# GoodBerry

Improving the stability of high-quality traits of berry in different environments and cultivation systems for the benefit of European farmers and consumers – **Blackcurrant update**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement Number 679303.

# GoodBerry in a Nutshell


- GoodBerry – facilitation to develop **highly productive** and **top quality berry fruits** even under multiple suboptimal growth conditions at competitive costs
- GoodBerry – a four year **collaborative research project** (01 March 2016 – 29 February 2020)
- GoodBerry – funded by the European Union's Horizon 2020 framework programme for research and innovation with a **total budget** of **4.87 million €**
- GoodBerry – coordinated by Dr Sonia Osorio of Universidad de Málaga, Spain
- GoodBerry – **multi-actor approach** with pan-European partners, involving scientists and berry breeders with **complementary multidisciplinary expertise**

Find out more about **GoodBerry** at www.goodberry-eu.eu!

# What is GoodBerry about?

## Impact

GoodBerry contributes to the development of novel tools and cultivation techniques, and helps strengthen the competitiveness of European berry production

## Coordinator

Dr Sonia Osorio
Universidad de Málaga, Spain
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## Objectives

- Identification of **berry germplasm** exhibiting advantageous balance of production vs nutritional quality throughout the European Union
- Search for **innovative production systems** to maintain high yield in a range of European-wide environments
- Development of standardized and reliable **analytical tools** evaluating berry production and fruit quality under suboptimal growing conditions

# GoodBerry Consortium at a Glance

**19 partner institutions** from **eight European countries** (Spain, Belgium, France, Germany, Italy, Norway, Poland, United Kingdom), **one Asian** (China) and **one South American country** (Chile)

# WP1 - European Partners involved in black currant studies – Erika Kruger

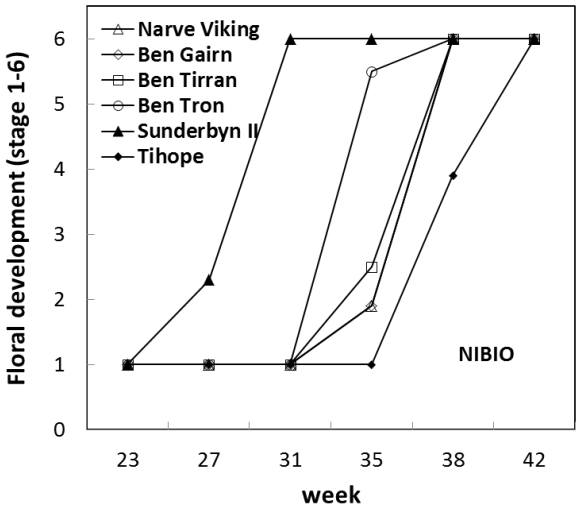
## European Partners involved in black currant studies

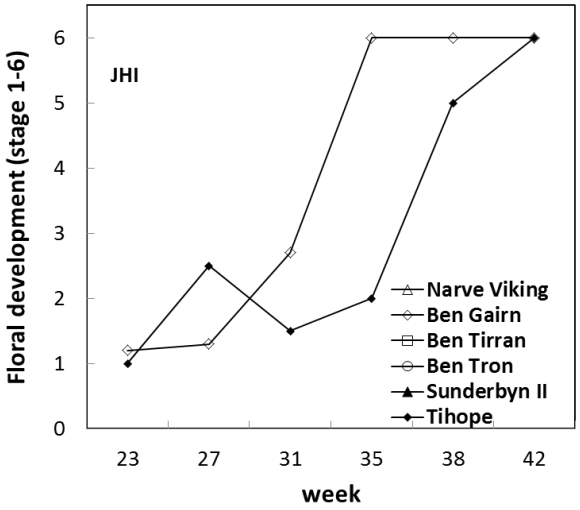
| | general plant performance | harvest | fruit sampling quality transcriptome | flower induc-tion/initiation | dormancy induction | dormancy release | phytotron experiment | transcriptome analyses |
|---|---|---|---|---|---|---|---|---|
| UMA - Spain | | | | | | | | + |
| NIBIO - Norway | + | + | + | + | + | + | planned | + |
| INHORT - Poland | + | + | + | + | + | + | | + |
| HGU - Germany | + | + | + | + | + | + | | + |
| JHI - Scotland | + | + | + | + | + | + | | + |

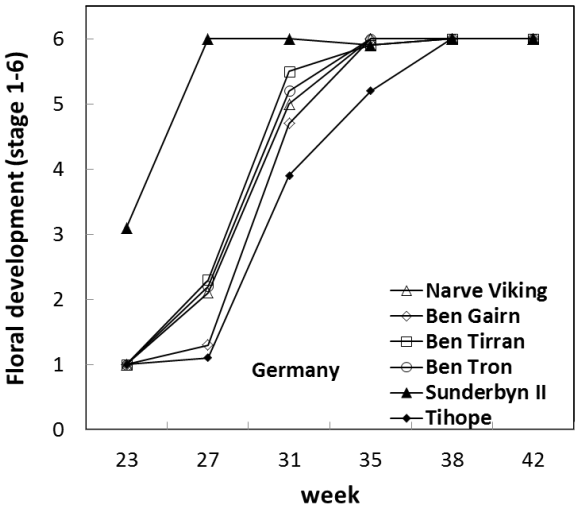
evaluation expected and done according to the first agreement

