

Cultivation trial and other studies on Finnish hop

Merja Hartikainen & Luke Hop Research Group

Natural Fibers - Naturfiber: Mångsidiga nischgrödor/
Yrkeshögskolan Novias tredje naturfiberseminarium 9.11.2022

Pic: Merja Hartikainen, Luke

In addition financing: 7 breweries
and 2 nursery actors



Euroopan maaseudun
kehittämisen maatalousrahasto:
Eurooppa investoi maaseutualueisiin



Maiju ja Yrjö Rihalan
PUUTARHASÄÄTIÖ



Maa- ja metsätalous-
ministeriö



Luke's hop research group 2017-



Lidija Bitz:
DNA studies,
hop call



Lucia Blasco:
microbiological
studies



Anna Happonen:
hop fiber
structure studies



Merja Hartikainen:
management, hop
call, morphological
studies, oral memory,
farmer cooperation



Susanne Heiska:
Hop production
development, Luke
hop services



Timo Hurme:
Statistics



Erja Huusela:
pest studies,
Integrated
plant protection



Marjo
Keskitalo:
Preliminary
studies
on hops
cultivation



Jaana Laamanen:
Hop certified
production



Antti Laine:
Cultivation
technology



Pertti Marnila:
Anti-
inflammatory
studies



Heikki Mäkinen:
profitability
accounting



Anna Nukari:
Hop in vitro
cultures,
management



Juha-
Matti
Pihlava:
Chemical
analyses



Marika
Rastas:
hop
diseases,
Integrated
plant
protection



Pekka Saranpää:
Hop side
streams



Terhi Suojala-
Ahlfors
Hop PGRs



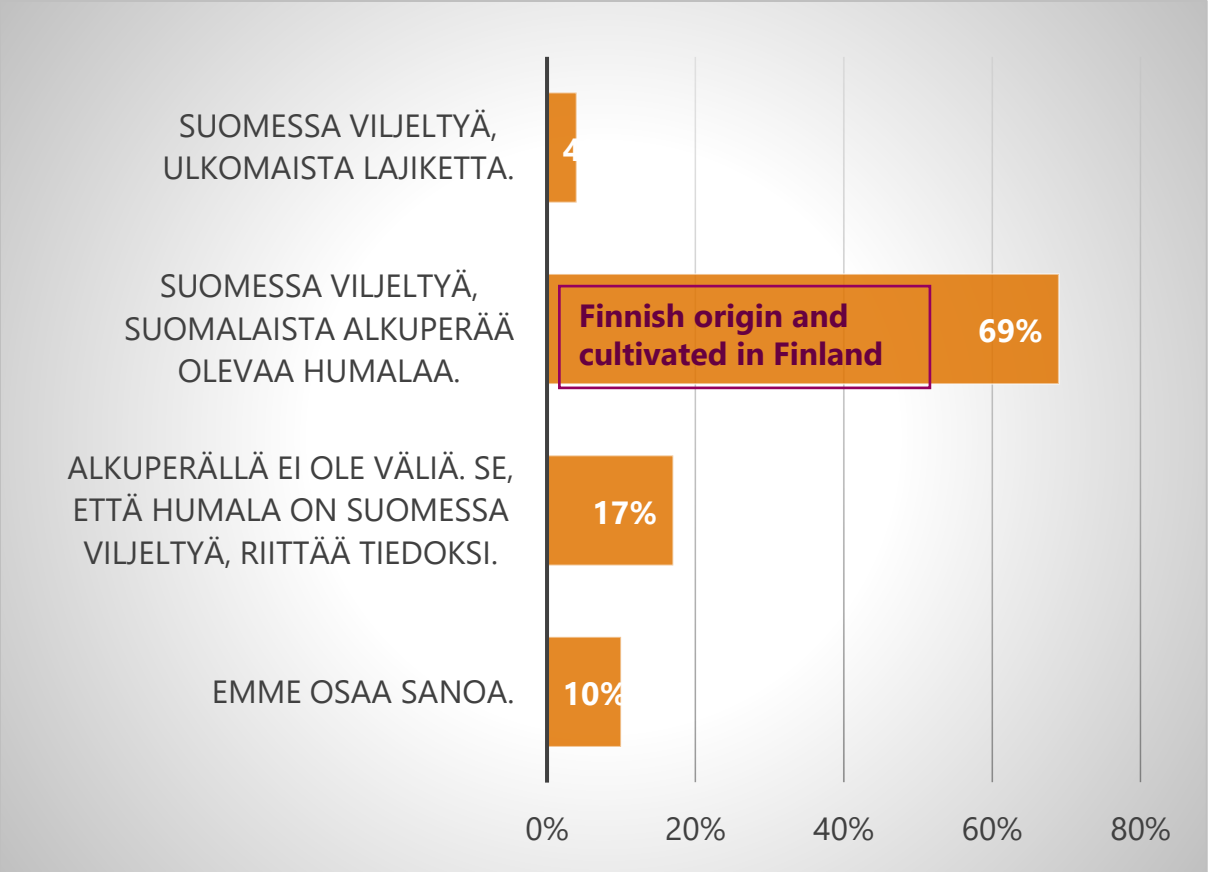
Teija Tenhola-
Roininen:
management,
questionary for
breweries

