

# Improve yield by proper storage of long canes

*Trial with different storage regimes*

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# Set up of the trial

A collaboration between:



WAGENINGEN  
UNIVERSITY & RESEARCH

Participating growers/nurseries

# Trial goals

- To establish the best storage regime for storing long canes of blackberries and raspberries till the end of April and till July.
- To determine the fungal diseases which causes plant failures.
- Flowering determination at an early stage to predict the flowering development for yield optimisation.

# Plant material

- Blackberry plants of variety **Loch Ness** of four origins, 6 canes per pot
- Raspberry plants of variety **Tulameen** of two origins, 2 canes per pot
- Plants were stored in boxes covered with perforated plastics
- Two replicates, plants were stored in separate boxes

# Three storage regimes

- First 4 weeks at 0 °C, from January 25, 2017 at **-0.5 °C**, covered in plastic
- First 4 weeks at 0 °C, from January 25, 2017 at **-1.5 °C**, covered in plastic
- First 4 weeks at 0 °C, from January 25, 2017 at **+0.5 °C**

# Plantings I

- At May 8th 2017, plants were removed from storage rooms and planted at KICK trial location
- 2 rows with Loch Ness: 3 pots with 6 canes/pot per replicate (A and B)
- 1 row with Tulameen: 6 pots with 2 canes/pot per replicate (A and B)
- All plants received the same amount of water and nutrition



Plants started growing well from the beginning



# Plantings II

- At the beginning of July 2017 all plants were removed from the storage rooms and were planted at several practical sites.

# Flowering determination at January 31th, 2017

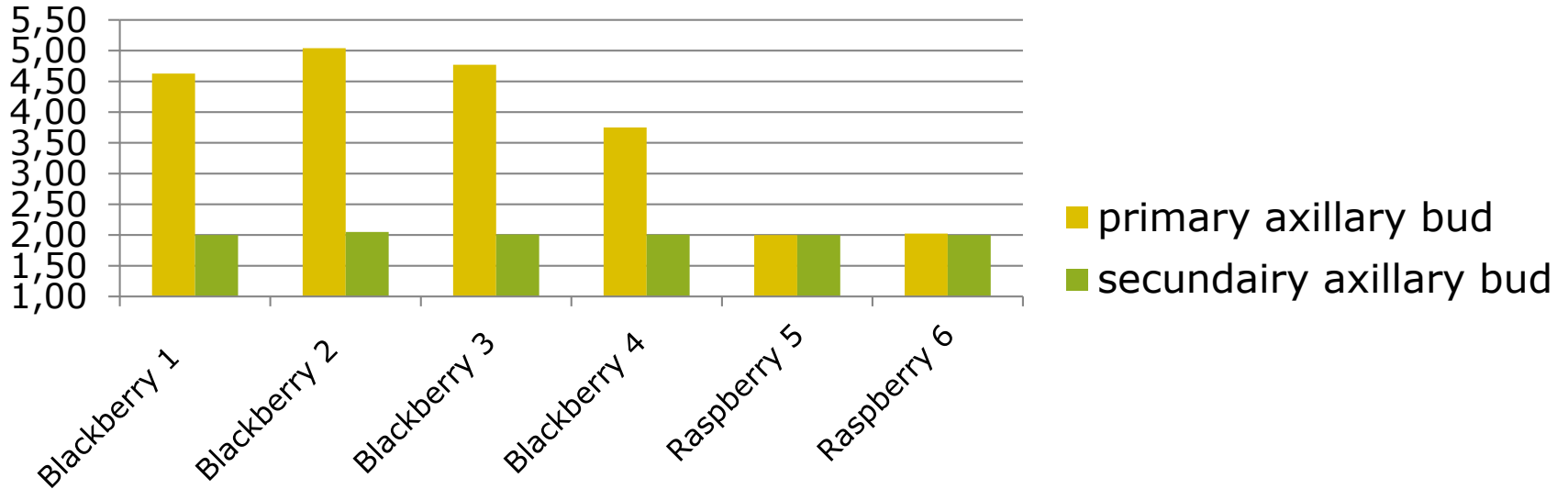
<u>apex development stage</u>	<u>development phase</u>
2	vegetative
2.5	vegetative ---- > generative
3	generative
4	generative
5	generative
≥6	generative

Vegetative = leafs

Generative = flowers

*Determination by Plantalogica*

# Results: flowering determination



Blackberry plants generative, raspberry plants vegetative

# Stored till May



Plants and pots were frozen deeply at  $-1.5\text{ }^{\circ}\text{C}$

# Stored till May

All plants were growing well after planting



22nd of May 2017



1th of June 2017

# Stored till May

The bark of the canes of some raspberry plants was completely cracked at  $-1.5^{\circ}\text{C}$ . After planting the green canes dried up and turned into brown and a new bark arisen. Flower buds started growing normally.



