Awareness program focused on the reduction of excessive nitrogenated fertilizers.

Learning guide

INTRODUCTION

To promote a responsible reduction of nitrates in the comprehensive water cycle, one of the important tasks LIFE LIBERNITRATE proposed is an **Awareness Program** focused on promoting the **reduction of excessive nitrogenated fertilizers**.

The Nitrates Directive of 12/12/91 obliges Member States to develop a Programme of Action to counteract the processes or risks of nitrate contamination in high Nitrate Vulnerability Zones supported by the Code of Good Agricultural Practice.

It is mandatory for the States (Regulation 73/2009 of the European Council) to establish farm advisory systems (FAS) to help farmers comply with EU environmental standards. However, these FASs **have been unsuccessful in trying to reduce nitrate contamination in groundwater, which is a growing trend**.

One important part of the Project is the development of a pedagogical guide that would support the reduction of at least 20-30% of the use of nitrogen fertilizers among farmers, aiming them to comply with the Code of Good Agricultural Practice, reduce costs and fulfill conditions for CAP (Common Agricultural Policy) payments.

Providing the correct advice to farmers to reduce the amount of nitrogen fertilizers as a corrective measure will reduce the presence of NO - in the soil, preventing it from reaching the rivers or wetlands where denitrification occurs, as a cause of leaching.

LIFE-LIBERNITRATE also contributes to the reduction of GEIs which are driving climate change, including nitrous oxide emissions. These emissions have increased an 8% since the nineteenth century and nowadays between at a yearly rate of 0.5 and 1.2%. This percentage is relatively low, compared to CO2, but contributes 6% to the greenhouse effect, as it has a warming potential 296 times higher than CO2.

According to the United Nations Environment Programme (UNEP), nitrogen oxide emissions could double by 2050 largely due to the substantial use of fertilizers with a huge impact due to its long life in the atmosphere, 120 years.

A project that aims to develop a smart, low-environmental fertilization must begin with the interest of addressing the problem of a lack of counseling and training of farmers.

The LIBERNITRATE team is grateful to all the support provided by national organizations that feed this stimulating project.

A MULTIPURPOSE TRAINING

This course has been elaborated for different kinds of training methodologies:

- It can be used as an online material that could be integrated into learning platforms.
- It can be used by trainers to perform lectures that can be given through streaming platforms or even in presential sessions.

This is actually a good supporting material for trainers from different countries. They will be able to adapt the materials to their own domestic contexts, by doing pertinent adaptations.

Consequently, the materials are not the end of a learning experience but just the beginning of it.

Contents

TEACHING MATERIAL

LIFE LIBERNITRATE AWARENESS PROGRAM; MODULE 1: FERTILIZATION.

LINK TO POWERPOINT MODULE 1

SLIDES MODULE 1

SLIDE 1. FERTILIZATION. BASICS.

Presentation of the module by the trainer.

SLIDE 2. WHAT WE WILL LEARN.

Oral lecture:

In this unit you will learn:

- More of the concept of fertilizer and its main types.
- To Apply the principles of good fertilization.
- To understand the environmental conditions of fertilization.
- Explore the consequences of poor fertilization.
- To comprehend that good fertilization depends on the context, culture system and country regulations.

SLIDE 3. WHAT IS A FERTILIZER?

Oral lecture:

A fertilizer is a substance that presents nutrients that can be assimilated by plants and that is added to the soil to maintain its essential elements for:

- Plant growth.
- Improve productivity
- The quality of the products

A more technical definition would be that a fertilizer is any natural or synthesis material that contains at least five percent of one or more of the three primary nutrients: **N, P_2O_5 and K_2O**.

Fertilizers or manures are necessary for the correct development of crops, but their management has an impact not only on yields, but also on the environment and on profitability. Therefore, it is important to establish the principles of rational use of fertilizers.

SLIDE 4. TAXONOMY.

Oral lecture:

Fertilizers can be classified according to many aspects, for example:

Depending on the origin, they can be classified into minerals, organic and synthetic. An advantage of organics is the slow release of nitrogen that helps to improve the soil in the long term, although they have the disadvantage, with respect to minerals, of heterogeneity in composition and the difficulty of storage.

Depending on their composition, fertilizers can be classified into nitrogen, phosphoric and potassium, mixed N-P-K formulas, and other nutrient presentations such as sulfur or microelements like boron and magnesium.

There are also other classifications, depending on the presentation, the nature of the mix or the time of application.

As we can see, there is an immense range of possibilities. The key is to know which method of fertilizer and nutrient graduation is right for us and what dosage we should apply. This depends on the needs of the crop and the potential yield we expect according to our soil, cultivation, climatic zone, etc.

