cider House, Kodas,  
Tori Jõesuu Siidri, Kloostrimetsa

Abuls cidery, Kloostrimetsa

LatHort, Jaanihanso Cider House

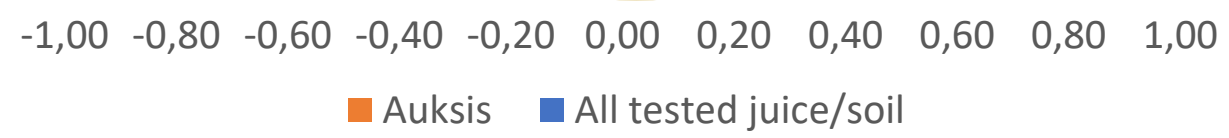


**Juice properties**

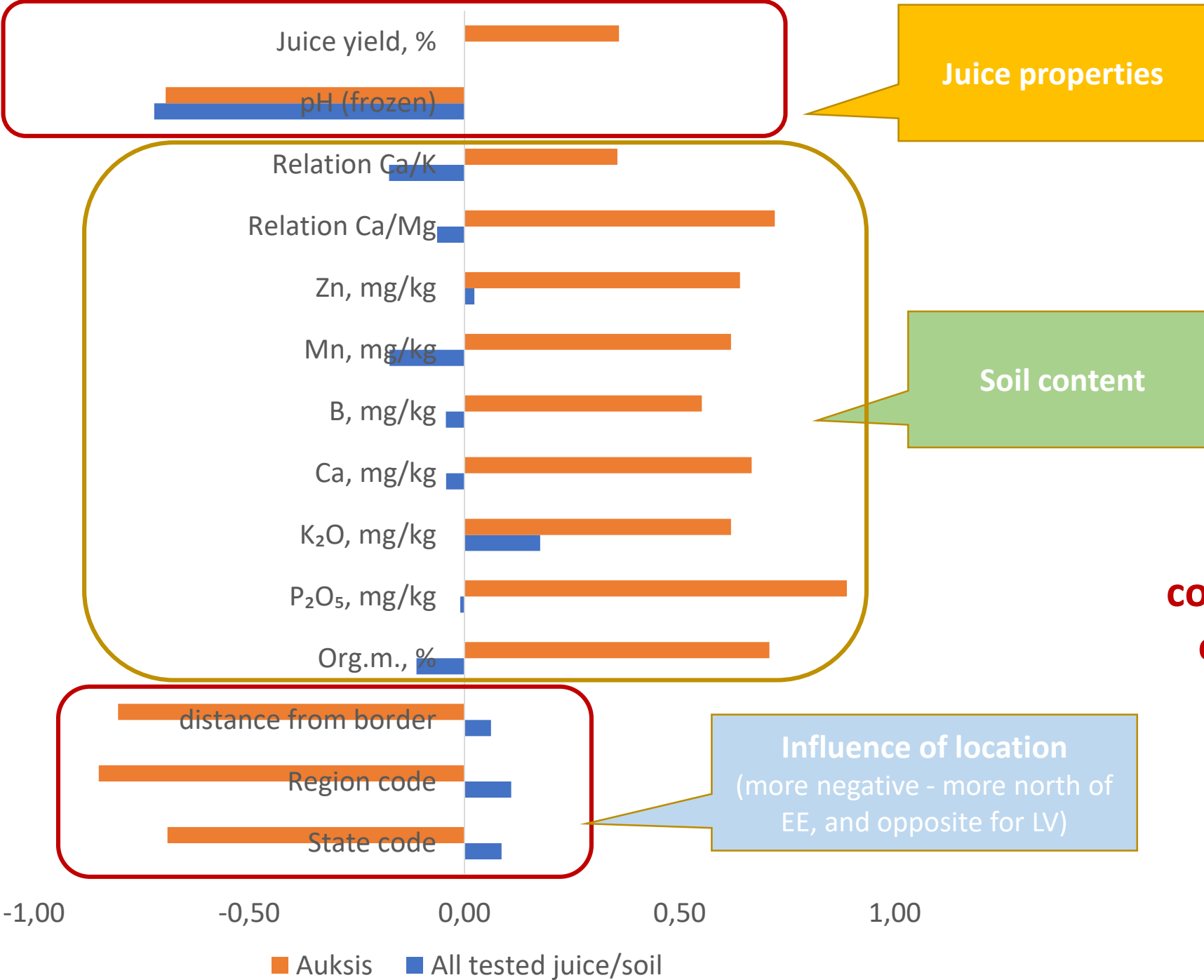


**Significant coefficients of correlation to distance from border of LV and EE**  
 (more negative - more north of EE, and opposite for LV)

**Soil content**



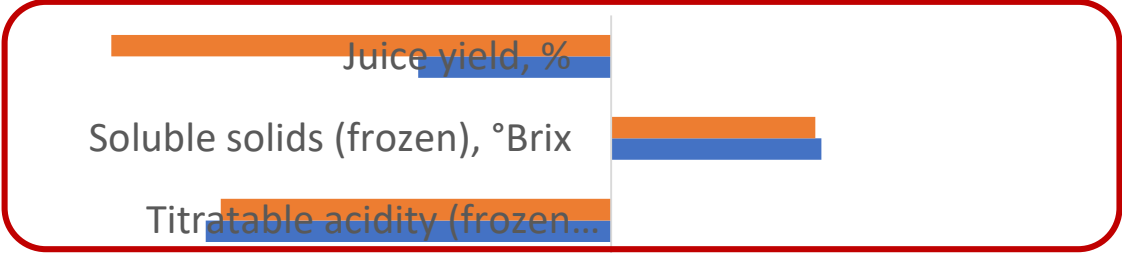
# Significant coefficients of correlation to titratable acidity of cider apple juice (frozen)



