International Master in Horticultural Science (IMaHS)

LIST OF COURSES AND TEACHING MODULES OFFERED AT UNIBZ IN THE THIRD SEMESTER.

Module	Semester	ECTS Credits
Production Chain Management	1	**12**
• Integrated Orchard and Vineyard Management *Canopy Management* *Soil and Water Management*		6
• Mineral Nutrition		3
• Applied Entomology in Horticultural Crops		3
Post-harvest Chain Management		**9**
• Supply Chain and Innovation Management		3
• Fruit Processing		3
• Post-harvest Management		3
Plant Protection and Disease Management		**9**
• Plant Protection Products and Residues	1	3
• Elements of Chemistry and Biochemistry of Agrochemicals 1	1	3
• Integrated Plant Disease Management	1	3
Efficient Resource Use in Production Systems		**9**
• Project Development and Management	1	3
• Applied Breeding and Sustainability	1	3
• Information and DSS in Fruit Production	1	3

Production Chain Management

INTEGRATED ORCHARD AND VINEYARD MANAGEMENT

Carlo Andreotti / Massimo Tagliavini

Learning Outcomes

The course will provide students with scientific and technical knowledge on the canopy and soil management in orchards, vineyards and nurseries. At the one hand, students will understand and critically consider the main factors involved in canopy architecture and its and management. At the other hand, the course will allow the students to use the available scientific knowledge and the modern technical tools to improve the management of ground cover, irrigation and fertilizer supply, in order make the best use of the natural resources and enhance soil fertility. Students will be able to adapt this knowledge to specific environmental and agricultural conditions for developing production systems that reconcile yields, fruit quality and environmental sustainability.

Course Contents

Students attending this class must possess basic knowledge of tree biology and physiology to fully understand the subjects presented during the course. These competences are obtained during the first level degree and in the first-year of the master program. The course is divided in two modules and will focus on the following topics:

A) Module CANOPY MANAGEMENT

Carlo Andreotti

- Introduction to the canopy structure (architectural models, fruiting habitus) and functionality (*Teaching unit length*: 2 hours)
  Relation between the vegetative and reproductive cycles
  Pruning as a tool to manage the competition between organs (roots, shoots, bud induction and differentiation, flowers, fruits, etc)
- Pruning techniques (*Teaching unit length*: 8 hours)
  Dormant pruning
  Summer pruning
  Mechanical pruning
  No pruning techniques
- Canopy training systems for low/intermediate/high density orchards (*Teaching unit length: 6 hours*)
  Training systems for fruit trees
  Training systems for grapevine
- Management of fruit load (*Teaching unit length*: 6 hours)
  Alternate bearing and fruit thinning
  Plant growth regulators to control tree growth and fruit quality

Control of ripening in grapevine

- Protection systems (Teaching unit length: 2 hours)
  Shading nets, hail nets, plastic tunnel against rain, wind barriers
- Production systems in nurseries *(Teaching unit length: 6 hours)*
  Production techniques
  Nursery management and legislation

B) Module SOIL AND WATER MANAGEMENT

Massimo Tagliavini

- Management of root growth and root activity (*Teaching unit length: 4 hours)*
  Root distribution
  Environmental and cultural control on roots
  Beneficial use of interactions between roots and micro-organisms in the rhizosphere
  Root pruning

- Mineral nutrient supply *(Teaching unit length: 10 hours)*
  Nutrient needs
  Nutrient availability
  Nutrient cycling within trees and ecosystems
  Soil and foliar nutrient supply; fertigation techniques
  Management of nutrient-related physiological disorders

- Water management *(Teaching unit length: 10 hours)*
  Soil water availability and water needs
  Plant and soil-based methods for irrigation scheduling
  Water stresses and irrigation strategies for enhancing fruit quality
  Strategies to enhance WUE and reduce water losses
  Regulated deficit irrigation and partial root drying
  Irrigation systems

- Orchard- and vineyard-floor Management systems *(Teaching unit length: 4 hours)*
  Ground-cover vegetation and ground-cover systems
  Weed control methods
  Green Manure

- Control of soil sickness and replant problems *(Teaching unit length: 2 hours)*

Teaching Methods

Frontal lessons make up 60% of the time allotted to this course. The remaining 40% of the time is dedicated to lab- and field-activities, and visits.

Readings/Bibliography
Lecture notes made available after the lesson on the on-line platform of unibz; handouts and articles provided by the instructor through internet services managed by unibz. Selected chapters from *FAO Irrigation and drainage paper 66* (available online), *Fundamental of temperate zone tree fruit production (*2005) and *Apple, Botany production and uses* (2003).