Saara
Tuohimetsä:
management,
cultivation trials

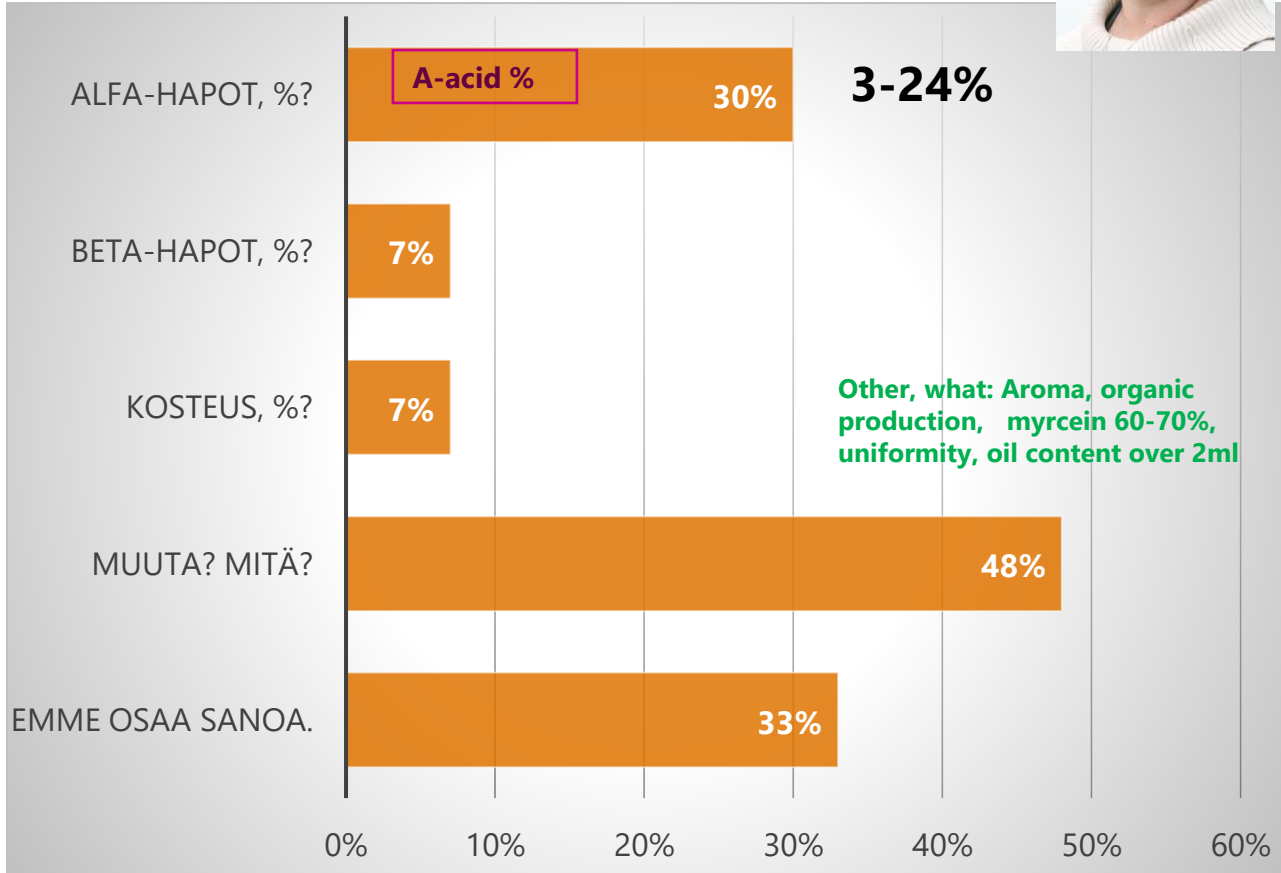
Questionary for the breweries about the need for hop production in Finland (2018; 29 answers)



What would you like to buy?



What qualities of the hop are most important?



Breweries would like to have 2-6 different Finnish varieties as pellets, also the oral history is important; organic production not so much

Call for Finnish hops 2017-2019

Wanted: hops with good yield & aroma, healthy plants cultivated in Finland 50 years or more



KASVIEN GEENIVAAAT

Luke

KASVIKUULUTUS

Missä kasvaa arvokkaita vanhoja humalia?

Luonnonvarakeskus (Luke) kerää tietoja Suomessa pitkään viljellyistä tai luonnosta kasvavista vanhoista humalista.