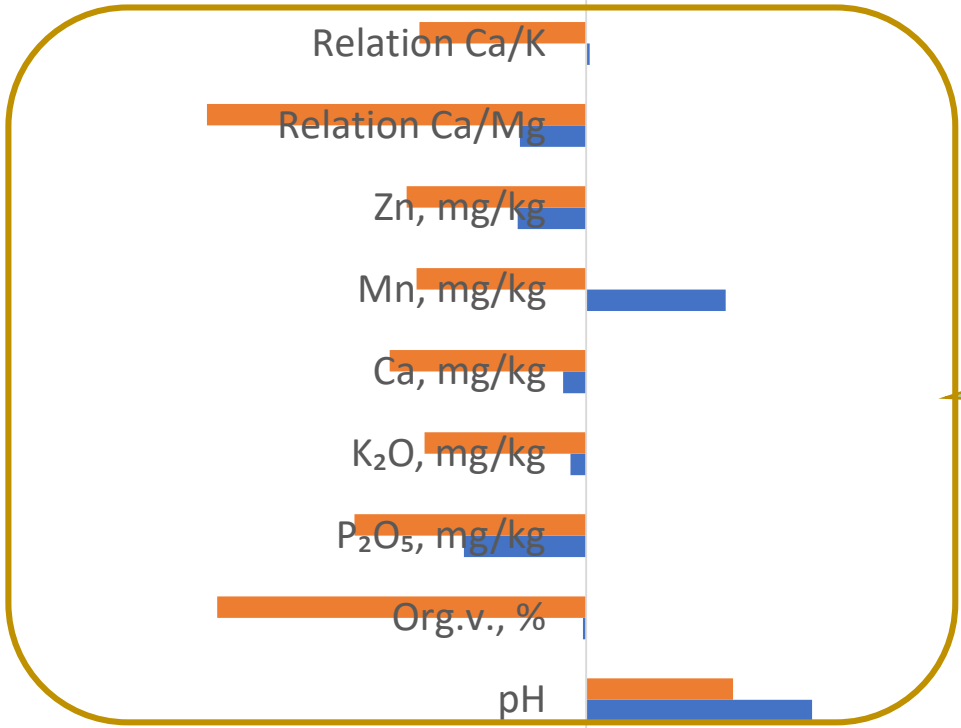
-1,00      -0,50      0,00      0,50      1,00

