Research project:

Fruit texture – the good old varieties – are they not a bit soft and mealy, if truth be told?

Hmmm, and if they are... what genes to blame?

Breeding ‘for genes’ more efficient than just breeding for common traits:

1. better choice of parents,

2. enabling of MAS (marker-assisted selection)
Several QTLs for fruit texture identified, as well as some potentially important major genes

DNA-based identification of four genes with an impact on fruit texture; two affecting ethylene synthesis and two affecting cell wall degradation
Impact on fruit softening (difference between firmness at harvest and after storage), PLS-DA (Partial least squares discriminant analysis) and weighted regression coefficients; time of harvest and initial firmness most important, effects of the four genes rather small!

Four genes (PG1, ACO1, ACS1 and EXP7), harvest time, number of weeks in storage and initial firmness explained 38% of the variation in fruit softening in 127 apple cultivars.
Research project:

Fungal storage diseases is a major problem in Sweden (no post-harvest dips!)

Inoculation tests were carried out in 2010 with *Penicillium* and *Gloeosporium* to detect genetic variation in tolerance levels.

Evaluation is conducted after 6 or 12 weeks of cold storage of the inoculated fruit, and one week of room temperature (for *Gloeosporium*).
An EST oligonucleotide microarray (INRA, Angers) will be used to study differences in gene expression (tolerant versus susceptible cultivars) in fruit samples taken at different time intervals after inoculation and storage. Help to identify metabolic pathways of importance for the difference between tolerance and susceptibility to fungal infections. Identification of candidate genes, and check with qRT-PCR. Future identification of optimal parents!
Research project:

Fire blight is spreading in Europe, causing much damage in apple orchards. Major resistance genes are difficult to find but quantitative resistance (tolerance) has been found in Cox’s Orange Pippin and some of its offspring.
Inoculation tests are performed in a greenhouse on young apple shoots, using a scissor dipped in spores of the bacterium *Erwinia amylovora*.
Amount of shoot tips with disease symptoms

Cvs Rubinola–Annero, except Guldborg, have two DNA-markers for quantitative fire blight resistance whereas the other cultivars lack these markers.
Research project:

**EU-funded Fruitbreedomics**

Improve the efficiency of fruit breeding (apple and peach) by bridging the gap between scientific genetics research and application in breeding; www.fruitbreedomics.com

Balsgård has recently become an ‘invited partner’
Phenotyping has become fashionable, again...!

i.e. the measuring of important traits, preferably over several years and/or several environments

Marker assisted selection (MAS) using biparental seedling families works well for genes with large effects.... BUT less useful for traits with many alleles of small effect

Association mapping (AM) applied directly to breeding populations (gene banks etc) could be a better alternative for QTL identification

Several gene banks, including Balsgård, now being phenotyped within Fruitbreedomics; flowering time, and fruit maturation, size, shape, colour, texture, taste etc.
Within Fruitbreedomics, all apple cultivars analysed with SSR to check identity

A 20 K SNiP Chip is now being made, for analyses of >1000 apple cultivars

Analyses will be conducted on associations between SNP patterns and phenotype data

Development of SNP-based tests for traits of interest, enable identification of superior crossing parents and marker-assisted selection
Will Fruitbreedomics also use Genome-Wide Selection (GWS)?

Instead of using markers for a specific trait, ALL marker data is included in a mathematical model to evaluate the breeding potential of a certain genotype for a certain trait. Recently undertaken in New Zealand with 1200 seedlings, genotyped with an 8 K SNiP Chip, to identify genes affecting eating quality and susceptibility to physiological disorders.

soft scald and bitter pit
Applied project:  
Centrum för innovativa drycker

Fruit- and berry derived beverages: research, education and innovation
Breeding of black currants, objectives

- **Powdery mildew resistance** (screening in greenhouse)
- **Gall mite resistance** (new DNA-markers available)
- **Black currant reversion virus resistance** (new RT-PCR system available)
- **Leaf curling midge resistance** (new sources identified!)
- **Field resistance septoria, antrachnose, white pine blister rust**
- **Mechanical harvesting, organic growing** (erect plants, proper berry size, strong skin)
- **Annual and high yield** (adapted to the climate in the north and south, winter and spring frost tolerance)
- **Mild typical black currant taste**
- **High content of ascorbic acid**
- **High content of anthocyanins**
- **High content of total phenols**
Research projects associated with breeding of black currants

- Climafruit. Transnational project between the berry industry and research organisations in Sweden, Norway, Denmark, Germany and Scotland 2009-2013. Organic and conventional field trials at Balsgård. EU/Interreg.

- Ontogenetic and genetic effects on health-promoting compounds in black currants (buds, leaves and fruits). PhD research project 2010-2013. SLF.
Selections of black currants for release

BRi9508-3A

BRi9508-3B

BRi9504-2-227

Växtförädling och Bioteknik, Balsgård
Kimmo.Rumpunen@slu.se
Breeding of sea buckthorn, objectives

• Breeding for organic growing

• Adaptation to local climate (winter frost, early – late flowering and ripening) in the north, (Öjebyn) and in the south (Balsgård) of Sweden

• Sweet taste (high in sugar, low in acidity)

• Absence of rancidity at full maturity

• High content of ascorbic acid

• Annual and high yield

• Suitability for harvesting by cut/freeze/shake

Växtförädling och Bioteknik, Balsgård
Kimmo.Rumpunen@slu.se
‘HIPPOHEALTH’- Research project associated with breeding of sea buckthorn

Prof. Ruan Chengjiang, China
Marie Curie grant, 2011-2013

Main focus: resistance to pathogenic fungi, and fruit quality

- Phenotyping (in the field and in the lab) the plant collections at Balsgård
- Development of DNA markers for the phenotyped traits
- Biochemical changes during berry development and maturation

Växtförädling och Bioteknik, Balsgård
Kimmo.Rumpunen@slu.se