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.