■ Auksis    ■ All tested juice/soil



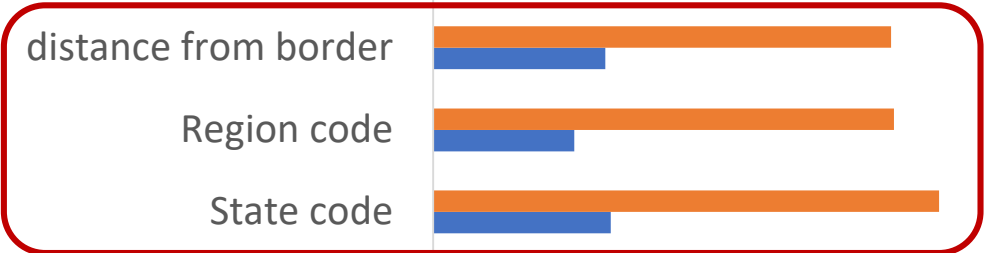


**Juice properties**

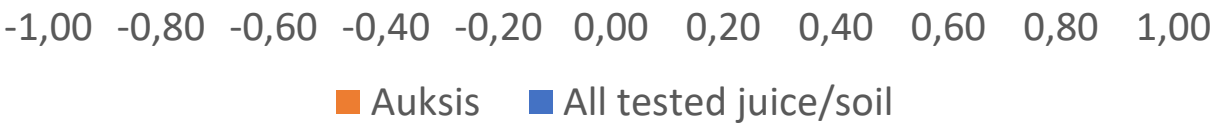


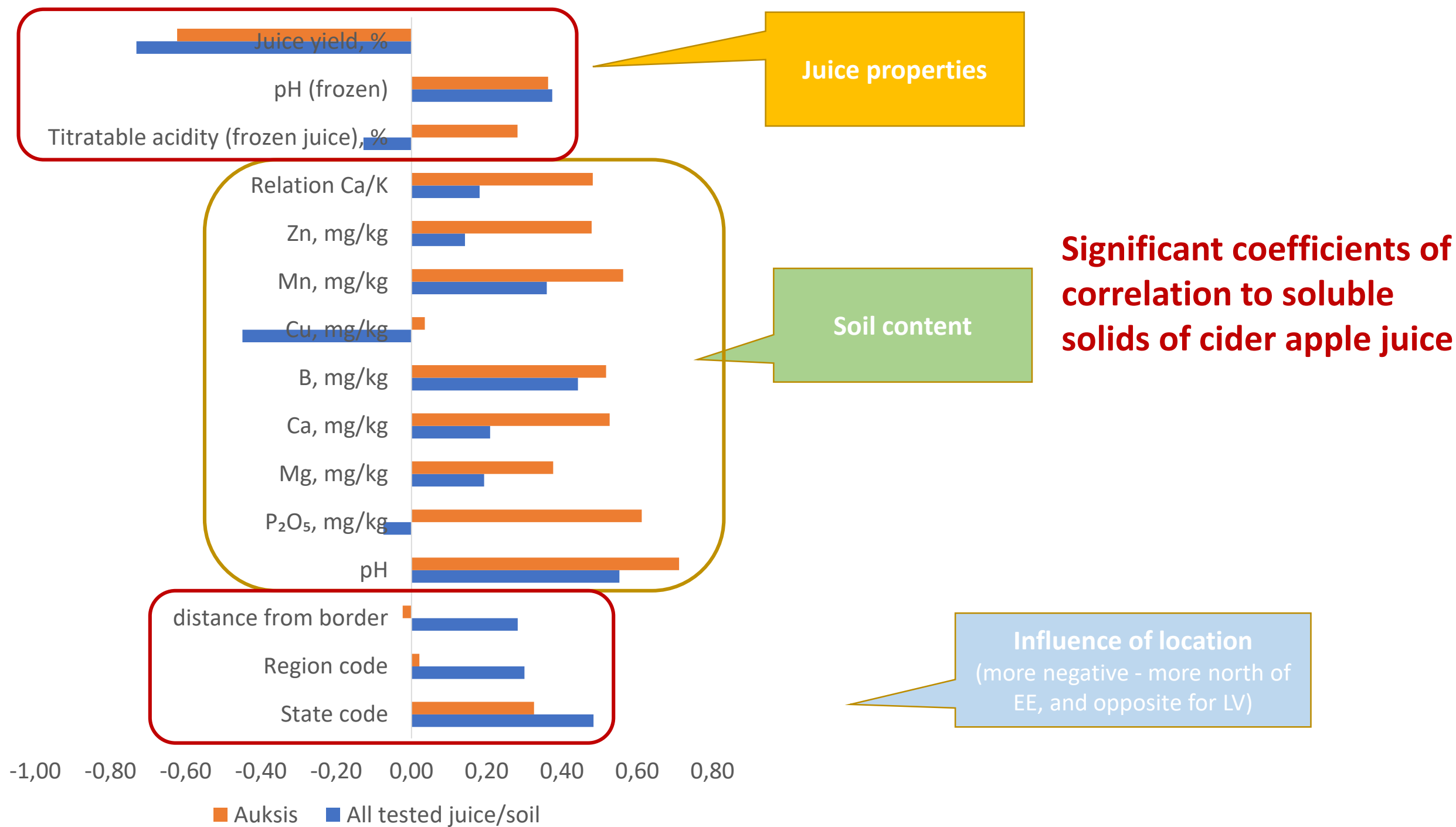
**Soil content**

**Significant coefficients of correlation to pH of cider apple juice**



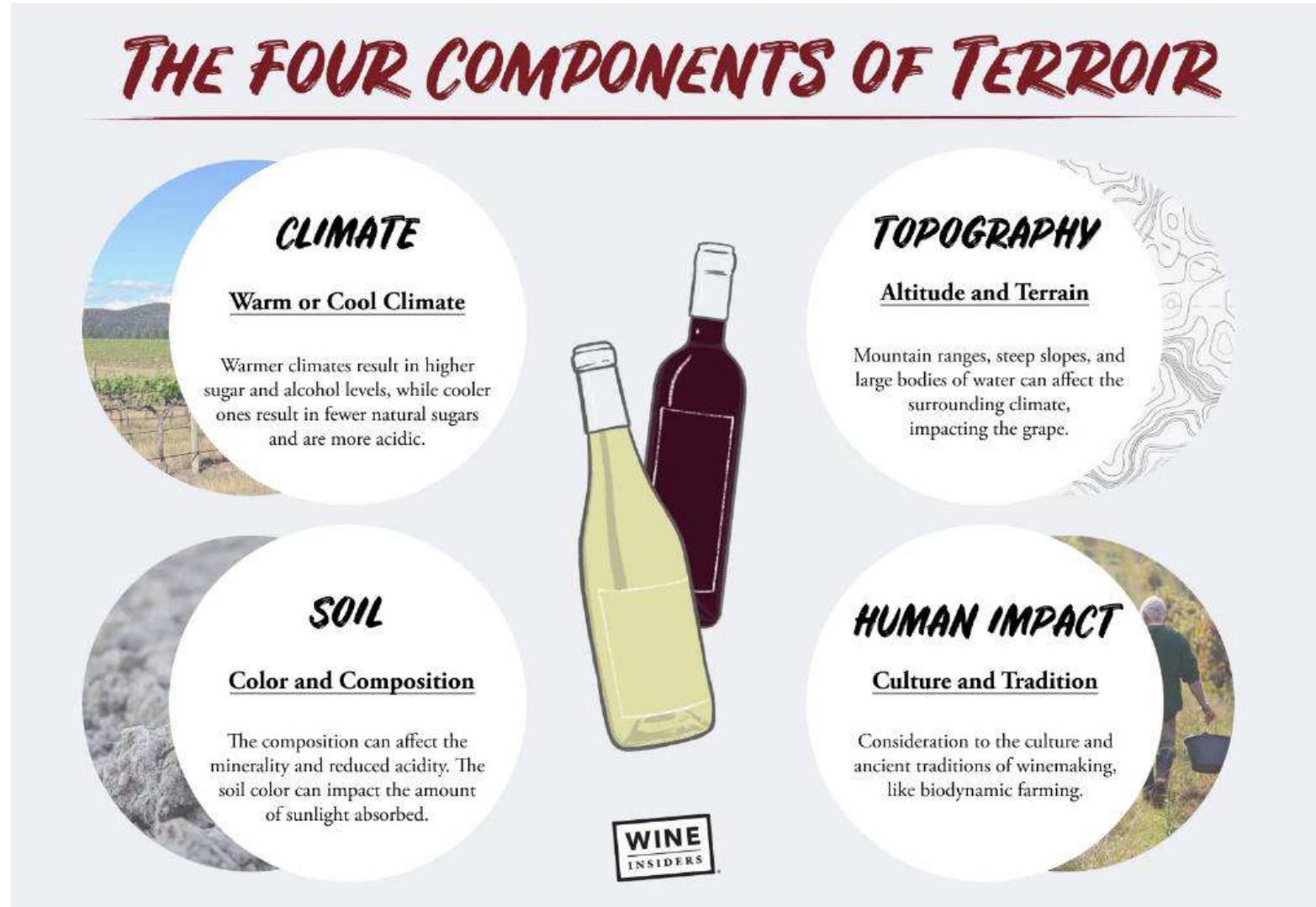
**Influence of location**  
(more negative - more north of EE, and opposite for LV)