# Cracked bark of the canes at raspberry plants



# Blackberry plants of origin 4 (25-7-2017)



+0.5 °C



-0.5 °C



-1.5 °C



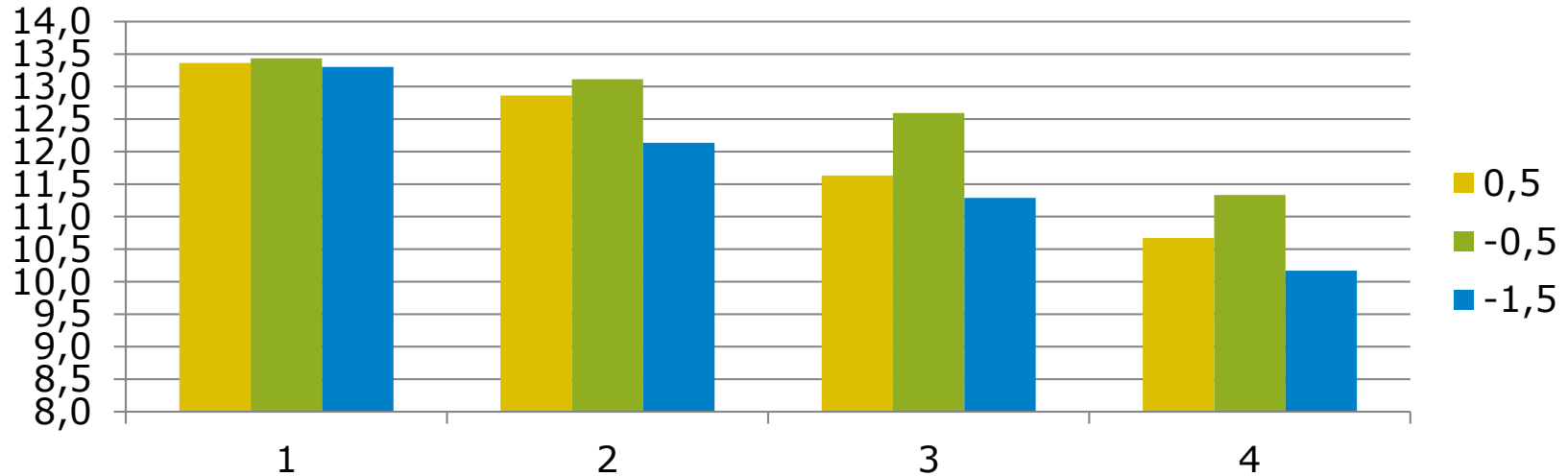
# Fruit size blackberries

	Average fruit weight (g/Fruit)
+ 0.5	8.6
- 0.5	8.8
- 1.5	8.6
Origin 1	9.3
Origin 2	8.8
Origin 3	8.3
Origin 4	8.3

- Fruit size is comparable between the storage temperatures.
- Big difference in fruit size between the several origins of the plants.

