Efficient Resource Use in Production Systems

INFORMATION AND DSS IN FRUIT PRODUCTION

Fabrizio Mazzetto

Learning Outcomes

The course aims to introduce the student to issues of decision-making processes of the agro-environment enterprises, mainly focusing on the requirements of farms oriented to fruit productions. Theoretical and practical aspects of the use of Farm Information Systems (FIS) and interactions between Information and Communication Technologies (ICT) and farm mechanization components will be presented and discussed in an integrated way. Relevant emphasis will be given to the designing, implementation and use of farm databases, particularly in view of their integration with GIS tools.

Course Content

The course will cover the following topics:

1. **ICT REQUISITES FOR PRECISION HORTICULTURE (PH).** The ICT's frontier in the context of agro-environmental and horticulture farming systems, between the emerging needs of precision farming and information management. The new requirements of the fruit supply full chain for traceability, reporting of processes and activities, automation in field process controls, site-specific farm management. The importance of automating data-logging and farm monitoring; types of monitoring and surveys classifications (environmental, crop and operational).
2. **ICT COMPONENTS.** Their general classifications in view of their use within the horticultural contexts. Basic electronic devices: sensors, actuators and identification systems; stand-alone and integrated applications in horticulture farming systems. Positioning systems (GPS and DGPS receivers). Computing hardware solutions: data-loggers, handhelds, personal computers and servers; data-transfer and communication systems, client-server architectures. Computing software solutions: general outlines on Farm-databases and necessity of a reference Farm-ontology. Fundamentals of Database Management Systems (DBMS) in farm applications. GIS outlines: mapping systems and geo-reference problems; backgrounds and layers; entities and attributes; links to databases; importing of GPS-paths from farm machinery activities.
3. **PH APPLICATIONS.** Operational monitoring: the role of moving- and stationary-user point mechanisation; the tractor as data-logger and information carrier; Computerized Farm Registers (CFR): general features and functionalities; basic structural frameworks (tractor-oriented e implement-oriented); inference engine algorithms to interpret the meaning of

farm operational raw-data: from the elementary and single field-activity to the farm historical memory. Crop monitoring: optical and acoustic sensors for performing remote- and proximal-sensing applications; discussion of some case-studies to detect the vigour and the volume of the crop canopy; from thematic maps to prescription-maps. Outlines on prescription farming solutions and related VRT technologies for automating field processes.

Teaching Methods

The course consists of lectures (18 hours frontal lessons) during which the Professor presents the different topics. Practical lessons and laboratory activities (12 hours laboratory) conducted by the Teacher and the Teaching Assistants are planned as well, to show DBMS and Crop Monitoring applications.

Readings/Bibliography

- E.C. Oerke, R. Gerhards, G. Menz (2010). Precision Crop Protection - the Challenge and Use of Heterogeneity. Springer, London - New York, pp.441.
- M. A. Oliver Springer (2010). Geostatistical Applications for Precision Agriculture. Springer, London - New York, pp.331.
- T.A. Brase (2006). Precision agriculture. Thomson Delmar Learning, pp.224.
- B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins, (2001). GPS Theory and Practice , Springer-Verlag, Wien, pp.370.

Assessment Methods

Assessment (at the end of the course) is conducted via oral examination that includes:

i) questions to assess the knowledge and understanding of the course topics

ii) questions designed to assess the ability to transfer these skills to case studies of crop production, and

iii) ability to manage the experiences carried out in laboratory, with special regards to the use of DBMS for PH.

Attribution of a single final mark awarded on the basis of the following criteria: the clarity of the response, the ability to summarize, evaluate, and establish relationships between topics, the independence of judgment, the ability to rework**.**

Teaching Tools

Course topics will be presented using Power Point presentations and at the end of a single lesson a paper copy will be distributed directly to students.

APPLIED BREEDING AND SUSTAINABILITY

Luca Dondini

Learning Outcome

Students have to demonstrate a good knowledge about the breeding approaches to select plant material suitable for the conditions where it has to be grown and with the right quality for the end-users. An increased yield is still the most important trait but sustainable plant production requires plant adaptation to abiotic stresses as well as resistance to pests and diseases. It is important for students to know the approaches for plant selection for specific traits.

Course Contents

Students should have a background in agriculture and horticulture, all with knowledge about basic elements of genetics.
Lectures are organised in two parts (frontal and lab practice).

Frontal lectures (18 hours)

Introduction: basic concepts about fruit trees and implications in fruit tree breeding. Strategies for conventional (double-pseudo test cross) and advanced (principles of in vitro culture, somaclonal variability and in vitro selection, development of molecular markers for MAS) breeding.

Overview of the main breeding goals for sustainable production and related applications:

- Breeding for resistance to biotic and abiotic stresses
- Breeding for low input production (habitus, self thinning and self-fertility)
- Breeding of rootstocks
- Application of genetic transformation for sustainable production in fruit tree species
- Cisgenic plants and breeding by DNA editing.

Lab practice (12 hours):

- Molecular marker analysis on a panel of genotypes for selected traits. - Visit to an experimental farm

Readings/Bibliography

Handouts and selected papers.

Teaching Methods

The course will be divided in two parts: the first part is focused on the main breeding strategies in fruit tree species and the relative applications for plant sustainable production. The second part in the laboratory, to learn by experience a technique for DNA extraction and test plant DNAs by PCR by using markers linked to specific traits.

Assessment Methods
Oral exam: One question about topics of the lab activities and two questions regarding topics of the frontal lectures.

Teaching Tools
Beamer, equipments in the biotechnology lab.

PROJECT DEVELOPMENT AND MANAGEMENT

Hans Karl Wytrzens

Learning Outcome
Upon successful completion of the course, students will be able to:

- Display basic knowledge of underlying theories and concepts of project organisation (Knowing and Understanding)
- Understand the development of project ideas (Knowing and Understanding).
- Check feasibility of projects; formulate project objectives, deliverables, exclusions, and limits (Applying).
- Plan and implement project activities professionally (Applying).
- Assess critically project management documents and processes (Judging).
- Form and lead a project team (Applying).

Course Contents
The course offers a practical introduction to project development and management. It shows the applicability of project management in horticulture as well as fruit production by focusing on

- feasibility checks and systematic development of project ideas
- project phases, types and context (stakeholder analysis)
- project plans (scope planning, work breakdown structure, scheduling, resource planning, budgeting)
- implementation activities (team building, and motivating, controlling, and steering projects)
- project reports and evaluations
- project closure

Readings/Bibliography
Lecture notes made available after the lesson on the on-line platform of unibz; handouts provided by the instructor through internet services managed by unibz.
Recommended supporting literature:

- Project Management Institute (2013) A Guide to the Project Management

Body of Knowledge (PMBOK® Guide)—Fifth Edition
- Wytrzens H.K. (2017) Projektmanagement. 5. Auflage; Facultas

Teaching Methods

Theory input (as frontal presentation) is followed up by interactive exercises, discussions, practical teamwork and case study training. Systematic feedback from the teacher rounds each teaching unit off.

Assessment Methods

Written exam at the end of the course on the entire program (lectures, and exercises) (50 % to 100% of the overall course mark) and results of a teamwork case study (0 – 50 % of the overall mark).

TeachingTools

Beamer for frontal lessons parts (aided by visual presentation); pinboard, flipchart, and moderation cards for the participatory coaching approach; pictures and short descriptions for case study examples.