## Soil properties depend of:

- soil granulometric content (sand – sandy loam – clay);
- Soil type (podzolic, gley etc.);
- Soil moisture regime;
- Relief, as well as processes of erosion;
- Orchard management practice (use of fertilizers organic or mineral, green manure, etc.);



# Tori Jõesuu Siidri



## Soil parameters

pH	5,4
Organic matter, %	5,7
P <sub>2</sub> O <sub>5</sub> , mg/kg	128
K <sub>2</sub> O, mg/kg	146
Mg, mg/kg	160
Ca, mg/kg	961
B, mg/kg	0,9
Cu, mg/kg	1,5
Mn, mg/kg	26,5
Zn, mg/kg	1,9
S-SO <sub>4</sub> , mg/kg	1,2
Ratio: Ca/Mg	6,0
Ratio: Ca/K	6,6

Soil parameters	
pH	4,9 – 6,6
Organic matter, %	2,6 – 4,6
P <sub>2</sub> O <sub>5</sub> , mg/kg	84 – 93
K <sub>2</sub> O, mg/kg	46 – 104
Mg, mg/kg	87 – 205
Ca, mg/kg	659 – 1169
B, mg/kg	0,8 – 1,2
Cu, mg/kg	1,4 – 1,5
Mn, mg/kg	63,5 – 82,8
Zn, mg/kg	1,3 – 1,7
S-SO <sub>4</sub> , mg/kg	< 1,0 – 1,0
Ratio: Ca/Mg	5,7 – 7,6
Ratio: Ca/K	6,3 – 25,4

Apple cultivars represented: 'Auksis' and 'Melba'

Soil parameters	
pH	7,1 – 7,4
Organic matter, %	6,4 – 9,1
P <sub>2</sub> O <sub>5</sub> , mg/kg	190 – 505
K <sub>2</sub> O, mg/kg	111 – 183
Mg, mg/kg	87 – 337
Ca, mg/kg	1626 – 7792
B, mg/kg	1,6 – 1,9
Cu, mg/kg	1,6 – 2,2
Mn, mg/kg	152 – 250
Zn, mg/kg	3,8 – 10,5
S-SO <sub>4</sub> , mg/kg	1,5 – 5,1
Ratio: Ca/Mg	18,7 – 23,1
Ratio: Ca/K	14,6 – 42,58

Apple cultivars represented: 'Dabinet' , 'Yarlington Mill', 'Auksis' and mix

# JAANIHANSO SIIDRIVABRIK

## Soil parameters

pH	7,1 – 7,2
Organic matter, %	6,8 – 8,8
P <sub>2</sub> O <sub>5</sub> , mg/kg	167 - 627
K <sub>2</sub> O, mg/kg	353 - 396
Mg, mg/kg	1794 - 5965
Ca, mg/kg	3340 - 10297
B, mg/kg	1,8 – 2,4
Cu, mg/kg	3,3 – 5,5
Mn, mg/kg	187 - 262
Zn, mg/kg	8,4 – 33,5
S-SO <sub>4</sub> , mg/kg	2,4 – 6,4
Ratio: Ca/Mg	1,6 – 1,9
Ratio: Ca/K	9,5 – 26,0

## TERROIR

We come from the North. Large parts of Estonia lay on a layer of limestone and the soil is generally rocky with limestone outcrops, just like in some of the best cider producing regions of South-West England and Normandy. Estonian summer is short and chilly but autumns are long, producing perfect less watery fruits full of flavors.