Assessment Methods
Oral exam at the end of the course on the entire program (frontal lessons and exercises/excursions). At least three questions on different subjects of the course will be asked. The number of questions is dependent from the quality and completeness of the answers given by the candidate.

Teaching Tools
Frontal lessons using ppt presentations. Use of software the computer room. Field exercises with the use of scientific instruments. Field visits.

MINERAL NUTRITION

Stefano Cesco

Learning Outcomes
The course aims at improving the knowledge about the mechanisms underlying the soil availability, root uptake, translocation and allocation of mineral nutrients in fruit tree crops. This knowledge will allow to manage the fertilization practices in orchards according to the physiological needs of plants.

Course Contents
General aspects of ion uptake mechanisms of plants: short (roots) and long (xylem and phloem) transport and allocation. Ion uptake by leaves (mechanisms underlying foliar fertilization). Forms and availability in the soil-plant system, plant contents, metabolic functions, symptoms of deficiency/excess, fertilizers and their field application of macro (N, P, K, Ca, Mg) and micronutrients (B, Zn, Fe, Mn, Cu) in relation to a sustainable and efficient use of the source. Examples of biofortification (Si, Se, Ni) and nutrient interactions (e.g. N vs Fe, N vs S, Fe vs S).

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 excursions/laboratory*) conducted by the Teacher and the Teaching Assistants are also foreseen.

Readings/Bibliography
Mineral Nutrition of Higher Plants, Ed: Petra Marschner , Academic press, 2012, ISBN: 978-0-12-384905-2

Assessment Methods
Assessment (*at the end of the course*) is conducted via oral examination that includes a) questions to assess the knowledge and understanding of the course topics and b) questions designed to assess the ability to transfer these skills to case studies of crop production. Space will also be dedicated to the evaluation of the ability to rework the experience of the laboratory.
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 ENTOMOLOGY IN HORTICULTURAL CROPS

Sergio Angeli

Learning Outcomes
By the end of the course, students should acquire knowledge that enables them to: identify the key pest insects of the major horticultural crops and small fruit crops; understand the pest complexes of the agro-ecosystems; have a broad idea of chemical ecology and tritrophic interaction amongst host plants, pests and their natural enemies; plan a monitoring program for pest insects; link sustainable agriculture with pest control; understand the fit of IPM in fruit cropping systems, with traditional and alternative control measures. The main goal of this course is to learn how to improve economic values of plants while defending and improving the environment and the ecosystem services such as self pest-regulation and pollination.

Course Contents
The course is designed to provide graduate students with an overview of pest insects and pest management strategies, emphasizing ecological principles and their applications within the major agro-ecosystems of fruit trees cultivation. Pest insect biology and management of the fruit production systems in temperate regions will be considered, as apple, grape, cherry, plum, peach, strawberry and other small fruit. Specific attention will be given to beneficial insects, biological control and IPM strategies. The course will cover the following topics: Overview on general entomology; Key pest insect species of apple, grape, cherry, plum, peach, strawberry and other small fruit; Chemical ecology and Tritrophic interactions; Synthetic insecticides and Integrated Pest Management; Biological Control, Benefical Insects in Organic Farming and Botanical Insecticides; Pollination Services; Case topics selected by the students.

Teaching Methods
This course involves consists of 18 hr of frontal lectures and 12 hr of practical part. The frontal lectures and topics are presented by the Professor. Practical parts, lab activities, and excursions are explained by the Professor and the Teaching Assistants. Numerous papers are brought to class for review. The practical part provides instruction mainly in key pest insect identification and biology of horticultural crops, extraction of botanical insecticides, insecticidal activity, etc.

Readings/Bibliography
Aluja M., Leskey T.C., Vincent C. (Eds.) 2009 "Biorational Tree-Fruit Pest Management", CABI Publishing, Wallingford, UK, 295 pp. ISBN: 1845934849. Heikki M.; Hokkanen T., Lynch J.M. (Eds.) 1996 "Biological Control - Benefits and Risks", Cambridge University Press, UK, 326 pp. ISBN: 9789048126651. Koul O., Cuperus G.W., Rolff J. (Eds.) 2007 "Ecologically Based Integrated Pest Management", CABI Publishing, Wallingford, UK, 462 pp. ISBN: 9781845930646. Lichtfouse E., Navarrete M., Debaeke P., Véronique S., Alberola C. (Eds.) 2007 "Sustainable Agriculture", Springer, the Netherlands, 919 pp. ISBN: 9789048126651. Pedigo L.P., Rice M.E. 2009 "Entomology and pest management", 6th Ed. Pearson Prentice Hall Upper Saddle River (NJ), 784 pp. ISBN: 0135132959. Peshin R., Dhawan A.K. (Eds.) 2009 "Integrated Pest Management, Volume 2: Dissemination and Impact", Springer, New York (NY), 634 pp. ISBN: 1402089899. Schowalter T.D. 2011 "Insect Ecology: An Ecosystem Approach", 3rd Ed. Academic, San Diego (CA), 633 pp. ISBN: 0123813514.

