Plasticity of **blackcurrants in a changing climate;** focus on water efficiency

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Introduction

During the last five growing seasons more extreme weather conditions have had a negative impact on the productivity and sustainability of blackcurrants. Weather conditions that currently threaten the production of blackcurrants in Denmark are extended periods of droughts, heavy rain during the production season and/or lack of winter chilling.

Traditionally, selections of blackcurrant genetic material were chosen based on productivity and disease resistance. However, with changing climatic conditions and reduced productivity, breeding material needs to be re-evaluated for increased adaptive and phenotypic plasticity. Therefore, as climatic conditions become unpredictable it is important to grow plant material that has plastic or adaptive traits so that it can cope with extreme drought or extreme rainfall and maintain a commercial crop.

Aim

The overall aim of this project is to identify elite cultivars that have adaptive and phenotypic plasticity and are therefore more likely to remain productive during unfavourable weather conditions. This will be achieved by identifying specific traits, such as an ability to maintain productivity and quality during drought stress or under heavy rain fall and recovery phases.

Blackcurrant genotypes respond differently to reduced or increased water availability and this will be reflected in differences in root growth and distribution, rate of photosynthesis, source/sink relations and flower initiations in blackcurrants.

Root distribution and root density of elite blackcurrant cultivars are phenotypical traits that are significantly correlated to growth plasticity during conditions of drought or water stress.

The rate of recovery following drought or extreme rain fall is significantly correlated to plant plasticity and this rate of recovery will provide a screening tool to identify cultivars that can adjust to unstable climatic conditions.

Materials and methods

Identification of drought resistant germplasm from the most important Scandinavian blackcurrant cultivars will be evaluated. Blackcurrant plant material for genome expression analysis in response to drought for all cultivars will be analyze at SCRI (Scottish Crop Research Institute).

Results and discussion

Experiment 1
Effect of water and CO_2 level on blackcurrant cultivars grown under potted conditions

Design: potted experiment trial
Plant material and location: 1 year plants in the greenhouse
Cultivars: Oyebyn, Titania, Ben Alder, Ben Tirren, Ben Gain

Experiment 1 will start in February 2011 in an experimental greenhouse, growing plants in plastic pot conditions. Evaluation of the response on the elite blackcurrant cultivars under water stress and increased CO_2 level will be determined. Cultivars will be selected that differ due to specific traits in growth vigour combined with different patterns in the water supply. Focus will be on stress responses and recovery phases during two week periods.

Experiment 2
Influence of water availability on crop development and on the yield of blackcurrant cultivars

Design: potted experiment trial
Plant material and location: the plants from Experiment 1 in the container area
Cultivars: Oyebyn, Titania, Ben Alder, Ben Tirren, Ben Gain

If plants are grown under different water treatments, they will show different physiological response. The influence of drought on plants can vary depending of the timing, duration and severity of the stress. Following Experiment 1, the pots will be transported to an outdoor container area in order to evaluate the crop development stages, fruit quality and yield.
The experiments in the greenhouse and container area will be carried out over a two year period, in order to determine the influence and effect of differences in climate conditions between the two years.

Experiment 3
Influence of different water availability on the root and shoot growth of blackcurrant cultivars

Design: field experiment, randomized block design with replications
Plant material and location: 1 year plants in the open field
Cultivars: Titania, Nave Viking and Ben Hope

Three different irrigation treatments will be applied in this experiment:

- Natural rainfall during the whole season (Treatment A)
- Optimal water supply at 100% with a drip irrigation system (Treatment B)
- Application of 200% water during flowering (Treatment C)

Roots play a major role in overcoming water stress/flooding and plant establishment. A reduced root system can result in reduced uptake of water and/or nutrients, leading to impaired crop growth. We will explore different water availabilities and use minirhizotron glass tubes to focus on root elongation. We hypothesize that different responses will depend on cultivar-specific drought/flooding tolerance.

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