<http://www.ciderhouse.ee/>



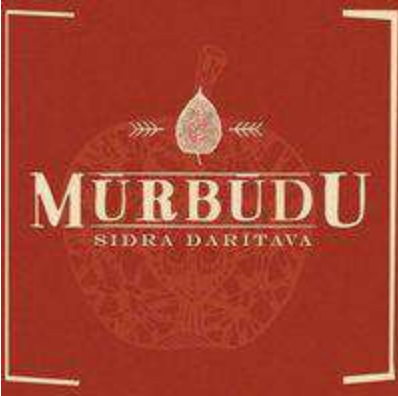
<b>Soil parameters</b>	<b>Auksis</b>
pH	7,2
Organic matter, %	2,1
P <sub>2</sub> O <sub>5</sub> , mg/kg	208
K <sub>2</sub> O, mg/kg	92
Mg, mg/kg	726
Ca, mg/kg	1544
B, mg/kg	0,9
Cu, mg/kg	1,4
Mn, mg/kg	96,7
Zn, mg/kg	1,9
S-SO <sub>4</sub> , mg/kg	1,3
Ratio: Ca/Mg	2,1
Ratio: Ca/K	16,8



Soil parameters	Kerr & Dabinet	Indriķis	Dagdas rūgtais
pH	6,4 – 6,6	7,1	5,1
Organic matter, %	2,5 – 2,9	4,6	3,7
P <sub>2</sub> O <sub>5</sub> , mg/kg	70 - 104	21	31
K <sub>2</sub> O, mg/kg	115 - 129	132	90
Mg, mg/kg	82 - 87	898	117
Ca, mg/kg	777 - 805	2640	589
B, mg/kg	0,8 – 1,1	0,9	1,1
Cu, mg/kg	1,4 – 1,7	1,5	1,6
Mn, mg/kg	91,9 – 105	93,7	79
Zn, mg/kg	1,7 – 2,5	1,6	1,6
S-SO <sub>4</sub> , mg/kg	< 1,0	1,8	< 1,0
Ratio: Ca/Mg	8,9 – 9,8	2,9	5
Ratio: Ca/K	6,1 – 6,7	20	6,5



'Dabinet'



Soil parameters	Līdumnieki	Dārzs
pH	5,7 – 5,9	7,1
Organic matter, %	4,0 – 4,6	2,4
P <sub>2</sub> O <sub>5</sub> , mg/kg	37 – 68	146
K <sub>2</sub> O, mg/kg	181 – 182	67
Mg, mg/kg	133 – 176	254
Ca, mg/kg	818 – 960	1075
B, mg/kg	1,0 – 1,1	0,7
Cu, mg/kg	1,4 – 2,0	1,2
Mn, mg/kg	97,6 – 128,0	87,8
Zn, mg/kg	2,4 – 4,0	2,5
S-SO <sub>4</sub> , mg/kg	<1,0	<1,0
Ratio: Ca/Mg	5,5 – 6,2	4,2
Ratio: Ca/K	4,5 – 5,3	16,0

[https://www.facebook.com/murbudu/?locale=lv\\_LV](https://www.facebook.com/murbudu/?locale=lv_LV)

Soil parameters	Auksis	Sandra, Liivika, Vambola, Veinioun, Šampanjer	Kerr, 73-15-155, Maimu, Sugisjoonik, Sidrunkollane talion
pH	5,5	5,9	4,9
Organic matter, %	2,5	3,2	2,8
P <sub>2</sub> O <sub>5</sub> , mg/kg	192	182	220
K <sub>2</sub> O, mg/kg	191	114	153
Mg, mg/kg	67	114	74
Ca, mg/kg	723	978	676
B, mg/kg	0,5	0,7	0,4
Cu, mg/kg	2,9	5,5	10,5
Mn, mg/kg	88,1	74,7	66,5
Zn, mg/kg	1,5	1,9	3,8
S-SO <sub>4</sub> , mg/kg	< 1,0	< 1,0	< 1,0
Ratio: Ca/Mg	10,8	8,6	9,1
Ratio: Ca/K	3,8	8,6	4,4

<b>Soil parameters</b>	<b>27.kv.</b> Auksis, Sinap Orlovskii	<b>16.kv.</b> Dabinet, etc.	<b>17.kv.</b>	<b>5./6.kv.</b>	<b>13.kv.</b>
pH	6,3 – 7,4	6,6 – 7,4	5,8 – 7,3	6 – 6,4	6,5
Organic matter, %	3,6	2,4 – 3,5	2,8 – 4	2,5 – 2,8	3,5
P <sub>2</sub> O <sub>5</sub> , mg/kg	84 – 94	74 – 149	45 – 101	99 – 123	88
K <sub>2</sub> O, mg/kg	128 – 161	159 – 305	100 – 235	178 – 202	138
Mg, mg/kg	193 – 1617	199 – 896	179 – 857	140 – 142	229
Ca, mg/kg	931 – 2985	960 – 2055	811 – 2044	753 – 791	1003
B, mg/kg	1,1 – 1,2	1 – 1,1	0,9 – 1,3	1 – 1,2	0,8
Cu, mg/kg	4,9 – 5,3	2,7 – 8,3	3,4 – 4,9	4,1 – 4,8	4,8
Mn, mg/kg	107 – 145	79,4 – 117	119 – 186	78,4 – 103	102
Zn, mg/kg	2,5 – 2,7	1,8 – 2,6	2,1 – 3	1,9 – 2,5	2
S-SO <sub>4</sub> , mg/kg	< 1,0 – 2	< 1,0 – 1,3	< 1,0 – 1,4	< 1,0	< 1,0
Ratio: Ca/Mg	1,9 – 4,8	2,3 – 5,1	2,4 – 4,5	5,4 – 5,6	4,4
Ratio: Ca/K	5,8 – 23,3	3,3 – 12,9	7,7 – 9,6	3,7 – 4,4	7,3