not involved in that kind of experiment or evaluation

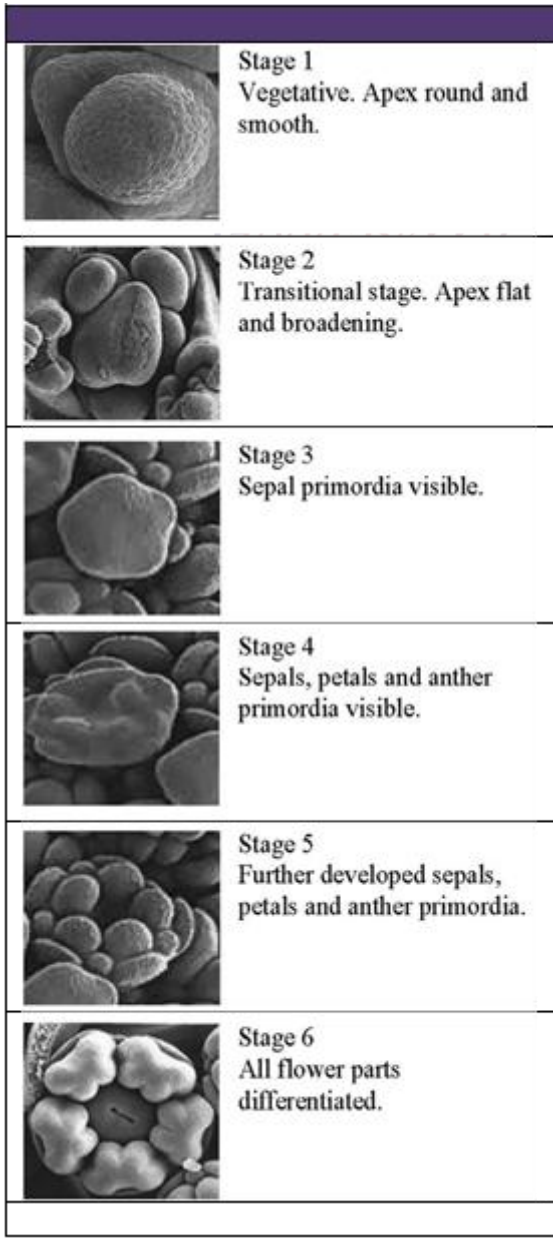
# WP1 – blackcurrant floral development



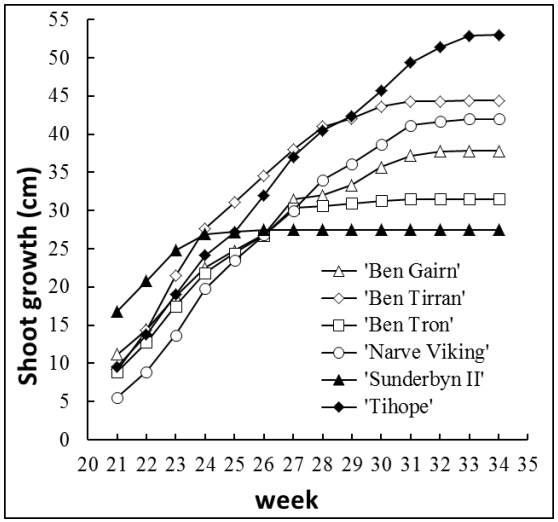



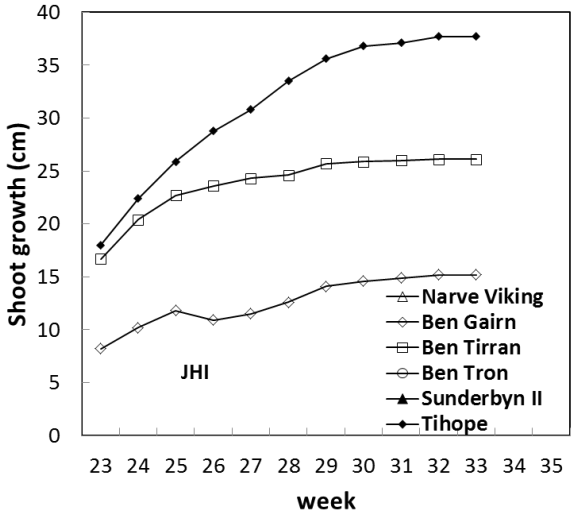



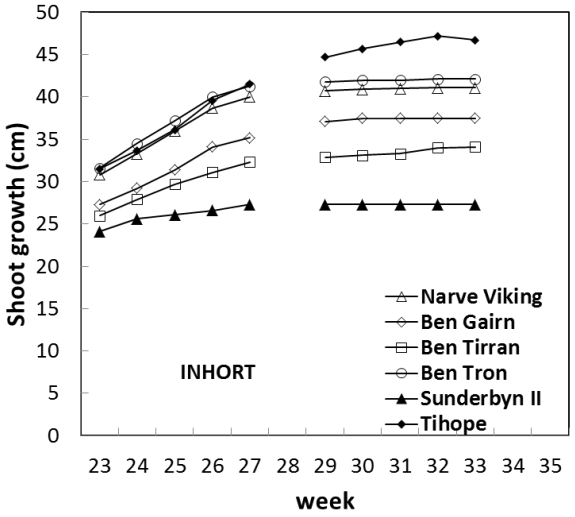

Floral development most advanced at Geisenheim

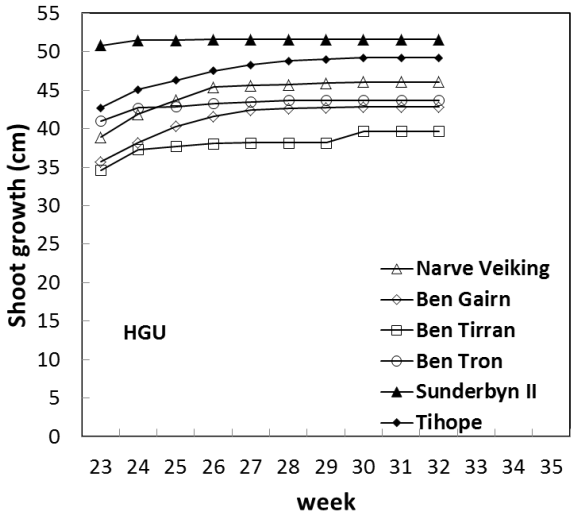


# WP1 – blackcurrant growth cessation




Growth cessation most advanced at Geisenheim

GoodBerry

Improving the stability of high-quality traits of berry in different environments and cultivation systems for the benefit of European farmers and consumers

