Pre-breeding strategies for obtaining new resilient and added value berries

# SENSORY QUALITY AND CONSUMER ACCEPTANCE OF BERRIES: Short and Long-Term Future Visions for Enhancing Fruit Quality in Cultivated Berries

**Dr. Terhi Latvala**

WORKSHOP

Advancing Berry Breeding:

From Phenotyping to Genomic Innovation

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# Overview of the presentation

1. Objectives of the study
2. Methodology and data
3. Results: Future visions for enhancing fruit quality
4. Conclusions

# 1. Objectives of the study

- The primary objective of this study is to present future visions for developing new breeding opportunities.
- The use of the plural form 'futures' emphasizes the multiple potential outcomes influenced by our actions.
- The goal is to develop European cultivars that are resilient to varying and changing climatic conditions, adaptable to diverse cultivation systems, and capable of producing fresh-fruit cultivars with high nutritional quality that align with consumer preferences.

# 2. Methodology and data

- Data was collected using the futures workshop approach.
- The methodology is planned with reference to the concept of the Future Workshop (Jungk and Müller 1987; Vidal 2006), which represents a methodology able to facilitate participation by actors and stakeholders in processes addressing real-life problems.
- This method is particularly beneficial when participants are responsible for implementing desired changes, such as breeding cultivars with ideal characteristics.
- Workshops were used to assess features and gather ideal visions for the future of berry breeding.

# 2. Future workshop methodology

- The methodology employed in this study represented a forward-looking research approach, addressing current challenges.
- We utilized the ACTVOD method, a future workshop technique specifically developed for short, applied practical foresight projects (Lauttamäki, 2016).
- Each workshop discussion was allocated 1.5-2 hours. This duration was feasible because all participants were experts in the sector, possessing extensive knowledge of the topics.

# 2. Phases of future workshop

In detail workshop discussion was constructed following phases:

- Main challenges regarding soft fruits quality: identification and analysis of the primary challenges affecting the quality of soft fruits.
- Strengths and weaknesses in soft fruits breeding: evaluation of the main strength and weaknesses in the current state of the quality
- Future visions: Development of a future vision for soft fruits breeding, encompassing both short-term and long-term goals.
- Implementation phase: Developing strategies to achieve suggested targets, and the necessary steps for implementation.

**The number of discussion groups and division of northern and southern European participants.**

- In each group, 4-8 participants.

| | North (Finland, United Kingdom) | South (Italy, Spain, Turkey) | Total |
|---|---|---|---|
| **Strawberry** | **1 online** | **1 online, 1 live workshop** | **3** |
| **Blueberry** | **1 online** | **1 online** | **2** |
| **Raspberry** | **1 online, 3 live workshops** | **1 online, 1 live workshop** | **6** |
| **Total** | **6** | **5** | **11** |

# 3. Future visions: Strawberry vision 1/3

**Main future objectives**

- **Extend shelf life**: Firmness and skin integrity, seasonal variation, long-term export opportunities
- **Visual aspect**: Pleasing color, symmetrical shape, adequate size, fresh calyx
- **Organoleptic qualities**: Taste and texture

**Quality Definition**

- **Short-term goals**: 40 grams, medium red color, firm skin, honeyed pulp, attractive flavor, 9-10 degrees Brix
- **Long-term goals**: Smaller fruit preferred due to urbanisation, portion sizes, specific packaging for door-to-door delivery services
- **Southern regions**: Testing labels for fruit maintenance, recyclable packaging for atmospheric control

# 3. Future visions: Strawberry vision 2/3

**Cultivation**

- Short-term goals: Organic/biological cultivation, enhancing health quality of mother plants
- Long-term goals: Biotechnological techniques (transgenesis, genetic editing), extending cultivation period, greenhouse/indoor production

**Research & Development**

- Focus Areas: Statistics, molecular tools, in genotyping reducing disease susceptibility, producing fruits without pesticide residues
- Smart agriculture and climate-smart agriculture: Integrated production, soil disinfection, adding biodiversity, improving water use efficiency

# 3. Future visions: Strawberry vision 3/3

**Communication & Consumer Needs**

- **Closer communication**: Among breeders, producers, consumers, market chain actors
- **Modern consumer needs**: Sensory satisfaction, freshness, ease of consumption, health benefits, Mediterranean diet alignment
- **Fruit identification**: Addressing supermarket practices, enhancing consumer choices

**Changing Consumption Patterns**

- **New varieties**: Enhanced properties for novel consumption and storage (e.g. salad, smoothies)
- **Year-round availability**: maintaining consistent quality

# 3. Future visions: Blueberry 1/2

**Northern regions**

- **Need:** Greater diversity of fruit varieties.
- **Preferences:** Sweet, non-acidic berries with enhanced flavor profiles.
- **Focus:** Health-enhancing properties of wild bilberry, optimizing ripening, and machine harvesting.

