# SUSTAINABLE USE OF AGRO-CHEMICALS IN AGRO-FOOD CHAINS

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COURSE AIMS AND INTENDED LEARNING OUTCOMES

The aim of the course is to provide students with (a) knowledge of the characteristics and sustainable use of agro-chemicals from an operational perspective, updated in line with the current interdisciplinary context of the agri-food production chain; (b) a basic knowledge of plant protection products and fertilisers in terms of the chemical and biochemical phenomena that regulate biological activity (efficacy), toxicology, degradation and metabolisation, behaviour in the environment, and the residues in agricultural production and foodstuffs from these derivatives; (c) knowledge of formulations, their miscibility and methods of good agricultural application.

Through the flow of topics covered, students will be able to understand the meaning of the scientific and technical procedures underlying a risk assessment, and establish guidelines for their sustainable use. The knowledge acquired during lectures will be consolidated through practical experiences carried out with experts in the field, through computer tutorials, seminar meetings with sector operators, and direct experience in the countryside at farms.

At the end of the course, students will be able to:

- apply the risk assessment procedures for the purposes of usage authorisation and correct agricultural management;

- collect the data necessary for estimating environmental effects and behaviour, and also process them through the use of mathematical models and the most modern simulation and analytical methods;

- apply sociological, economic and environmental interdisciplinary approaches to define the best risk mitigation strategies;

- read a label, make mixtures and use calculation tools;

- measure the sustainability of uses in livestock, vineyard and horticultural farms.

COURSE CONTENT

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| Introduction to the course and definitions |  |
| Introduction to the course and definition of agro-pharmaceuticals, plant protection products, pesticides, biocides, and fertilisers. Use of chemicals and their effect on food availability and the health status of populations. | 0.3 |
| Production and consumption of agrochemicals |  |
| Global and national consumption of plant protection products and their evolution over the years. | 0.1 |
| Toxicology of agrochemicals |  |
| Toxic phenomena. Acute and long-term toxicity and the parameters for expressing them. NOEL, ADI and RMA. | 0.3 |
| Legislation covering production, marketing and use |  |
| Fundamental concepts of regulatory requirements for production, marketing and application. | 0.3 |
| Classification |  |
| Nomenclature. Classification in terms of chemistry and function, usage, etc. | 0.3 |
| Formulations |  |
| Characteristics of the target surfaces, types of application and chemical-physical characteristics of the formulations. | 0.3 |
| Metabolism and degradation |  |
| General principles of metabolism and chemical degradation. Behaviour of an agro-pharmaceutical in the soil (adsorption, mobility, volatilisation, degradation, etc.) and from the environment to the food chain, to food. Residues and metabolites. | 0.4 |
| Undesirable and desired effects |  |
| General elements of systemic and functional population ecology.  The study of effects. Mode of action of toxic potentials. Main forms of exposure of living organisms. Mechanisms of action of certain environmental toxicants.  Damage measurement using ecotoxicological tests (DL50, LC50, EC50, LT50, NOEL, LOEL). | 1.0 |
| Measuring damage. Forecasting exposure and the effects. Chemical-physical properties of toxic potentials. The environmental partition coefficients. Evaluation models. Fugacity. The prediction of effects through QSAR. Hansch's theory.  Risk calculation. The integrated approach to risk estimation. Development of risk indices for environmental impact assessments. Data required for authorisation and sustainable use at an Italian and European level. | 1.0  1.0 |
| Classroom seminars with experts on:   * Use of QSAR and TDK models for effect prediction: organic and inorganic contaminants. * Use of EFSA databases and models for calculating pesticide-related food risk (PRIMO model).   Tutorials  Use of the QSAR and FOCUS mathematical models for assessing exposure and the effects. Use of partition coefficients, stochastic analysis, and kinetic toxic analysis of effects. Real case study scenarios for an inorganic and an organic agro-pharmaceutical. Application of sustainable usage guidelines in agricultural scenarios.  An **educational outing** to a farm, including a demonstration test of usage, the application of good practices, the measurement of dosages, and risk mitigation. | 2.0 |
| Where to find the information |  |
| Bibliographic documentation on agro drugs, including: chemical-physical characteristics, toxicology, formulation, doses, methods of use, and residues in agricultural production and food. | 0.2 |
| General considerations, selectivity, classification, chemical-physical characteristics, usage, mode of action, mechanism of action, toxicology, phenomena of induced resistance, degradation, environmental impact, etc. | 1.8 |

READING LIST

Texts

* M. Gennari, M. Trevisan – *Agrofarmaci* – *Conoscenze per un uso sostenibile* – Gruppo Perdisa Editore, Bologna, 2008.
* P. VIOLANTE *Chimica e fertilità del suolo*. Edagricole.

TEACHING METHOD

Frontal theoretical lectures during which the general topics of the course will be addressed.

Computer tutorials where calculation tools will be used and exercises conducted.

Classroom seminars with experts.

Educational outings to agricultural companies during the preparation of mixtures and applications in the field.

All the material presented during lectures will be available to students and on Blackboard.

ASSESSMENT METHOD AND CRITERIA

The exam is both written (tutorial test results) and oral.

The written test is aimed at ascertaining the students’ ability to calculate and their understanding of the logical procedures of data analysis. In other words, it is an assessment of the learning achieved through the execution of computer exercises. Students have at least 30 minutes per exercise for a maximum number of 3 exercises. The final assessment is a maximum of 3/30.

The oral exam envisages an audiovisual presentation involving the discussion of a risk assessment project on a contaminant in an agri-food production chain.

For those students who have attended lectures and participated in all the course activities, the oral exam will focus solely on the content of the project and its discussion. For those students who have not attended the course and have not participated in the tutorials, the oral exam will focus on the full course contents, including the tutorials. The final assessment is a maximum of 27/30.

Participation in educational outings and seminar activities is recommended and constitutes an objective element for achieving a distinction.

NOTES AND PREREQUISITES

Participation in laboratory tutorials, educational outings and seminars is strongly recommended.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

Information on office hours available on the teacher's personal page at http://docenti.unicatt.it/.