Ilmoita meille vähintään 50 vuotta vanhasta tai sitä ennen Suomessa viljellystä humalasta, joka:

- tuottaa hyvän sadon vuosittain
- on terve, taudinkestävä ja hyvin kasvava
- sopii oluen valmistukseen tai sitä voi hyödyntää muulla tavoin
- tuottaa esim. aromiltaan, maultaan tai tuoksultaan erityislaatuisia käpyjä

Ilmoita kasvista 31.7.2017 mennessä:
www.luke.fi/ilmoitakasvi

Keräämme tietoja myös hedekasveista.

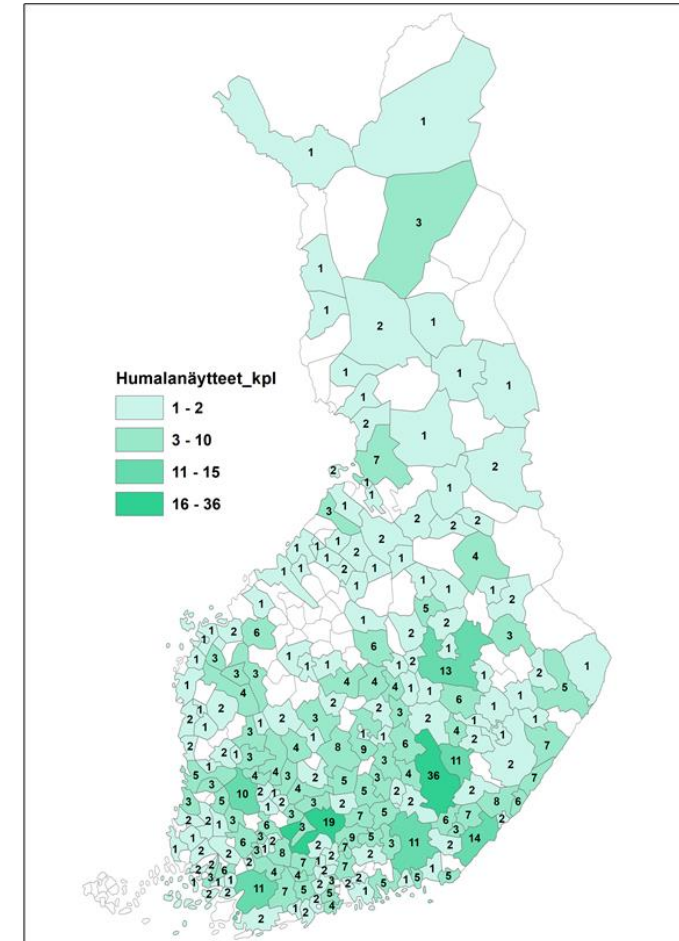
Data was sent by citizens via on line service:

www.luke.fi/ilmoitakasvi

- 1400 announcements
- Samples received from about 1000 accessions: leaves (DNA-studies) and cones (chemical analysis)



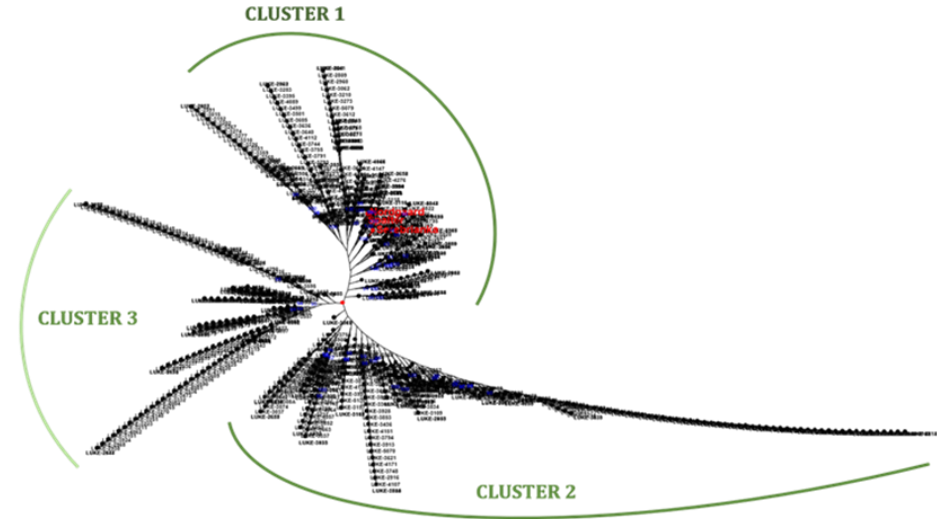
Pic: Lidija Bitz, Luke



Genetic analyses

- 25 microsatellites
- 260 genotypes; hop is native to Finland
- Dendrogramme available

<https://peda.net/id/269c66aec24>



Chemical analyses

- The liquid and gas chromatography
- Amount of the α -acids 1.7-10.7 %
- Aroma profiles was created for the volatile compounds