Assessment Methods
Coursework will be weighted as follows: final written exam (70%), student seminar (15%) exercises and excursions (15%). It will not be possible to pass the course if the final written exam has a mark lower than 18.

Teaching Tools
Generally, Power Point presentations are available in the course reserve collection database of the Faculty 1 day after each single lecture. Additional material are provided by the Professor.

Post-Harvest Chain Management

SUPPLY CHAIN AND INNOVATION MANAGEMENT
Christian Fischer

Learning Outcomes
Supply chain management (SCM) is concerned with the coordination of the physical flow of goods and services across space, time and different types of organisations. In this course, SCM is approached from the point of view of (industrial, or business-to-business) marketing, strategic management and transaction cost economics always

with a focus on the fruit industry. The course offers an introduction into the topic and aims at providing the participants with a basic understanding of the involved issues, concepts and methods, so that they can apply them in their later job activities. In addition, the participants will learn and be able to apply the basics of innovation management, in particular collaborative innovation activities across the supply chain.

Course Contents

1) Introduction
2) Fundamentals of supply chain management
3) Fundamentals of innovation management
4) Applications to the fruit industry
5) Summary

Teaching Methods

24 hours frontal lessons, 6 hours group work.

Readings/Bibliography

- Lecture materials and slides
- Fawcett, S., Ellram, L. and Ogden, J. (2007): *Supply Chain Management – From Vision to Implementation*. Pearson Prentice Hall, Upper Saddle River, NJ, USA
- Fischer, C. (2010): Opportunities for innovation in specialised fruit & vegetable retailing – results from an Auckland greengrocers survey. In: Hewlett, E. & Johnson, J. (eds), Proceedings of the Australasian Postharvest and Managing Quality in Chains Conference, Napier, New Zealand, 2009. ISHS *Acta Horticulturae* 880. Pages 91-97.

Assessment Methods

Final exam at the end of the course. In addition, there is study project to complete which contributes up to 30% of the final module mark.

Teaching Tools

Teaching materials (slides, scientific articles etc) made available on unibz's Leganto platform.

FRUIT PROCESSING

Matteo Scampicchio

Learning Outcomes

By the end of the course, students should acquire knowledge that enables them to: identify the main key processing steps used during fruit transformation; understand the main effects of the processing on the quality characteristics of the processed fruits; have a detailed overview of main chemical and biological events occurring during fruit juice production, jam preparation, fruit drying and storage; understand

the possible preventive measure to control or even enhance the stability and shelf life of the processed fruits.

Course Contents

The course is designed to provide graduate students with an overview of the main processing steps used during the transformation of fruits, emphasizing the chemical, physical and biological changes occurring during processing. Specific attention will be given to the production of fresh cut fruits, fruit juices, jams, jellies and marmalades and dried fruits. Accordingly, the course will cover the following topics:

1. Fresh cut fruits;
2. Fruit juice processing
3. Enzyme use in fruit processing
4. Fruit preserves and jams making
5. Use of pectins in fruit processing
6. Drying of fruits
7. Thermal processing of fruits
8. Hurdles technologies and
9. Fruit by-products.

Teaching Methods

This course involves consists of 20 hr of frontal lectures and 10 hr of practical part. The frontal lectures and topics are presented by the Professor. Practical parts, lab activities, and excursions are explained by the Professor and the Teaching Assistants. The frontal lectures will be offered with digital slides, videos and the lecture of selected scientific literatures. The practical part includes exercises with spreadsheet at the PC, laboratory activity for the measurement of the main quality fruit attributes and some practical laboratory activity on the use of enzymes and pectins in fruit processing.

Readings/Bibliography

The content of the course is based on the following bibliography:

- Slides presented during the lectures.
- Mircea Enachescu Dauthy, in: Fruit and vegetable processing, FAO AGRICULTURAL SERVICES BULLETIN No.119, freely available online at http://www.fao.org/docrep/V5030E/V5030E00.htm

Furthermore, for a deeper understanding of the topic presented during the course, it is recommended the reading of the following book:

- Diane M. Barrett, Laszlo Somogyi, Hosahalli S. Ramaswamy in: *Processing Fruits: Science and Technology*, Second Edition, CRC Press.

