Improved growth (eco-physiology)

Research subjects

What plant characteristics are most relevant?
Salix is a perennial crop, where a final yield assessment can be made only after several years of growth in the field. This complicates breeding research, compared with annual crops. We intend to facilitate breeding by finding appropriate measures (i.e. plant characters) in juvenile plants. The characters should be both simple to measure in large populations and reflect the biomass production after several years of growth in the field. Deciduous plant species grown in temperate-boreal regions, such as *Salix*, commonly shed their leaves in autumn and grow new leaves in the following spring. The timing of bud-burst in spring and leaf fall in autumn is critical for potential biomass yield, because it affects the duration of the leafy period in which production occurs. We investigate commercial *Salix* varieties to examine the relationships between shoot growth and important phenology traits (bud-burst in spring, height growth cessation and leaf abscission in autumn).

Improved nutrient use efficiency
The efficient use of nutrients will be important for maintaining or increasing biomass yields in the future, mainly due to limited land and water resources available for biomass production, higher costs of inorganic fertilizer, and increasing environmental concerns. We try to identify plant traits that enhance nutrient (mainly N) use efficiency and that can be used in the plant breeding.

Resource use efficiency and biomass yield under drought
The relationships between shoot growth and water economy are crucial for breeding of perennial biomass crops with respect to the potential markets in warmer (and drier) parts of the world, and a future world where temporary drought conditions (e.g., occasional dry periods) are likely to become more frequent due to climate change. For example, preliminary results indicate that both N uptake efficiency and leaf N efficiency (shoot production per unit plant N) are important traits to improve growth under drought, and as such relevant for breeding. Also, the kind of drought treatment, e.g. temporary or permanent drought, affects plant response and adaptation. Thus, breeding and selection strategies in *Salix* should be different depending on the kind of drought treatment that is relevant.

Current research activities

To gain more knowledge of the properties related to nutrient and water use as well as their genetic background, we study the relevant plant characteristics in different field trials, e.g., a field experiment near Uppsala and a field trial with contrasting water availability in Northern Italy. We partly apply a method based on stable isotopes that indirectly provides information on transpiration and water use in relation to yield and stress tolerance (cropping security) of the plant material. The main focus is to identify useful traits for the assessment of resource use efficiency in breeding populations. Jointly with the colleagues working with the genetic background of phenotypic traits, the ultimate goal is to identify genome regions that are linked to traits important for regulating nutrient and water use and drought tolerance, and to construct genetic markers close to the genes regulating nutrient and water use.

Willow plantations have probably a great potential for biomass production also under warmer and drier conditions compared to Sweden. Many of the research activities within SAMBA are performed in a Salix *breeding population field-grown in Sweden and Northern Italy (photo).*

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