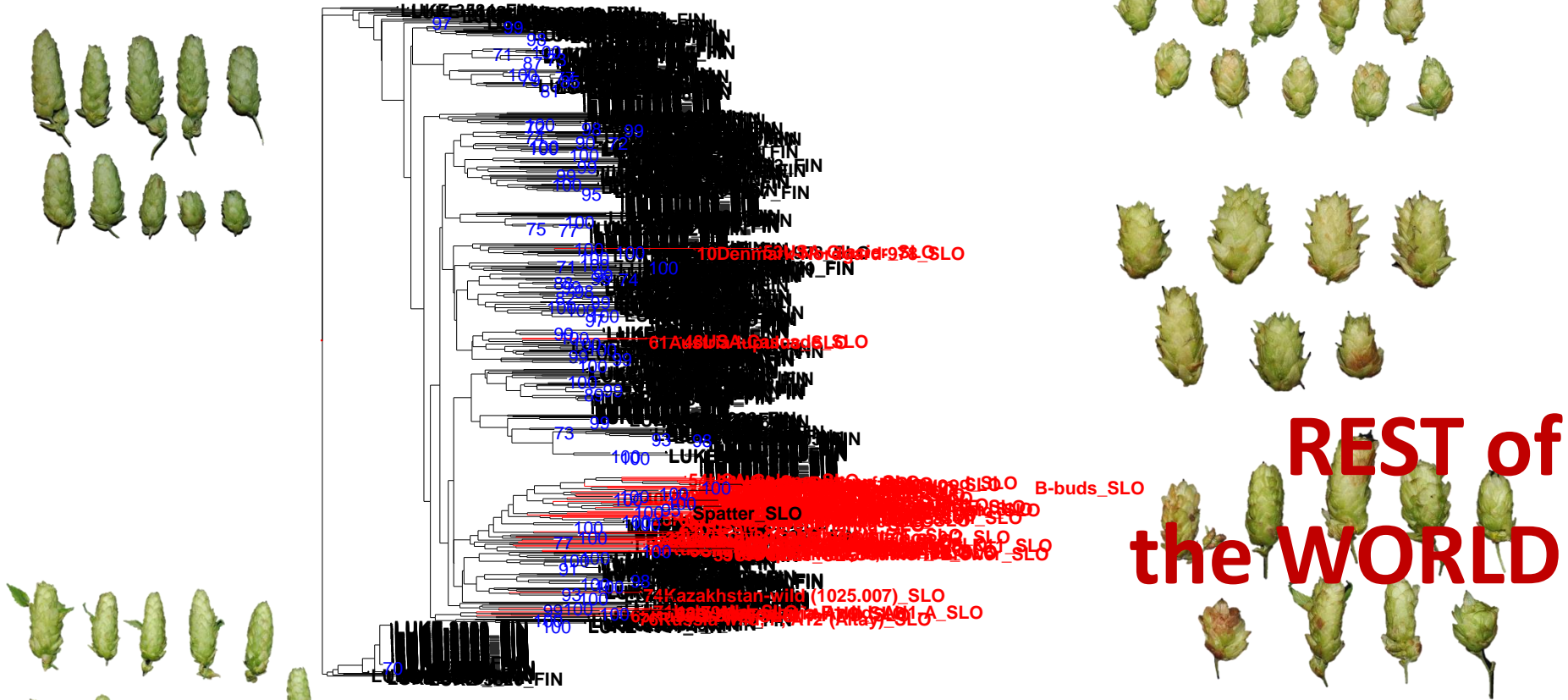
	α -acids			β -acids		Sum	Sum	ratio
	Cohumulone	Humulone	Adhumulone	Colupulone	n-Lupuloni+AdL	α -acids	β -acids	α vs β
n = 547								
Average	0.7	1.5	0.4	1.5	1.5	2.6	3.0	0.9
stdev	0.5	1.0	0.3	0.8	0.8	1.7	1.5	0.5
max	5.1	5.6	1.4	5.6	4.3	10.7	10.0	5.2
min	0	0	0	0.1	0.1	2	0.2	0

Bitz, L. et al.(2021). Genetic and chemical evaluation of hops from Finland. Acta Hort. 1328, 23-30 DOI: 10.17660/ActaHortic.2021.1328.3 <https://doi.org/10.17660/ActaHortic.2021.1328.3>

GENETIC ANALYSIS of FINNISH HOPS

Final dendrogram from 25 microsatellite markers
available: <https://peda.net/id/24a7d72e906>