Assessment Methods
Coursework will be weighted as follows: final written exam (100%). It will not be possible to pass the course if the final written exam has a mark lower than 18.

Teaching Tools
Generally, Power Point presentations are available in the course reserve collection database of the Faculty 1 day after each single lecture. Additional material are provided by the Professor.

POST-HARVEST MANAGEMENT

Angelo Zanella

Learning Outcomes The course will provide students with scientific and technical knowledge on the post-harvest management of the main horticultural crops. An understanding will be developed concerning the interactions between the biological crop system at post-harvest, the surrounding environment and the influencing technical factors. This understanding will allow the students to manage future post-harvest challenges by adaptive knowledge.
Course Contents
Basic knowledge of fruit histology, physiology, ripening processes and biochemistry is assumed and will be deepened during the course. The course itself is divided in two sections:
A) Understanding the inter-linkage of post-harvest principles:
Reasons and scope for the post-harvest management; single post-harvest handling principles and inter-linkage; quality and safety management; potential of non-destructive quality evaluation techniques; definition, sources, prevention of post-harvest losses; influencing post-harvest ripening; adaptive storage procedures; innovation in storage technologies
B) Post-harvest handling of the main horticultural crop categories:
Post-harvest handling of following horticultural crop categories: tropical-, subtropical fruits, small fruits, pome fruits, stone fruits, fruit vegetables, flower- leafy- stem-vegetables, underground vegetables.

Teaching Methods
Frontal lessons will alternate with elements of flipped classroom and team-work with the aim of enhancing the degree of interaction and active knowledge acquisition, including lab-activities and visits.
Assessment methods: Written exam at the end of the course on the entire program (lectures, results of team-work and exercises/excursions), participation to team-work and lab activity.
Teaching tools: Frontal lessons aided by visual presentation. Flipped class room approach. Team work and team presentations. Lab demonstrations and exercises. Field visits.

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

Recommended supporting bibliography:

- R. Wills et al. (2016, 6th Ed.); Postharvest of fruit, vegetables & ornamentals; CAB International
- A. Kader et al. (2002); Postharvest technology of horticultural crops; University of California

Recommended supplementary bibliography:

- W.J. Florkowski, R.L. Shewfelt, et al. (2014); Postharvest Handling – A Systems Approach, Third Edition; Academic Press
- R. Wills et al. (2015); Advances in Postharvest Fruit and Vegetable Technology; CRC Press

Optional Course 1

Plant Protection And Disease Management

PLANT PROTECTION PRODUCTS AND RESIDUES

Sanja Baric

Learning Outcomes

The knowledge acquired will allow the understanding of European and national regulations on registration and application of plant protection products. The student will link the correct use of agrochemicals with the resulting residues on horticultural products. Students will also acquire tools to become constantly updated on the future evolution of the plant protection product portfolio.

Course Contents

- Review of the properties and the application of plant protection products
- European and national legislation on plant protection products
- Procedure for the approval of active substances of plant protection products including toxicological and ecotoxicological risk assessments
- Authorisation of plant protection products
- Sustainable use of plant protection products
- Maximum residue levels of plant protection products

Teaching Methods

18 hours of frontal lectures combined with class discussions; 12 hours of exercises.

Readings/Bibliography

Handouts and selected papers shall be given to the students during the course.

Assessment Methods

Final written exam at the end of the course.

Teaching Tools
PowerPoint presentations of the lectures as well as technical and scientific papers will be made available through the online platform of the Free University of Bozen-Bolzano.

ELEMENTS OF CHEMISTRY AND BIOCHEMISTRY OF AGROCHEMICALS

Youry Pii

Learning Outcomes
The course aims at providing students with the knowledge and expertise on the agrochemicals modes of action and the fate of these chemicals in the agro-ecosystem. This knowledge will allow the sustainable management of this agricultural practice for the protection of cultures.

Course Contents
Classification of agrochemicals. Agrochemicals and their metabolism within cells: mode of action of fungicides (interference with respiration, biosynthesis of sterols, chitin, tubulin and nucleic acids); mode of action of insecticides (neurotoxic and decoupling insecticides); mode of action of herbicides (interference with photosynthesis, biosynthesis of amino acids and biosynthesis of lipids). Agrochemicals metabolism in plants: reactions of oxidations, reduction, hydrolysis and conjugation. Agrochemicals fate in soil: movement (leaching, run-off, volatilization), adsorption (adsorption isotherms and adsorption coefficients) and degradation (photodecomposition, chemical and microbiological degradations). European and Italian legislation of agrochemicals, labeling and their storage. Practical exercise: determination of agrochemical adsorption and agrochemical degradation in soils.