# Influence of controlled nutrient feeding during floral initiation and berry development on shoot growth, flowering and berry yield and quality in black currant (*Ribes nigrum* L.)

Anita Sønsteby

Norwegian Institute for Bioeconomy Research (NIBIO)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement Number 679303.

# Methodology

- Use of an experimental system with single-stemmed plants grown in pots
- fertilized by controlled trickle fertigation during both the period of flower formation (Expt. 1) in autumn and during berry development (Expt. 2)

- **Note**: Results published in 2017

# Expt. 1:

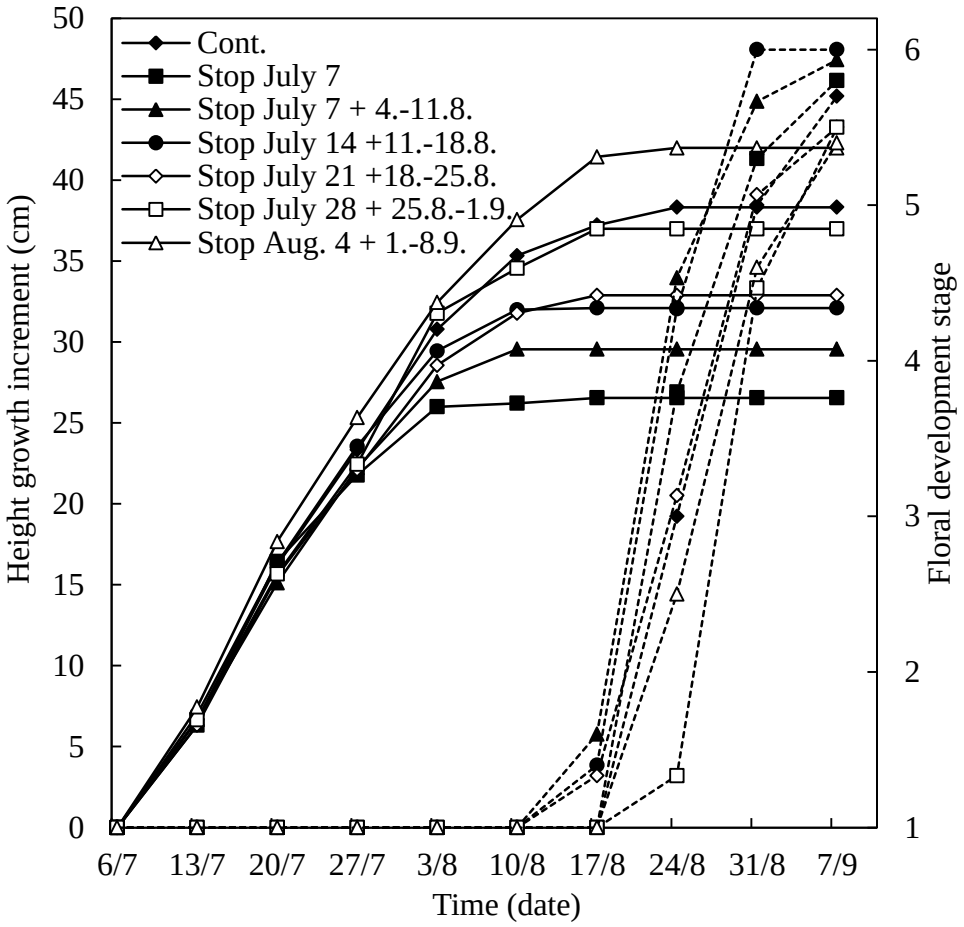
- Cultivar: ‘Ben Tron’
- Raising of one shoot/pot
- In open tunnel from >25 leaves (May 27)
- Fertigation EC 1.5 until July 7