# AROMA COMPOUNDS



Title	Description
Butanoic acid, ethyl ester	Ester with a distinct fruity aroma; often found in fruit juices as a flavour-enhancing compound.
Acetic acid, butyl ester	A fruity, volatile ester that gives juices a specific aroma and contributes to sensory richness.
Hexanal	Aldehyde with a fresh, grassy aroma; naturally occurring in fruits, giving them a characteristic grassy note.
1-Butanol, 2-methyl, acetate	A fruity ester that enhances the sweet aromas in fruit juices and enriches their aromatic profile.
1-Butanol	A medium-volatile alcohol with a fruity smell; naturally occurring in the fermentation process, giving fruit juices a characteristic aroma.
1-Butanol, 2-methyl-, (S)	A natural isomer of alcohol with a fruity smell, often found in fruit fermentation products.
2-Hexenal	Aldehyde with a distinctly fresh aroma; gives fruit juices a natural freshness and herbal note.
Acetic acid, hexyl ester	Ester with a fruity and floral scent; naturally occurring in juices, participates in the formation of the aromatic properties of fruits.
2-Hexen-1-ol, acetate	A compound with a sweet and fruity scent contributes to creating complex aromas in juices and their persistence.
2-Hexen-1-ol, acetate, (Z)	A sweet and strongly aromatic ester that helps accentuate the composition of fruit scents in juices.
1-Hexanol	A combination of alcohol with the aroma of grass, and plants; gives juices a touch of naturalness.
2-Hexen-1-ol (Z)	A natural blend with a fruity and grassy aroma; found in fruits and enriches juices with a note of freshness.
2-Hexen-1-ol (E)	A natural alcohol blend with a fresh, grassy aroma; gives natural aromatic depth to fruit juices.