# Total yield of the blackberries per temperature regime

Total average yield in kg at 6 blackberry plants



Highest yields at  $-0.5^{\circ}\text{C}$

# Raspberry plants of origin 5 (25/7/2017)



+0.5 °C



- 0.5 °C



-1.5 °C

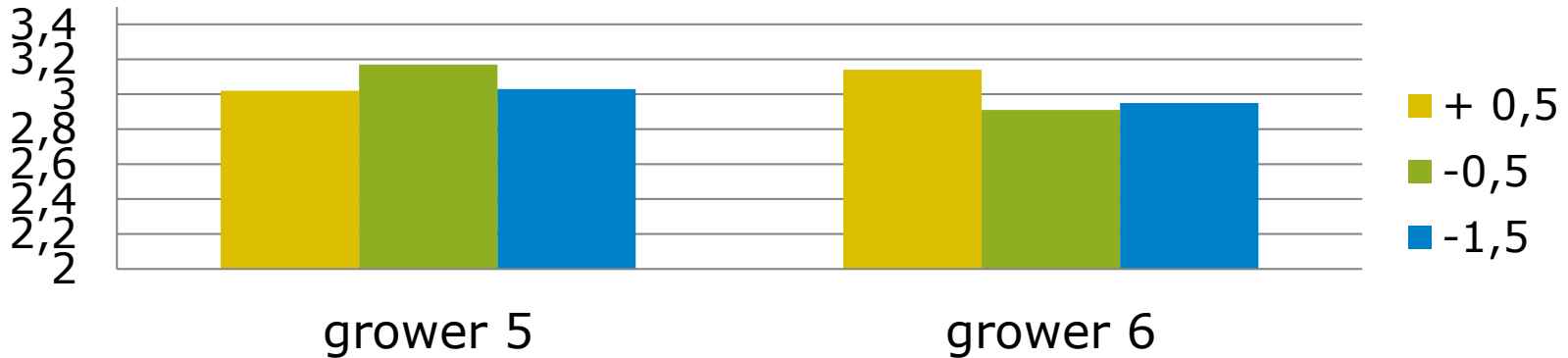
# Fruit size raspberries

	<b>Average fruit weight (g/Fruit)</b>
+ 0.5	6.3
- 0.5	6.1
- 1.5	6,2
Origin 5	6.3
Origin 6	6.1

Fruit size is comparable between as well the storage temperatures as the origins of the plants.

# Total yield of the raspberries per temperature regime

**Total average yield in kg per raspberry plant of 2 canes**



Only small differences between the temperatures

# Fungal diseases



# Storage till May

Loch Ness: *Botrytis* fungus have infecting several canes at the flowering buds.  
By the development of the plants, the size of the affection has increased.



# Diseases

Plants	Diseases at January 2017
Blackberry Loch Ness	<i>Penicillium, Botrytis</i>
Raspberry Tulameen	<i>Cladosporium, Alternaria, Botrytis, Fusarium</i>



In June at the blackberries only  
*Botrytis cinerea* was determined  
-> cane botrytis

Source : WUR



# Storage till July

More fungal diseases were observed at the long canes in July compared to at the start of the storage period (December 2016) and in May 2017 at all temperatures.



Pictures: WUR

# Storage till July

- At  $-1.5\text{ }^{\circ}\text{C}$ : plant still completely in rest
- At  $-0.5\text{ }^{\circ}\text{C}$ : first start of growing development
- At  $+0.5\text{ }^{\circ}\text{C}$ : first green parts at the buds visible



$-1.5\text{ }^{\circ}\text{C}$



$+0.5\text{ }^{\circ}\text{C}$

Pictures: WUR

# Ice

As soon as canes are stored in ice, the growing potential of it is disturbed which results in very low yields; most of the buds did not start growing.



# Summary blackberries

- Flower determination at the end of January: blackberries have generative flower buds.
- Highest yields at the storage temperature of  $-0.5\text{ }^{\circ}\text{C}$
- The plants stored at  $-1.5\text{ }^{\circ}\text{C}$ , have grown normally and produces regular yields.
- Big difference in yields and fruit size between the long canes plants of different origins.
- More *Penicilium and Botrytis* has appeared in plants stored till July -> more research is needed.

# Summary raspberries

- Flower determination at the end of January: raspberries have vegetative flower buds.
- The bark of the canes of some raspberry plants was completely cracked by  $-1.5\text{ }^{\circ}\text{C}$ , but it has dried up and grown normally.
- The yields were comparable at the difference storage temperatures and from plants from different origins.
- *Cladosporium*, *Alternaria*, *Botrytis*, *Fusarium*: several diseases have appeared -> more research is needed.

# Proper storage needs attention I

- Start with the storage of long canes for a short storage period.
- When the temperature is high at packing up the canes, the plastic needs to be open till the canes / boxes are in the storage room.
- Start grading out the smaller plants due to the worse quality for storage.
- Pack up the plants when these are a little bit humid, but not too wet.

# Proper storage needs attention II

- Use plastic with little holes in it for humidity drain.
- The amount of plants per box must be not too high for enough air flow.
- Shortly before packing up the plants carry out sprayings (fungicides) against fungal diseases.

More results of the plants which are stored till July will come as soon as the data is complete.

**Thanks for your attention!**

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