**Fertilization treatments (EC):**

1. EC = 1.5 until 7 July (thereafter water only)
2. EC = 1.5 “ 7 July + EC = 3.0 from 4 -11 August
3. EC = 1.5 “ 14 July + EC = 3.0 “ 11 – 18 August
4. EC = 1.5 “ 21 July + EC = 3.0 “ 18 – 25 August
5. EC = 1.5 “ 28 July + EC = 3.0 “ 25 Aug. – 1 September
6. EC = 1.5 “ 4 Aug. + EC = 3.0 “ 1 – 8 September
7. EC = 1.5 continuously until 15 September

- Half of the plants over-wintered in field (9.10.)
- Other half of plants in cold storage (0°C), and planted next spring (13.4.)
- Recordings of growth, growth cessation, and time of flower induction in autumn
- Recordings of time for bud break, over wintering, and yield the next year

# Expt. 1: Fertilization affects time of growth cessation and flower induction



No winter damage observed

# Flowering and yield

| Time of fertilization | Tot. no. of infloresc. | Tot. no. of flowers | Flowers per infloresc. | Aborted flowers (%) | Fruit yield (g/plant) | Number of berries | Mean fruit weight (g) |
|---|---|---|---|---|---|---|---|
| 1. Until 7 Jul. | 34.7 bc | 404.8 c | 11.8 c | 29.5 a | 202.1 c | 284.7 b | 0.7 b |
| 2. Until 7 Jul. + 4 Aug. - 11 Aug. | 37.3 abc | 473.9 ab | 12.7 ab | 25.0 ab | 273.1 ab | 355.4 a | 0.8 ab |
| 3. Until 14 Jul. + 11 Aug. – 18 Aug. | 34.0 c | 444.2 bc | **13.1 a** | 25.6 ab | 243.9 bc | 329.8 ab | 0.7 ab |
| 4. Until 21 Jul. + 18 Aug. – 25 Aug. | 38.0 abc | 473.4 ab | 12.4 abc | 26.9 a | 264.0 ab | 340.1 a | 0.8 ab |
| 5. Until 28 Jul. + 25 Aug. – 1 Sep. | 38.2 abc | 449.1 bc | 11.8 c | 19.3 b | **299.7 a** | 361.1 a | **0.8 a** |
| 6. Until 4 Aug. + 1 Sep. – 8 Sep. | 40.4 a | 485.3 ab | 12.0 bc | 27.0 a | 282.2 ab | 351.8 a | **0.8 a** |
| 7. Until 15 Sep. | 38.9 ab | **496.9 a** | 12.8 ab | 23.8 ab | **304.8 a** | 376.7 a | **0.8 a** |
| Mean | 37.4 | 461.1 | 12.4 | 25.3 | 267.1 | 342.8 | 0.8 |
| P-value | 0.05 | 0.02 | 0.03 | 0.05 | 0.02 | 0.05 | n.s. |

# Expt. 2: Fertilization during berry development

**Cultivars:**
'Imandra', 'Hedda', 'Ben Tron', 'Narve Viking'
-Raised in pots the first year (1 shoot/pot)
-Over-wintered in cold store (0°C)
-Forced in plastic tunnel from May
-Fertigated 3 x per week until harvesting

**Treatments:**

**EC 0.5* – 1.5 – 2.5 mS $cm^{-1}$**

-*replaced by water only, from July 7
-Recording of yield and
-berry quality

| Cultivar | EC | Yield (g/plant) | Berry weight (g) | Aborted flowers (%) |
|---|---|---|---|---|
| Imandra | 0.5* | 610 bc | 1.3 de | 7.1 bcd |
| | 1.5 | 566 bc | 1.2 e | 8.9 bc |
| | 2.5 | 556 c | 1.2 e | 10.9 b |
| | | 577 | 1.2 | 8.9 |
| | | | | |
| Hedda | 0.5* | 451 d | 1.6 abc | 8.8 bc |
| | 1.5 | 461 d | 1.6 abc | **17.1 a** |
| | 2.5 | 427 d | 1.5 bcd | **19.2 a** |
| | | 447 | 1.6 | 15.0 |
| | | | | |
| Ben Tron | 0.5* | 625 b | 1.4 cd | 3.6 de |
| | 1.5 | **733 a** | 1.6 ab | 5.5 cde |
| | 2.5 | **738 a** | 1.7 a | 5.8 cde |
| | | 699 | 1.6 | 5.0 |
| | | | | |
| Narve Viking | 0.5* | 441 d | 1.3 de | 5.6 cde |
| | 1.5 | 561 bc | 1.7 a | 2.9 de |
| | 2.5 | 559 bc | 1.7 a | 2.4 e |
| | | 520 | 1.6 | 3.6 |

