

General information	
Academic subject	Soilless culture systems <b>(Choice module)</b>
Degree course	Agricultural Sciences and Technologies
Academic Year	2021-2022
European Credit Transfer and Accumulation System (ECTS)	6
Language	Italian (English will be used when required for foreign students into didactic material)
Academic calendar (starting and ending date)	Second semester
Attendance	Not mandatory

Professor/ Lecturer	
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Department and address	Agricultural and environmental science (DISAAT)
Virtual headquarters	M. Teams
Tutoring (time and day)	Every day by email

Syllabus	
<b>Learning Objectives</b>	<p>Provide high knowledge to produce soilless vegetable species and to improve the quality of products and the production process, while respecting the environment and food safety.</p> <p>At the end of the course, you will be able to produce the main vegetable and flowering crops with soilless cultivation systems. Furthermore, you will be able to develop a cultural itinerary to improve the quality of the product and the production process.</p>
<b>Course prerequisites</b>	Basic knowledge of "Agronomy" and "Vegetable and floriculture crops".
<b>Contents</b>	<p>Lessons (32 hours and 4 ECT)</p> <ol style="list-style-type: none"> <li>1. Presentation of the program and teacher (2 hours and 0.25 ECT)</li> <li>2. History and spread of soilless crops (1 hour and 0.125 ECT)</li> <li>3. Classification of soilless crops (1 hour and 0.125 ECT)</li> <li>4. Advantages and disadvantages of soilless crops (1 hour and 0.125 ECT)</li> <li>5. Nutrients and elemental composition of plants (1 hour and 0.125 ECT)</li> <li>6. Essential (macro and microelements) and non-essential elements (1 hour and 0.125 ECT)</li> <li>7. Nutrient mobility and deficiency symptoms (1 hour and 0.125 ECT)</li> <li>8. Methods to express the concentration of nutrient solutions (2 hours and 0.25 ECT)</li> <li>9. Fertilizers, composition and calculation of the nutrient formulations of the nutrient solution (4 hours and 0.5 ECT)</li> <li>10. Calculations for the formulation of the nutrient solution: use of a spreadsheet, preparation and verification (2 hours and 0.25 ECT)</li> <li>11. Electrical conductivity, O<sub>2</sub>, pH and temperature of the nutrient solution (2 hours and 0.25 ECT)</li> <li>12. Characteristics of the water (1 hour and 0.125 ECT)</li> <li>13. Chemical and physical characteristics of the main substrates used (4 hours and 0.5 ECT)</li> <li>14. Cultivation methods: substrate cultivation, rockwool, sub-irrigation, ebb and flow, NFT, floating system and aeroponics (2 hours and 0.25 ECT)</li> </ol>

	<p>15. Management of the closed cycle and efficiency of use of the nutrient solution in soilless crops (2 hours and 0.25 ECT)</p> <p>16. Programming of fertigation and control systems (2 hours and 0.25 ECT)</p> <p>17. Quality of soilless products and comparison with those obtained on soil (2 hours and 0.25 ECT)</p> <p>18. Production of microgreens (1 hour and 0.125 ECT).</p> <p>Laboratory and field classroom, working groups, study case, and transferring of stakeholders' experiences (28 hours and 2 ECT)</p> <p>1. Visit to the "La Noria" Experimental Farm (4 hours and 0.3 ECT)</p> <p>2. Characteristics of fertilizers to be used in soilless crops (2 hours and 0.15 ECT)</p> <p>3. Exercises for the formulation of the nutrient solution: use of a spreadsheet, preparation and verification (4 hours and 0.3 ECT)</p> <p>4. Analysis of nutritional solutions: pH, electrical conductivity, dissolved oxygen, temperature, concentration of the main inorganic anions and cations (4 hours and 0.3 ECT)</p> <p>5. Production of microgreens (4 hours and 0.3 ECT)</p> <p>6. Recognition and rapid analysis of substrates: pH, electrical conductivity, hydrological characteristics, porosity, apparent mass (2 hours and 0.15 ECT)</p> <p>7. Fertigation and planning of fertigation interventions (2 hours and 0.15 ECT)</p> <p>8. Technical visits to some commercial and experimental soilless crops (6 hours and 0.45 ECT).</p>
<b>Books and bibliography</b>	<p>PARDOSSI A., GIANQUINTO PROSDOCIMI G., SANTAMARIA P., INCROCCI L., Orticoltura. Principi e pratica (a cura di). Edagricole - New Business Media, Milano, 2018.</p> <p>DI GIOIA F., SANTAMARIA P., 2015. Microgreens. Eco-logica editore, Bari (also with pdf).</p> <p>SANTAMARIA P., 2007. I sistemi di allevamento in vaso con subirrigazione a ciclo chiuso (a cura di). Aracne editrice, Roma.</p> <p>SIGNORE A., SERIO F., SANTAMARIA P., 2016. A targeted management of the nutrient solution in a soilless tomato crop according to plant needs. Front. Plant Sci. 7:391.</p>
<b>Additional materials</b>	<p>All texts are recommended for in-depth study.</p> <p>To study, students will be able to use lecture notes and documents shared by the teacher via M. Teams or Dropbox.</p> <p>Example of website: <a href="http://www.soilless.it">www.soilless.it</a></p>