Depending on the rate of nitrogen release, it can be classified into three types:

Type I: Organic fertilizers from livestock farms, compost and sewage sludge. Most of the N contained is organic, releasing a portion of it in the year of application and successive.

Type II: Mineral and organo-mineral fertilizers with N in ammoniacal and organic form.

Type III: Mineral fertilizers with N mainly in nitric and ureic synthesis form.

SLIDE 5. FERTILIZER CONSUMPTION IN EUROPE.

Oral lecture:

According to Fertilizers Europe, the EU's agricultural area currently occupies 134 million hectares, of which 90 million are fertilized annually.

Long-term, reductions in the consumption of major fertilizers have been observed. Further reductions in nitrogen consumption and a slight recovery in phosphoric and potassium are expected over the next ten years.

Experts highlight the enormous influence of environmental regulations on this evolution, although an improvement in fertilizer quality and fertilization techniques is also expected.

SLIDE 6. GENERAL PRINCIPLES.

Oral lecture:

The assimilation of the nutritional elements in the soil does not depend only on the chemical form in which they are found, but is also a function of the climate, the genetics of the plant, its state of development, the physical and chemical properties of the soil and cultural practices.

Erosion and flow cause nutrient losses that leads to crop extractions. The plant has nutritional needs at certain times in its vegetative cycle during which soil reserves may be insufficient.

SLIDE 7. RESPONSIBLE HANDLING INCREASES EFFICIENCY.

Oral lecture:

It is everyone's obligation to take responsible management of fertilization to increase their efficiency. It should be noted that the values set for a plot and crop are not directly extrapolated for other plots or campaigns, as environmental conditions can vary significantly, between one locality and between years.

Three are the basic laws of proper fertilization.

- The Law of Restitution that requires a balance of ins and outs and act to keep the fertilized soil. Use of the most appropriate nutrients
- The Law of the Minimum, which indicates that excess one nutrient does not compensate for deficiency in another nutrient that is in limiting quantity.
- Diminishing Returns Law, illustrated in the accompanying graph. When no fertilizer is applied, the yield is at its minimum level. At first, yields increase as the fertilizer application rate increases, until it reaches the maximum level. From this point on, any addition of additional fertilizer will not increase the level of yield and even when fertilizer application rates are too high, yield decrease.

It's a matter of knowing and applying properly what you're going to expend and what you're going to expend on. At least 30 to 50% of the yield is attributed to the application of fertilizers. This significant contribution explains why many farmers believe that by applying more fertilizers, they will get higher yields. The relationship between fertilizer application and potential yield is described in the following diagram.

Rational fertilization is achieved by applying the four basic principles called the "4R's", proposed by the IPNI, the International Plant Nutrition Institute.

These principles are the use of the right source, the right dosage, right time and right place.

By acting in this way, we can maximize the absorption of the growing system, reducing losses and therefore negative impact on the environment. We need to know the nutrients already available in the soil and the additional sources.

SLIDE 8. THE 4R- SPECIFIC RECOMMENDATIONS.

Oral lecture:

Some specific recommendations for the implementation of the 4Rs:

- About “What and How?”

In fertigation, use specific fertilizers for this technique, e.g. N nitric. Check the calibration of the fertilizers, according to the specifications.

- In relation to “Where?”

Apply nutrients as close as possible to absorbent roots considering that phosphoric and potassium are less mobile than N.

- In relation to “How much?”

It is necessary to pre-estimate a balance of nutrient inputs and outputs to determine dosages.

- And in relation to “When?”

A recommendation is to split the fertilizer application whenever is possible.

SLIDE 9. CONSEQUENCES OF BAD FERTILIZATION.

Oral lecture:

The consequences of poor fertilization are very varied. The most common are soil erosion, salinization and soil contamination:

- Erosion causes loss of agricultural soil. In Spain, 50% of agricultural land is classified with a medium-high risk of erosion.
- Salinization is caused by some fertilizers that contain high levels of salts that are potentially harmful.
- When fertilizers are overused they can cause water contamination in rivers, seas, aquifers and underground wells.

It is also necessary to take into account the influence of essential nutrients on the health of plants and their susceptibility to diseases. Plants that suffer from nutritional stress will be more susceptible to disease, while plants that receive adequate nutrition are more tolerant or resistant to disease.

Keep in mind that the same nutrient can decrease the incidence of one disease and increase the incidence of others.

The availability of nutrients depends on the application of the right fertilizers, but also on cultural practices, such as soil whitening to adjust pH, irrigation, organic amendments, tillage etc.

Interview: A farmer showing the consequences of a bad fertilization with real images.

SLIDE 10. CONTRIBUTION TO A MORE EFFICIENT USE OF NUTRIENTS.

Oral lecture:

For an energy intensive industry like it is the fertilizer industry, this will have major impacts on many fronts, especially in the carbon sector, but it will also open opportunities. For Europe to become green in industry and agriculture, it is important an efficient and innovative European fertilizer industry.