FINLAND



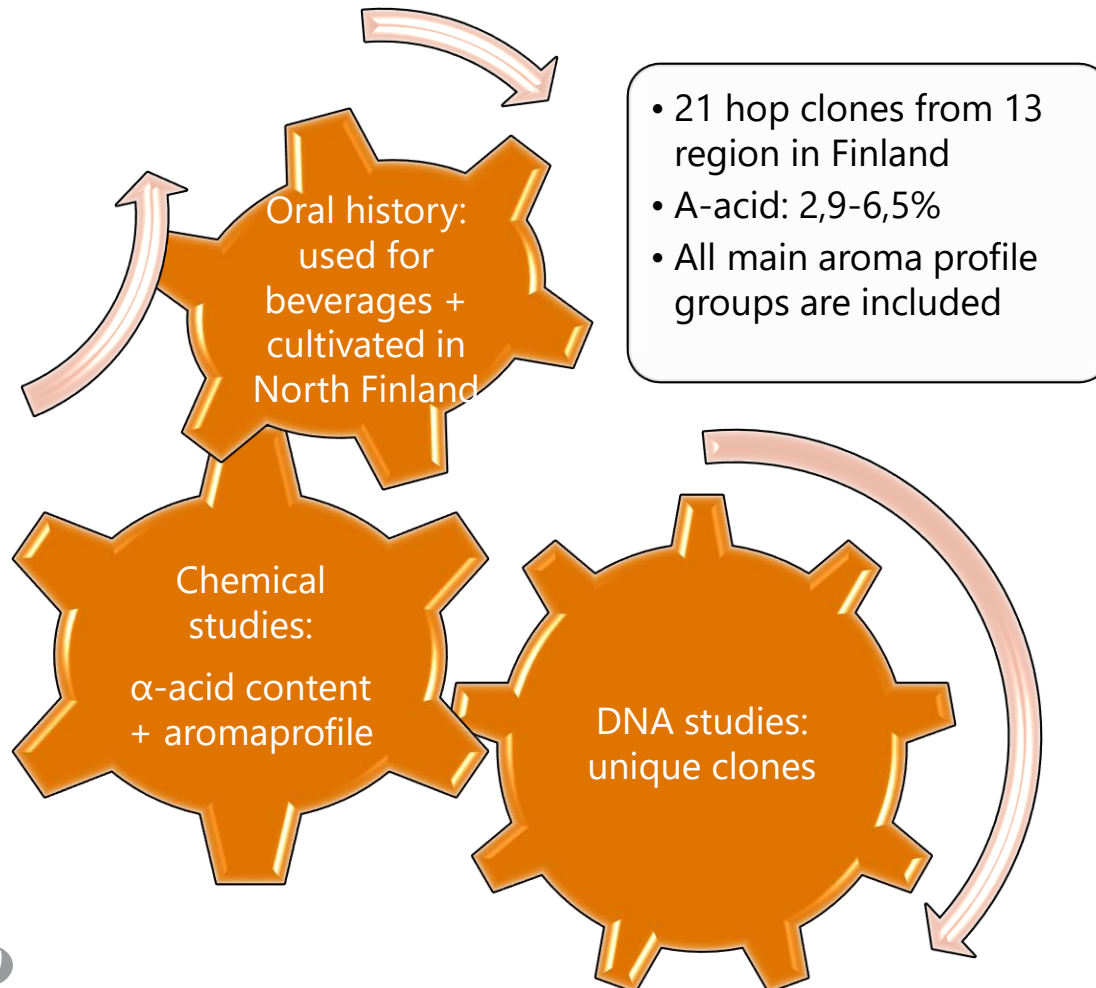
By Lidija Bitz, Luke

10 microsatellites, Multiplexes 1, 2, and 3

Software DARwin was used for calculation of genetic distance matrix based on dissimilarity coefficient from allelic data and dendrogram was Neighbour-Joining method. Software DARwin 6 was used to resample the data for bootstrap analysis with 500 replicates.



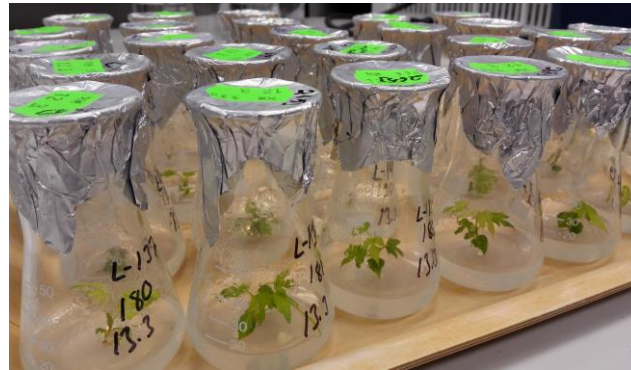
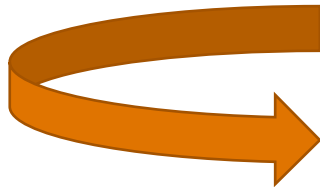
Choosing the hops for Cultivation studies