| Cultivar | EC | Dry matter (%) | Soluble solids (%) | Titratable acidity (%) | L-AA (mg/ 100 g FW) | AOC (mmol/ 100 g FW) | TMA (mg CGE/ 100 g FW) | TP (mg GAE/ 100 g FW) |
|---|---|---|---|---|---|---|---|---|
| 'Imandra' | 0.5 | 13.6 | 12.9 | 5.4 | 118.6 | 6.1 | 163.2 | 452.1 |
| | 1.5 | 12.8 | 11.9 | 5.6 | 111.7 | 5.3 | 122.9 | 357.3 |
| | 2.5 | 13.1 | 12.2 | 5.8 | 119.1 | 5.4 | 130.1 | 380.5 |
| Mean | | 13.2 d | 12.3 c | 5.6 a | 116.8 c | 5.6 c | 138.7 c | 396.6 c |
| | | | | | | | | |
| 'Hedda' | 0.5 | 14.9 | 13.5 | 3.8 | 58.0 | 4.6 | 130.8 | 312.3 |
| | 1.5 | 14.0 | 12.7 | 4.1 | 51.5 | 3.6 | 101.2 | 251.0 |
| | 2.5 | 14.3 | 13.2 | 4.2 | 54.5 | 3.6 | 104.2 | 239.6 |
| Mean | | 14.4 c | 13.1 b | 4.1 b | 54.5 d | 3.9 d | 112.1 d | 267.6 d |
| | | | | | | | | |
| 'Ben Tron' | 0.5 | 17.1 | 16.5 | 3.6 | 170.0 | 12.7 | 308.9 | 909.1 |
| | 1.5 | 15.4 | 14.1 | 3.8 | 134.5 | 9.7 | 218.8 | 645.7 |
| | 2.5 | 15.3 | 14.5 | 3.8 | 120.4 | 8.6 | 208.3 | 591.5 |
| Mean | | 16.0 b | **15.0 a** | 3.7 c | 141.6 b | 10.4 a | 245.3 a | 715.5 a |
| | | | | | | | | |
| 'Narve Viking' | 0.5 | 18.5 | 15.4 | 3.6 | 189.9 | 10.4 | 212.7 | 747.9 |
| | 1.5 | 16.7 | 14.2 | 3.9 | 147.4 | 7.5 | 172.7 | 512.9 |
| | 2.5 | 17.5 | 14.5 | 3.9 | 153.0 | 7.6 | 174.0 | 537.3 |
| Mean | | 17.6 a | 14.7 a | 3.8 c | 163.4 a | 8.5 b | 186.5 b | 599.4 b |

# Conclusion – autumn fertilization


- delayed growth cessation and floral initiation
- increased total flowering and berry yield in the following season
- did not adversely affect plant winter survival and growth vigour in the spring

# Conclusion – fertilization during fruit development


- Berry yield and fruit size increased with increasing nutrient supply during fruit development in cvs. ‘Ben Tron’ and ‘Narve Viking’, while they were unaffected in ‘Hedda’ and decreased with increasing supply in the high-arctic ‘Imandra’
- Berry dry matter and the concentration of soluble solids and a range of health-related chemical constituents decreased with increasing nutrient supply in all cultivars. This was mainly a dilution effect related to increases in berry size

# Practical implications

- Autumn fertilization proved to have clear advantages over spring application in black currants
- Thus, fertilizer applications in early autumn specifically promoted and enhanced flower bud formation and subsequent berry yield, without adversely affecting berry concentrations of soluble solids (°Brix) and important health-related chemical constituents
- Under commercial production conditions, the optimal time of application should be immediately after berry harvest

# EU GoodBerry 2017 Blackcurrant LC-MS analysis

Will Allwood May 2018

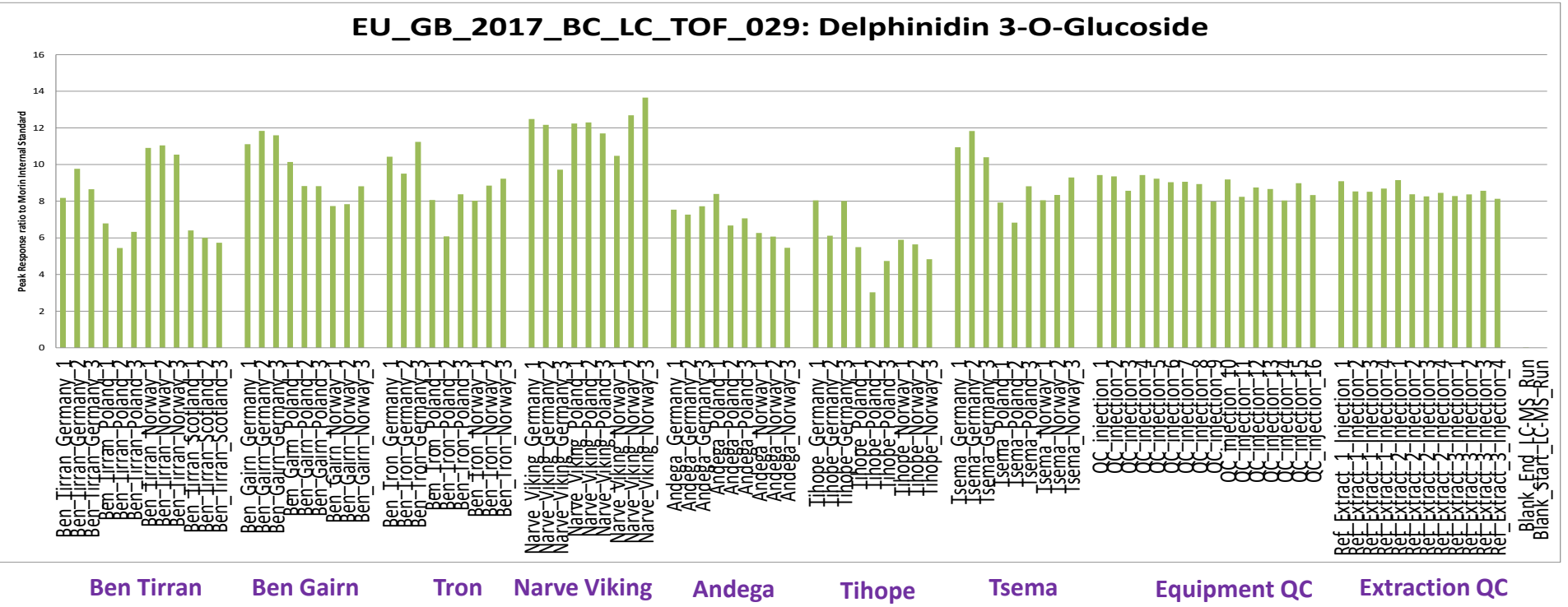
Identification levels:

Level 1: RT, accurate mass and MS2 match to reference standard

Level 2+: accurate mass and MS2 matched. RT sensible compared to literature. No standard to confirm against

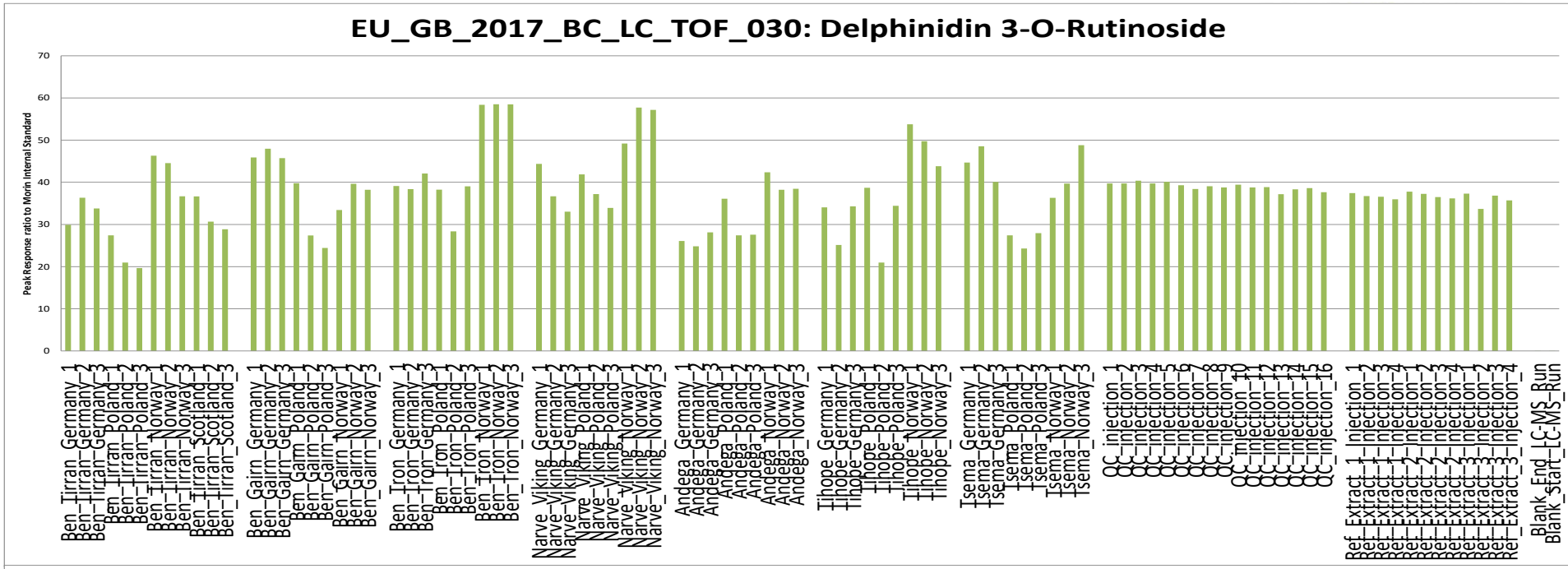
Level 2: Accurate mass match only. MS2 not obtained. No standard.