# AROMA COMPOUNDS 'AUKSIS'

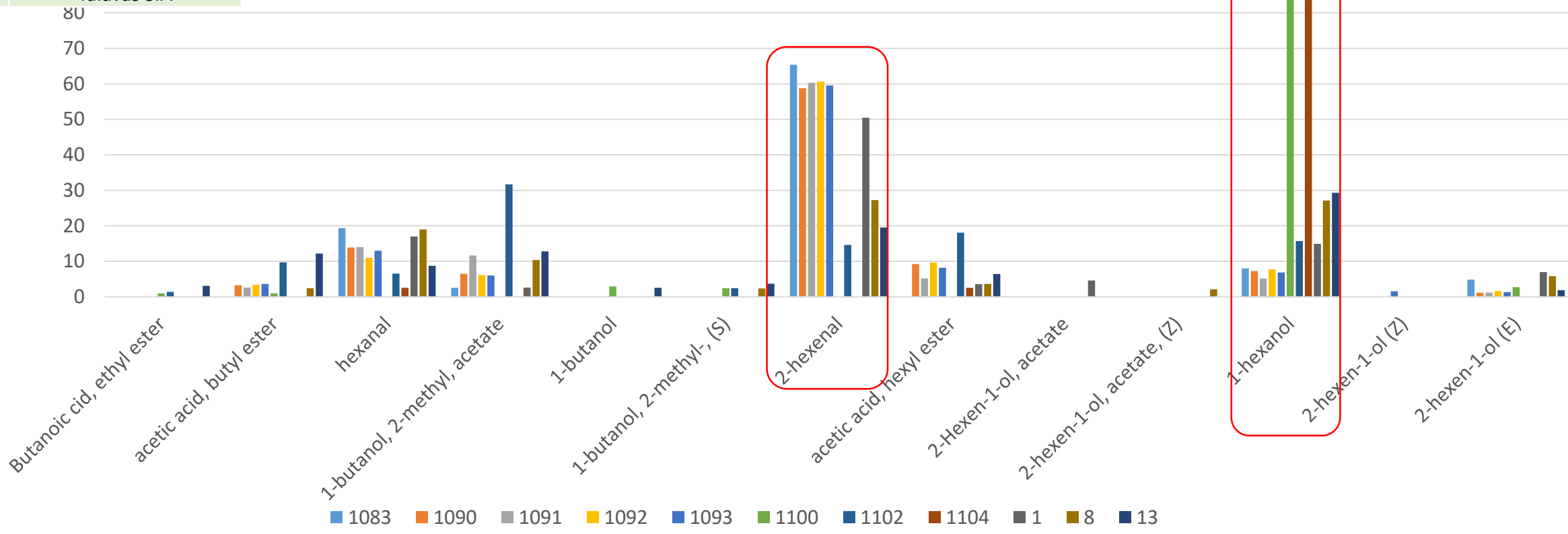


TOTAL, %		Tori	Jaanihanso	Kodas	Polli	Kloostrimetsa	Kloostrimetsa (own juice)	Jaanihanso (own juice)	Tori (own juice)	LatHort	LAUSKIS	Tālavas SIA
CAS	Aroma compound	Sample no										
		1083	1090	1091	1092	1093	1100	1102	1104	1 (LV)	8 (LV)	13 (LV)
105-54-4	Butanoic acid, ethyl ester						0.93	1.39				3.08
123-86-4	Acetic acid, butyl ester		3.27	2.57	3.36	3.62	0.94	9.67			2.37	12.18
66-25-1	hexanal	19.33	13.90	14.01	10.97	12.97		6.52	2.54	16.98	19.00	8.71
624-41-9	1-butanol, 2-methyl, acetate	2.50	6.47	11.62	6.11	5.98		31.66		2.56	10.36	12.78
71-36-3	1-butanol						2.90					2.50
1565-80-6	1-butanol, 2-methyl-, (S)						2.38	2.37			2.35	3.69
505-57-7	2-hexenal	65.38	58.74	60.27	60.65	59.57		14.62		50.47	27.26	19.51
142-92-7	acetic acid, hexyl ester		9.20	5.18	9.62	8.16		18.10	2.54	3.55	3.64	6.39
10094-40-3	2-Hexen-1-ol, acetate									4.56		
56922-75-9	2-hexen-1-ol, acetate, (Z)										2.10	
111-27-3	1-hexanol	7.97	7.27	5.16	7.66	6.82	90.14	15.67	94.92	14.92	27.13	29.29
928-94-9	2-hexen-1-ol (Z)					1.58						
928-95-0	2-hexen-1-ol (E)	4.82	1.15	1.20	1.63	1.31	2.71			6.96	5.80	1.87

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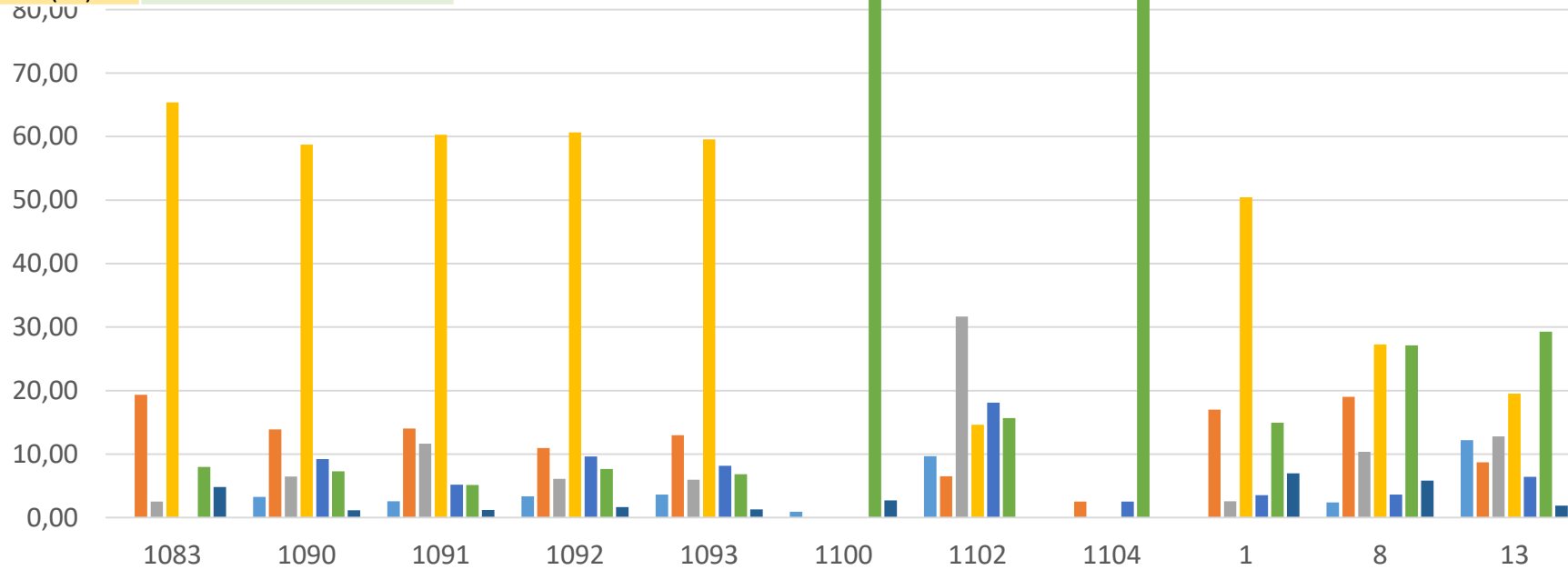
1083	Tori
1090	Jaanihanso
1091	Kodas
1092	Polli
1093	Kloostrimetsa
1100	Kloostrimetsa (own juice)
1102	Jaanihanso (own juice)
1104	Tori (own juice)
1 (LV)	LatHort
8 (LV)	LAUSKIS
13 (LV)	Tālavas SIA



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- acetic acid, butyl ester
- hexanal
- 1-butanol, 2-methyl, acetate
- 2-hexenal
- acetic acid, hexyl ester
- 1-hexanol
- 2-hexen-1-ol (E)