Pic: Luke/ Kasvinpolku database

Plant material on the selected hop clones for the further studies

- Propagation from the roots
- Heat treatment for the plants
- *In vitro* cultivations
- Virus testing (ApMV, ArMV and HvMV)
Hop mosaic virus infected clones was eliminated
- Clones identity was checked by the DNA study



Pics: Luke archive

Cultivation trials on Finnish hops 2020-2024

Main field at Luke Piikkiö

Main goals

- Select a few hop clones (5-7) as varieties suitable for brewing (2024)
- Produce propagative material for nurseries via certified plant production
- Develop the integrated plant protection
- Mapping challenges and possibilities of the Finnish hop production in cooperation with nurseries, breweries and farmers.
- Enhance the cultivation know how in Finland

Luke projects

- HopUp –Starting the production of Finnish hop (2020-2022)
- Arctic Hop for Breweries (2022-2025)
- Laatumala (2022-2024)

In co-operation

- Two training farms (Schools at South Ostrobothnia and Lapland), nine farmers
- Seven breweries, 2 nursery actors

Report how to establish a hop farm will be published in the end 2023



Pic: Merja Hartikainen, Luke

15.8.2022 hop workshop at Luke Piikkiö

rivin suuntaan
kulkeva vaijeri
6mm

yksi kasvi tuetaan kahteen naruun,
jotka menevät V-asentoon rivin
päällä kulkeviin vaijereihin

V-tuenta

vaakaan kulkeva tukivaijeri 8mm

taimiväli 2m

riviväli 4m



Luke Piikkiön humalatarhasta

Dia: Saara Tuohimetsä, Luke and planned by Antti Laine, Luke
Huom. Koeasetelman takia normaalia pidempi taimiväli

Pic: Saara Tuohimetsä,
Luke 17.6.2020







Pic: Saara Tuohimetsä, Luke



Pics: Terhi Suojala-Ahlfors,
Luke

8.11.2022



Field trial structures at Luke
Piikkiö in August 2020, Pic:
Saara Tuohimetsä, Luke



Methods for choosing clones as a variety

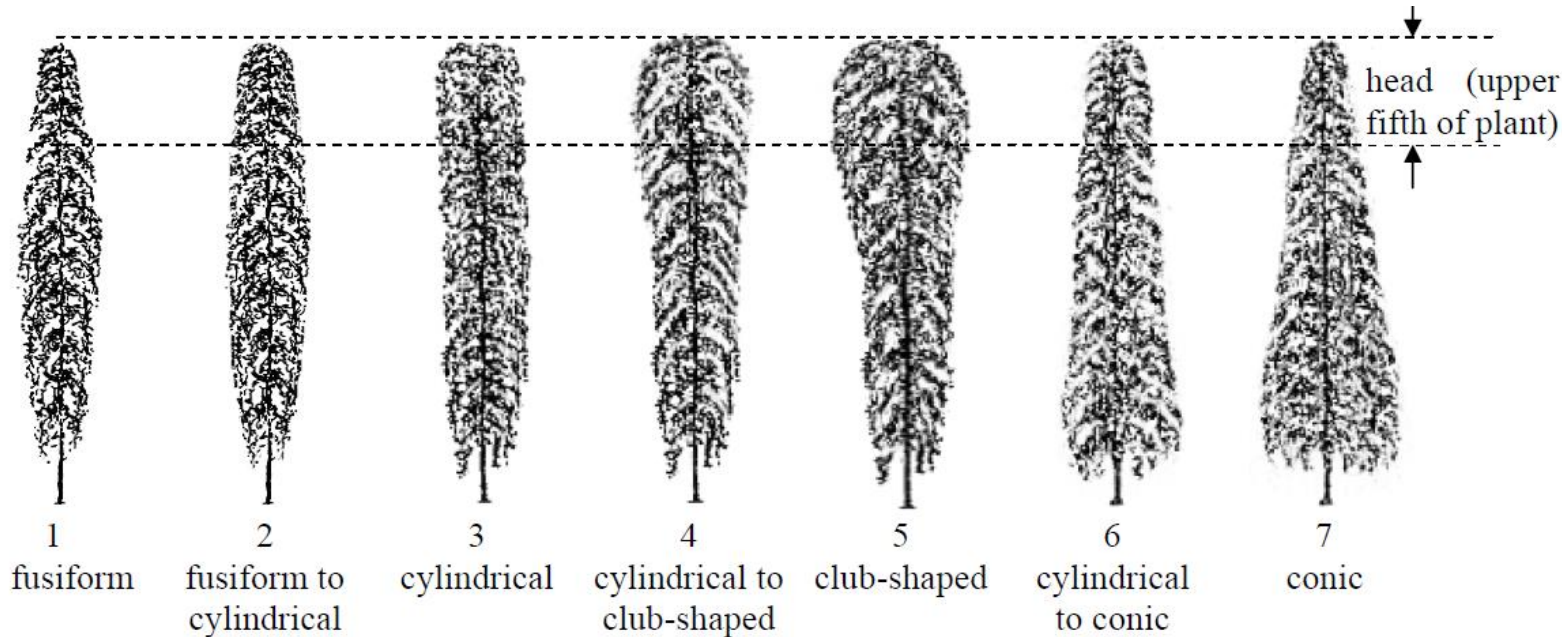
1. Phenologic, morphologic and agronomic observations and analyses (UPOV)
2. Chemical analyses
3. Sensory analyses
4. Observations on diseases
5. Brewing tests
6. Statistics