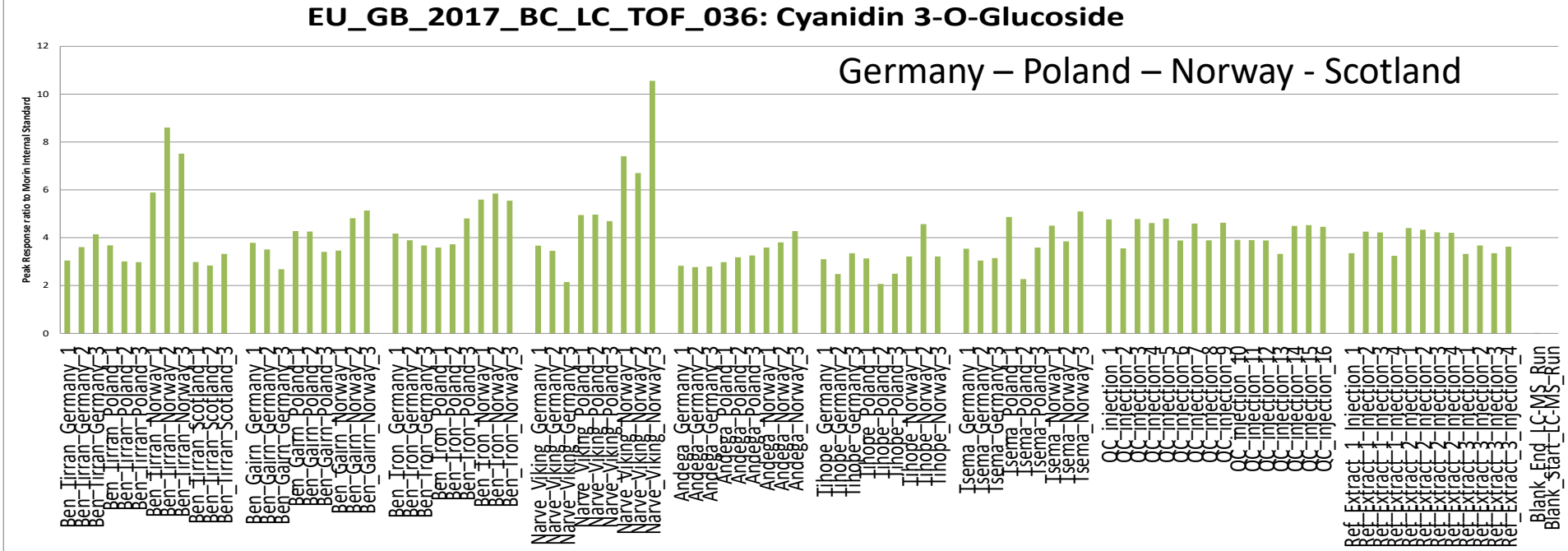
# ESI positive mode: Level 1 identified compounds – Phenolics



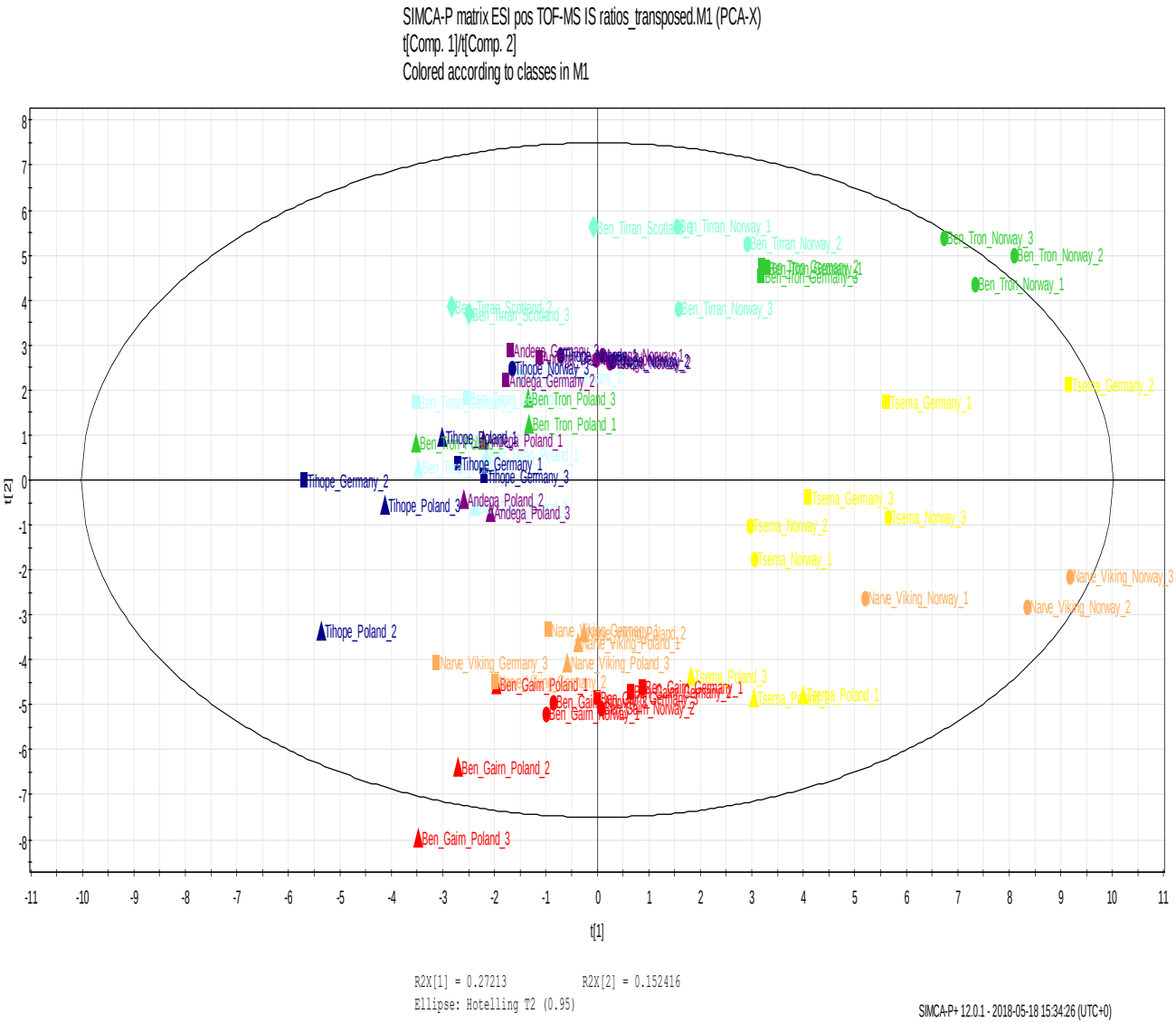

Germany – Poland – Norway - Scotland

Ben Tirran | Ben Gairn | Tron | Narve Viking | Andega | Tihope | Tsema | Equipment QC | Extraction QC