<b>Work schedule</b>			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
<b>Hours</b>			
150	32	28	90
<b>ECTS</b>			
6	4	2	
<b>Teaching strategy</b>			
<p>During the health emergency imposed by the COVID-19 pandemic, lectures will be held remotely with the use of M. Teams.</p> <p>The topics of the course will be treated with the help of Power Point presentations and with the support of videos. Students will receive the pdf format of the frontal lesson with the addition of useful texts for their study to the images.</p>			

	<p>Each lesson (ppt and pdf) will be enriched with curiosities, links, insights, exercises to be carried out and questions for self-verification.</p> <p>The activities of exercises will develop in the greenhouse (but also at home for those who want it) the production of microgreens, to be carried out also in groups.</p> <p>Laboratory activities, technical visits in the field and in leading companies will be carried out.</p>
<b>Expected learning outcomes</b>	
<b>Knowledge and understanding on:</b>	Planning and sustainable management of soilless crops to improve the qualitative, quantitative and sanitary aspects of productions.
<b>Applying knowledge and understanding on:</b>	Ability in innovative design and management of greenhouse production through soilless cultivation systems even in urban areas.
<b>Soft skills</b>	<ul style="list-style-type: none"> <li>• Making informed judgments and choices <ul style="list-style-type: none"> <li>• Ability to analyze the different situations of a production and market context, to plan actions and manage interventions to improve the quality and efficiency of horticultural productions, also in terms of sustainability and eco-compatibility.</li> </ul> </li> <li>• Communicating knowledge and understanding <ul style="list-style-type: none"> <li>• Personal skills aimed at communication, multidisciplinary group work and judgmental skills both at the technical and the human and ethical levels.</li> </ul> </li> <li>• Capacities to continue learning <ul style="list-style-type: none"> <li>• Use the technical reports, scientific articles and links to ongoing or completed research projects, provided with the teaching material, to continue the study autonomously over the course of life.</li> </ul> </li> </ul>

<b>Assessment and feedback</b>	
Methods of assessment	Written and oral
Evaluation criteria	<ul style="list-style-type: none"> <li>• Knowledge and understanding <ul style="list-style-type: none"> <li>• Correctly express the concentration of solutes in a solution.</li> <li>• Choose the best compounds and formulations to meet the mineral needs of plants.</li> <li>• Recognize the symptoms of nutritional deficiencies.</li> <li>• Knowing how to calculate the quantities of salts needed to prepare a nutrient solution.</li> <li>• Knowing how to design the integrated production of crops and horticultural products without soil in a sustainable way to improve the qualitative, quantitative and sanitary aspects of the productions, shelf life and marketing.</li> <li>• Know the physical, chemical and biological characteristics of the growing substrates.</li> <li>• Increase the efficiency of use of resources through the principles of precision agriculture acquired.</li> </ul> </li> <li>• Applying knowledge and understanding <ul style="list-style-type: none"> <li>• Knowing how to calculate the quantities of salts needed to prepare and manage a nutrient solution for different species and during the entire crop cycle.</li> <li>• Knowing how to manage the integrated production of crops and horticultural products without soil to improve the qualitative, quantitative and sanitary aspects of the productions, shelf life and marketing.</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>• Autonomy of judgment <ul style="list-style-type: none"> <li>• Being able to critically evaluate the different situations of a production and market context, to plan actions and manage interventions to improve the quality and efficiency of horticultural productions, also in terms of sustainability and eco-compatibility.</li> </ul> </li> <li>• Communication skills <ul style="list-style-type: none"> <li>• Assessment of personal skills, aimed at communication, multidisciplinary teamwork and judgment skills, both on a technical and human and ethical level, even during the course of teaching and in relation to the interactivity developed.</li> </ul> </li> <li>• Capacities to continue learning <ul style="list-style-type: none"> <li>• demonstration of having acquired all the arguments;</li> <li>• development of problem analysis and argument structure.</li> </ul> </li> </ul>
Criteria for assessment and attribution of the final mark	<p>The evaluation of the students' tests takes place on the basis of pre-established criteria which include:</p> <ol style="list-style-type: none"> <li>a) carrying out exercises</li> <li>b) consistency with the topics of the program</li> <li>c) the quality of the discussion</li> <li>d) the ability to analyze</li> <li>e) the level of structure of the arguments.</li> </ol> <p>The measure of the performance follows the following scheme.</p> <p>Grade: 30 or 30 with honors: Excellent preparation, high level of knowledge, absolute mastery of the subject and of the language. Demonstration of having acquired all the arguments at a high level. Excellence in developing problem analysis and argument structure.</p> <p>Rating: 27-29: Accurate preparation, excellent level of knowledge, good command of the subject and of the language. Demonstration of having assimilated all the topics at a good level. Good ability to analyze problems and structure arguments</p> <p>Rating: 23-26: Satisfactory preparation, fair level of knowledge, fair command of the subject and language. Demonstration of having understood all the arguments. Fair ability to analyze problems and structure arguments.</p> <p>Rating: 18-22: Sufficient preparation, level of knowledge adequate to the minimum level of requests, sufficient mastery of the subject and language</p> <p>Acceptable ability to analyze problems and structure arguments.</p>
<b>Additional information</b>	
	Students will be invited to participate in the research activities conducted ( <a href="http://www.soilless.it">www.soilless.it</a> ).