**2-Hexenal** Aldehyde with a distinctly fresh aroma; gives fruit juices a natural freshness and herbal note.

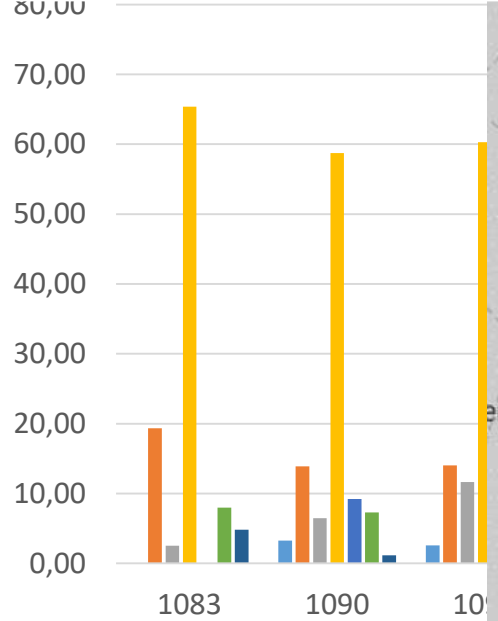
**1-Hexanol** A combination of alcohol with the aroma of grass, and plants; gives juices a touch of naturalness.



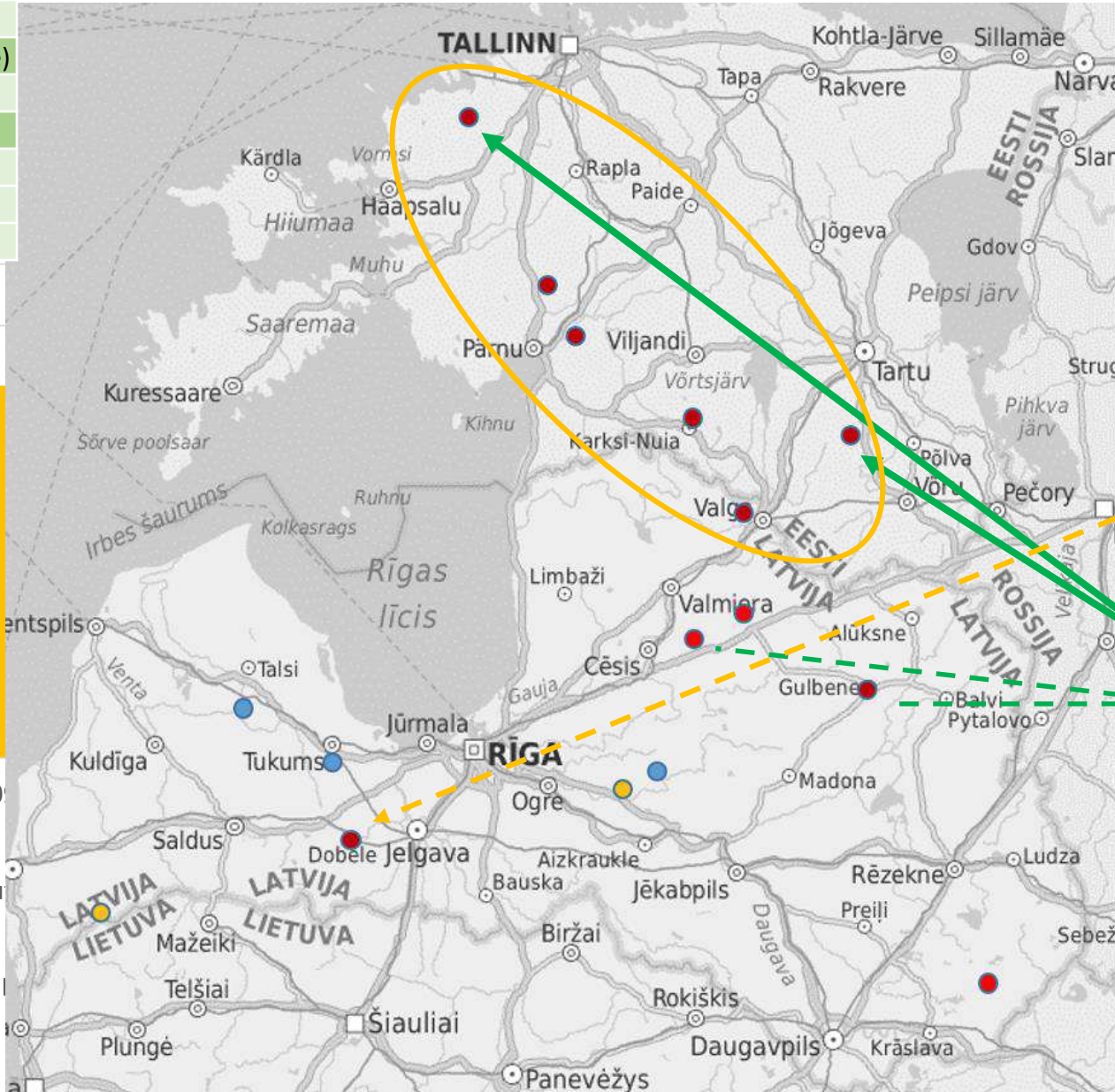
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■ acetic acid, butanoic acid  
■ 2-hexenal  
■ 2-hexen-1-ol (linalool)



2-Hexenal Aldehyde with a distinctly fresh aroma; gives fruit juices a natural freshness and herbal note.

1-Hexanol A combination of alcohol with the aroma of grass, and plants; gives juices a touch of naturalness.

## Next steps:

- Complete sample collection and analyses;
- Add data including horticultural practices, meteorological information of 2024, and long term (last 30 years);
- Mark a cider road, describe related climate, relief, and typical soils;
- Questionnaires of cider producers, cider consumers