Teaching Methods
The course consists of lectures (18 hours frontal lessons) during which the teacher will present all the topics foreseen in the course content. Practical lessons (12 hours) to be held in the laboraory by the teacher are also foreseen.

Readings/Bibliography
Gennari M. and Trevisan M. “Agrofarmaci - Conoscenze per un uso sostenibile” ISBN 978-88-8372-444-2
Müller F. “Agrochemicals : composition, production, toxicology, applications” ISBN 3-527-29852-5
Roberts T.R. “Metabolic pathways of agrochemicals” ISBN 0-85404-494-9; ISBN 0-85404-499-X

Assessment Methods
Assessment (at the end of the course) is carried out by oral examination, which will include:

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

ii) questions designed to assess the ability of transferring the acquired skills to case studies. Also the knowledge acquired during the practical lessons will be assessed.

A single final mark will be awarded on the following criteria:

i) clarity of the answers

ii) ability to summarize, evaluate and establish relationships between topics

iii) independence of the judgment and

iv) the ability of reworking.

Teaching Tools

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

INTEGRATED PLANT DISEASE MANAGEMENT

Annamaria Pisi

Learning Outcomes

The course emphasizes the importance and need of the integrated management of plant diseases within the integrated pest management approach, with the least possible disruption to the agro-ecosystems and the least hazard to people, animals, and environment. The course will enable the students: to acquaint with the principles of an integrated approach to plant disease management; to become familiar with the basic principles involving fungal, bacterial, phytoplasma and viral based diseases in plants; to acquire knowledge of the environmental factors influencing plant diseases, to gain an understanding of the influence of plant pathogens in crop-ecology finalized in rationalise disease control; to know the most successful plant protection strategies by physical, genetic, cultural, chemical and biological means; to gain knowledge of the use of predictive models.

Course Contents

The mission of the course is addressed to the study of the integrated plant disease management strategies that incorporate conventional and novel biological, cultural, chemical, genetic and other environmentally sound and economically profitable approaches. Discussion of the principles of managing insects, diseases in the context of developing stable agricultural systems. During the course it will be provided the basis of understanding, interpretation, selection, development and application of the most effective methods of Integrated Crop Management, with the least disruption to the environment. A more detailed understanding of the effects of pest pressure on crop productivity and the development of threshold levels for action will be developed.

The course will provide the main elements involved in the integrated plant disease management: Exclusion — keep pathogens, vectors and infected plants out of disease-free areas. Eradication — destroy a disease organism after it has become established (destruction of infected plants, disinfection of storage bins, containers and equipment, and/or soil disinfection by fumigation, pasteurization, solarization or drenching). Protection – use a physical barrier such as a row cover. or chemical applications available to prevent a disease from becoming established. Resistance — plant resistant varieties. Therapy – use chemicals that are systemic in the plant. Avoidance – use good cultural practices such as planting date selection, seedbed preparation and water management to avoid disease.
Evaluation of the benefits and risks of the treatments and choose the best solution with the least negative environmental impact. The challenge, when using pesticides, is to pick the one that will cause the least harm to non-target organisms in the forest or landscape.
Discussion of the new scenario of crop protection created by the policy on the use of pesticides started 20 years ago by the European Union to reduce their impact on health and environment. It is a topic that should be known since the new legislation for crop protection is becoming a very complex practice, because it is based on technical means more and more difficult to use also for legislative limitation. The EU policy is changing the regulatory framework for the homologation and use of products for plant protection in member states and this will have an impact in the different European countries.

Readings/Bibliography
Handouts and selected paper will be given to the students during the lecture by the instructor.

Teaching Methods
The course will be subdivided in two parts: The first concentrated on the different control methods of the main plant pathogens, giving more emphasis and preference to host-resistance, cultural practices and biological control other than the use of pesticides. The second part in the laboratory for the identification of the main pathogens and better study the most advanced methods to control plant pathogens responsible of the most important crop diseases.

Assessment Methods
At the end of a course it will be a final exam that tests the acquired knowledge and abilities. The students should produce a power point presentation on a subject chosen with the instructor of about 15 minutes long. Then questions on the main subjects of the course will follow. The final grade will be calculated by arithmetic mean among the integrated courses.

Teaching tools
PC, slide projection and handouts.

Optional Course 2

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).

Teaching Tools

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.