**Southern regions**

- **Need:** Crunchy, aromatic fruits with balanced sugar-to-acid ratio.
- **Focus:** Improving skin quality, early production of highbush varieties during winter months.

# 3. Future visions: Blueberry 2/2

- **Consumer challenges**
  - Difficulty recognizing high-quality produce.
  - Appreciation for genuineness, naturalness, external appeal, size, and waxy coating.
- **Breeding goals**
  - Differentiate population in terms of quality.
  - Breed for consumer preferences.
  - Optimize maturity and fresh taste.
  - Improve research and development tools for examining quality issues.

# 3. Future visions: Raspberry 1/3

**Key focus areas in North**

- Consumer preferences: Develop traits aligning with consumer preferences and economic viability.
- Superior cultivars: Promote cultivars with superior organoleptic characteristics and productivity.
- Robotic picking: Develop varieties suitable for robotic picking, maintaining quality post-harvest.
- Greenhouse and tunnel cultivation: Focus on varieties for greenhouse and tunnel cultivation.

**Techniques and practices**

- Genetic and genomic breeding: Use advanced techniques for breeding germplasm
- Mechanization and automation: Improve efficiency through full mechanization and precision in inputs and management.
- Sustainable practices: Enhance resource efficiency through water and nutrient recycling, and cultivation practices should aim for a full return to soil-based growth.

# 3. Future visions: Raspberry 2/3

**Key focus areas in South**

- Focus on well-known genotypes and improve crossing and selection processes to enhance characteristics such as shelf-life and disease resistance.
- Exploring food metabolomics, including the analysis of sugars, acids, phenolics, aroma, and nutritional composition, is crucial for understanding shelf-life, post-harvest characteristics, management, adulteration, and storage.
- Resilient varieties should be developed to withstand climate changes, particularly heat tolerance and disease resistance.
- Machine harvesting will be necessary for the fresh market in the long run.
- Genetic resources should be established to support further breeding programs. Given the high energy prices in winter, the use of solar panels is recommended.

# 3. Future visions: Raspberry 3/3

**Market and consumer dynamics**

- **Self-sustainability:** Focus on seasonality and local consumption patterns.
- **Consumer education:** Educate consumers about raspberry varieties and their benefits.
- **Carbon footprint labeling:** Indicate the low carbon footprint of berries on packaging.

**Technological Integration**

- **Renewable energy:** Implement e.g. solar panels and PV cells to reduce energy costs and promote sustainability.
- **Improving production systems:** Enhance efficiency and reduce labor costs through mechanization of picking and multi-year production systems.
- **Heat-resistant varieties:** Develop varieties to withstand climate changes and improve soil health.

# 4. Conclusions

- Varying breeding needs between southern and northern regions.

  South: Availability of labour becomes  a significant challenge. Technological advancements in the automation of picking processes have partially mitigated the labor shortage and reduced labor costs.

  North: In the north, more cold-resistant varieties and local variety breeding are required. Additionally, consumer demands for quality need to be better understood.

**Climate change** affects the cultivation environment of berry crops. Gene banks have a wealth of berry genetic resources stored to help adaptation to the climate change. By utilizing the genetic characteristics of the varieties, adaptation to change can be facilitated and the agricultural environment can be maintained, and the competitiveness of plant breeding and cultivation can be secured in changing climate conditions.

The level and quality of berry yields depend on the resource efficiency, tolerance to abiotic conditions (temperature, water resources), and tolerance to biotic stresses (diseases and pests) of cultivars. In berry species, resilience to different environmental factors is available in germplasm.

Thank you for you attention!

Kiitos huomiostanne!

¡Gracias por su atención!

Dikkatiniz için teşekkür ederim!

Grazie per la vostra attenzione!