Methods for developing integrative plant protection

1. Observations on pests and diseases
2. Literature studies on pests and diseases & plant protection methods
3. E.g. small scale trials on flower lanes for pests' predators

Some observations from the first summer

- Shape of the hop vine varies;
- Length of the side shoots varies

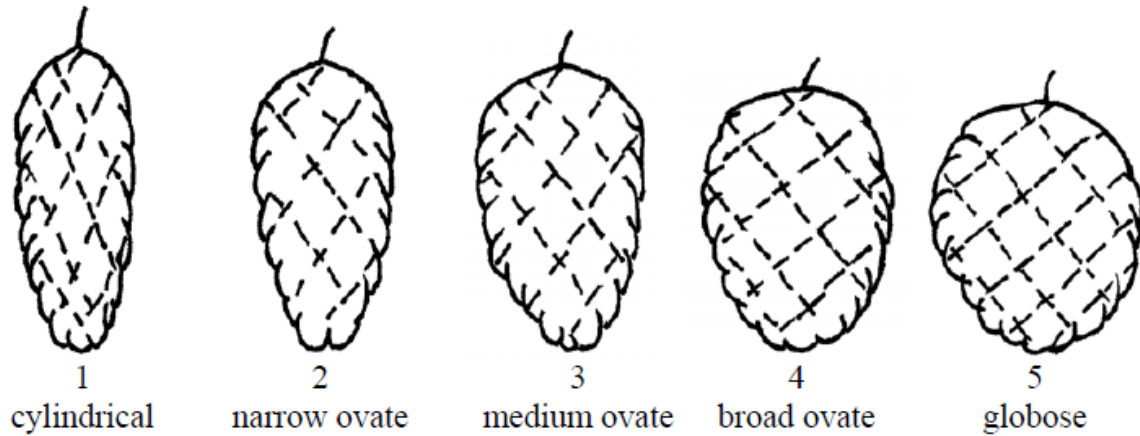
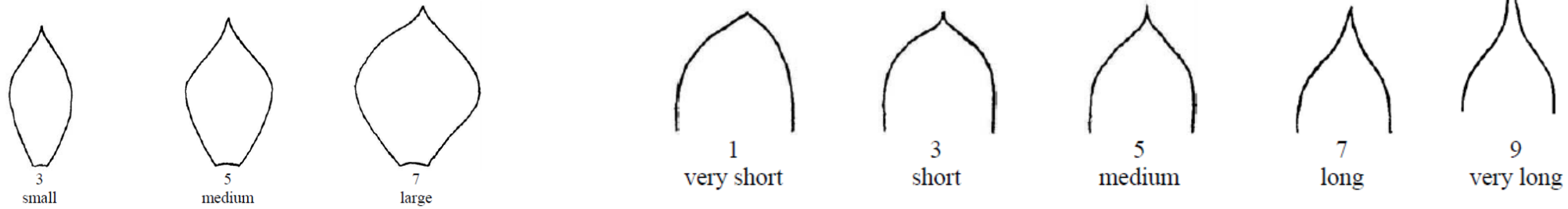


Pic: Saara Tuohimetsä, Luke

Pic: Protocol for distinctness, uniformity and stability tests *Humulus lupulus* L. Hop. 2006. UPOV, European Union Community Plant Variety Office. CPVO-TP/227/1 15/11/2006. s. 14.

Size and shape of the cones and shape of the bracts vary a lot in different clones

Pics: UPOV 2006, 15.



Pic: UPOV 2006, 15.