# HPLC-TOF/MS (ESI+) Blackcurrant – blanks, QC's and Refs removed PC1 x PC2




X Blanks

* QC's

* Reference samples

Ben Tirran – Germany

Ben Tirran – Poland

Ben Tirran – Norway

Ben Tirran – Scotland

Ben Gairn – Germany

Ben Gairn – Poland

Ben Gairn – Norway

Ben Tron – Germany

Ben Tron – Poland

Ben Tron – Norway

Narve Viking – Germany

Narve Viking – Poland

Narve Viking – Norway

Andega – Germany

Andega – Poland

Andega – Norway

Tihope – Germany

Tihope – Poland

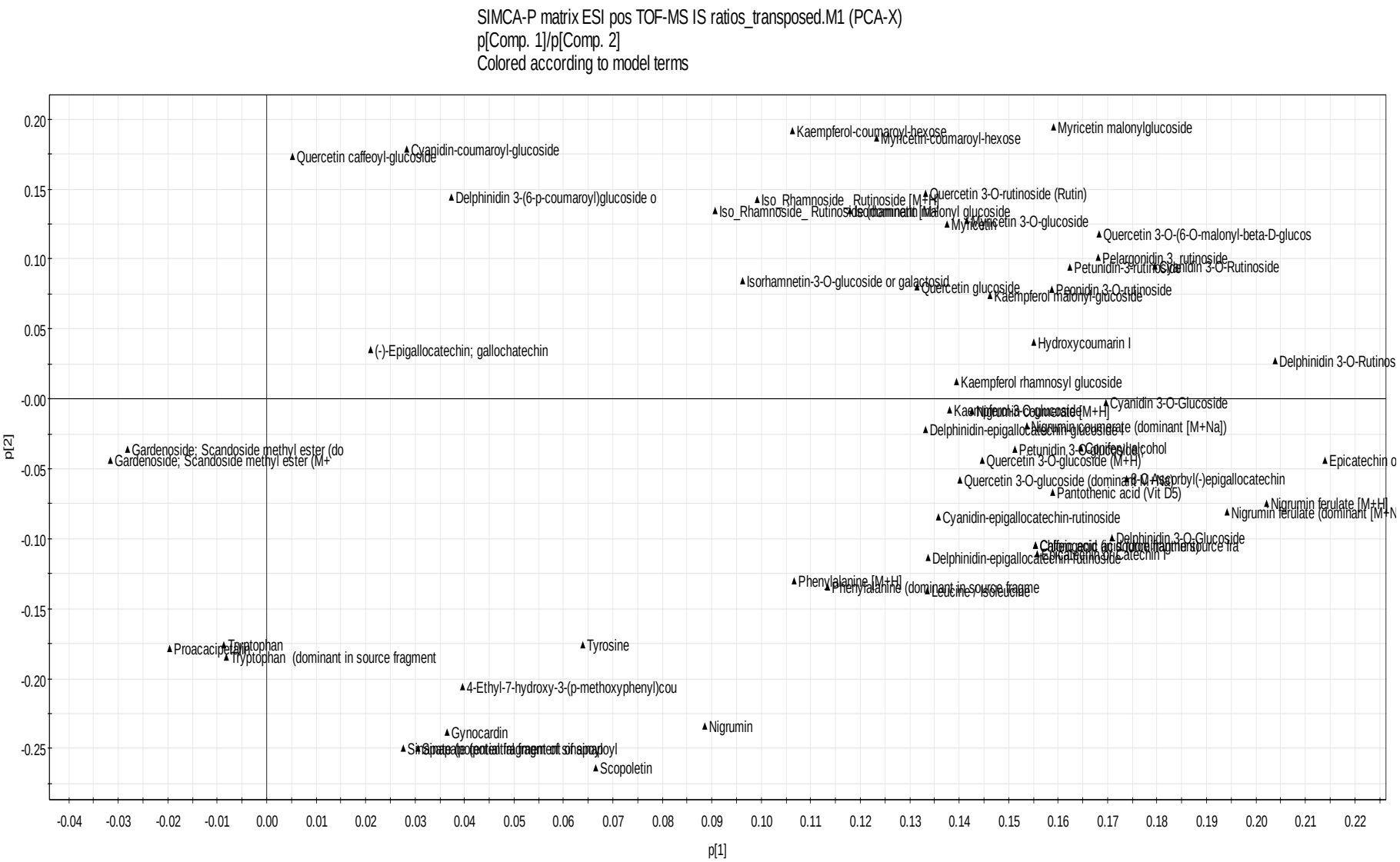
Tihope – Norway

Tsema – Germany

Tsema – Poland

Tsema – Norway

# HPLC-TOF/MS (ESI+) Blackcurrant – blanks, QC's and Refs removed PC1 x PC2



https://files.eurice.eu/downloads/GoodBerry/GoodBerry_Project_Clip_Eurice_final.mp4

# Thank you

GoodBerry