^ L-139, L-146
 < L-148
 Pics: Saara
 Tuohimetsä, Luke

Observation on agronomical features

Saara Tuohimetsä

Pics: Juha-Matti Pihlava and Merja Hartikainen, Luke

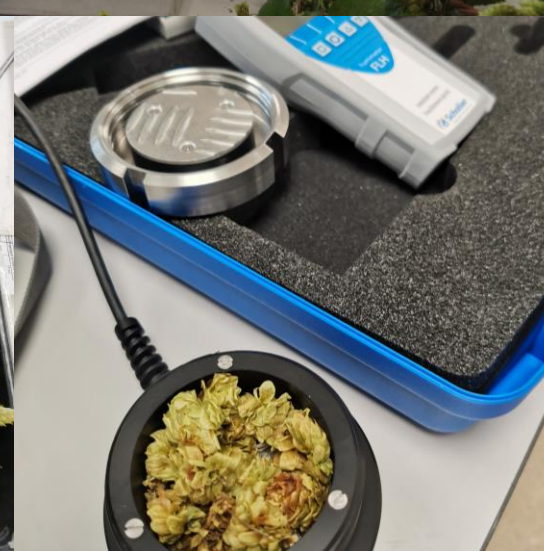
1. Maturity of the cones

- Mostly in August, four clones in September

2. Yield potential: Biomass of the whole plant and of the cones



Merja Hartikainen, Luke



Chemical and sensory analyses



- Samples from the Luke Piikkiö and 2 schools from all the clones
- Cones were dried by the barn drier, vacuumated and frozen for the chemical and sensory analyses
- Sensory analyses will be done from the hop tee

Kuvassa: Kerättyä satoa. Kuva JMP, Luke



Merja Hartikainen, Luke

Observed diseases 2022



- Hop downy mildew (*Pseudoperonospora humuli*) infected almost all plants at Luke Piikkiö and at Mustiala back up collection
- On the cones there were another disease that have not yet been identified (Brown spots)

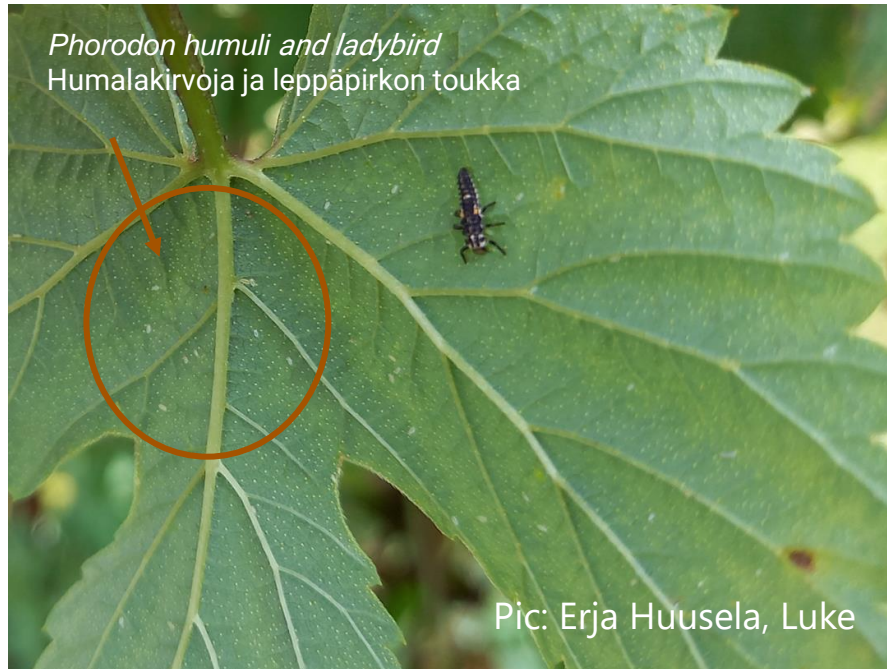


Pics: Marika Rastas, Luke

Observed pests 2022



- The Hop Aphid (*Phorodon humuli*) was very common at Luke Piikkiö
- Also larvae of the butterflies like *Hypena rostralis*, *Anglais io*, *Anglais urticae* and *Polygonia c-album* were found
- Also natural predators, like ladybirds (*Coccinellidae*) was observed



Workshop at Luke Piikkiö 15.8.2022





Pics: Luke archive

Other studies in Finland



- Calculation of profitability on hop cultivation in Finland

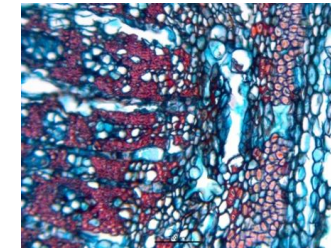
Includes acquisition of support structures, the establishment of a plantation, procurement of special farming machinery, input use and workflow during the growing season and harvest, and the value of the crop when dried on the farm

Will be updated later on; Available: <https://peda.net/id/304ebcb288c>

- Studies on microscopic structure of hop

All accessions were alike by their structure;

The length of the hop fibers are similar as in hemp.



- Effects of the cone extracts to the growth of some bacteria

The effect on Gram positive bacteria was greater; some of the hop clones were more effective

- The anti-inflammatory effect of the hop has studied (P. Marnila)

- Some preliminary studies how to use sidestreams of hop e-g. as biocomposites with VTT has been shortly carried out.



Hop Service at Luke

<https://www.luke.fi/fi/palvelut/humalapalvelut>

Consists of the

1. Uniqueness of the hop (DNA studies)
2. Chemical analyses
3. Purification of the propagative material (virus free *in vitro* cultures)
4. Plant propagation

Customer can choose the services he needs.



**Thank
you!**

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