The new Common Agricultural Policy reform promotes eco-schemes which concern good agricultural practices suitable to address the challenges highlighted in the Green Deal.

Video: The European Green Deal.

SLIDE 11. SUSTAINABLE CULTIVATION SYSTEMS.

Oral lecture:

There are very different production systems that coexist in the agriculture, special connotations that must comply the rules established by the Administration.

"**Vulnerable zones**" are those whose filtration can lead to excess nitrates in aquifers **must be considered**.

- A first system to be considered in to apply in a Vulnerable Zone is the **integrated production**, which allows the use of chemical fertilizers, always establishing a maximum limit for the total contribution of N/ha in each crop.
- A second clearly expanding system **in Spain** is **organic farming**. The European regulation of it allows fertilizers derived from organic waste and also minerals such as natural phosphate or potassium sulfate, for example. (PLEASE ADAPT TO EACH COUNTRY)

- Finally, the concept of **precision agriculture** that contemplates spatial variability within plots of the same farm is being implemented. Current digital technologies allow variable application of fertilizers, according to the specific needs of each point, derived from agro- climatic conditions.

Interview: A professor explaining the comparison of Integrated production and Organic production.

SLIDE 12. ONE EXAMPLE OF SUSTAINABLE CULTIVATION SYSTEM: CONSERVATION AGRICULTURE (CA).

Oral lecture:

To illustrate what a **sustainable system** is:

Rational fertilization cannot be detached from soil-keeping practices.

Conservation agriculture is a farming system that can prevent the loss of arable land while regenerating degraded land.

It is based on three fundamental principles:

- **Minimal mechanical alteration of soil (i.e. non-working cultivation) by direct depositing of seeds and fertilizers.** This reduces soil erosion and preserves soil organic matter.

- **Organic soil cover with crop residues or cover crops. A protective layer of vegetation removes weeds, preserves soil moisture and prevents compaction.**

- **Diversification of species through associations and sequences of varied crops.** This promotes a variety of flora and fauna that contributes to the cycle of nutritious elements.

Interview: A professor on the practice and the benefits of CA.

SLIDE 13. PRACTICAL RECOMMENDATIONS FOR FERTILIZATION.

The principles set out above should be complemented by a number of additional recommendations:

The first is that soil, water and plant analysis needs to be analyzed to determine optimal amounts.

The second is to plan fertilization taking into account all factors. In the case of nitrogen, it is necessary to know the maximum needs of N for each crop and to carry out a fertilized plan with all sources that provide N.

- the initial mineral N in the soil,
- the N that mineralized from organic sources (organic soil matter, harvest remains),
- biological fixation of N,
- possible input provided by irrigation water,
- nitrogen from fertilizers of any kind

The third principle is to take crop rotations into account to define the fertilization plan.

The fourth is to implement the conservation practices that we will mention below.

The fifth is to know and respect the regulations for the protection against nitrate contamination.

Thus, nitrogen fertilizers should not be applied at a legally established distance from water bodies, natural watercourses and aquifer operating points (wells and others).

Finally, we must respect the Codes of Good Agricultural Practice (COGAP), for the use of nitrogen and urea in each territory, and also take into account the conditionality regulations established at all times by the Common Agricultural Policy.

SLIDE 14: COMMON AGRICULTURAL POLICY: EXAMPLES OF CONDITIONALITY.

Oral lecture:

We can also cite some examples of conditionality, which are inferred from the application of CAP regulations that are currently under review during the negotiation for the post-2020 CAP:

- That the farm has a Fertilizer Registration Book and a Registry Book of Production and Movements of Manure.
- That the farm has sufficient capacity deposits and water resources for the storage of silages as well as manures, or that it has the justification for the system of withdrawal thereof from the holding.
- That the periods in which the application of certain types of fertilizers is prohibited are respected.
- That the maximum amounts of nitrogen fertilizers per hectare established by regions are respected.
- That no fertilizers, manures and slurry are applied in a land band close to watercourses, according to the width established by the regions.
- Mineral or organic nitrogen fertilizers are not applied on plots with a certain slope.

SLIDE 15.

"Your country's government has released further guidelines and recommendation, in most cases developing European Union's legislation"

Accompanying material:

An example of practical recommendation produced by the Government of Spain.
https://www.mapa.gob.es/es/agricultura/publicaciones/01_FERTILIZACIÓN(BAJA)_tcm30-57890.pdf

SLIDE 17. SUMMARY.

Oral lecture:

Fertilizers allow the nutrient elements that plants extract to be restored to soils, making available to crops the nutrients they need at all time.

There is no single formula for rationally fertilizing in all territories. The 4R scheme helps us focus on the "what", the "how much", the "when" and "where" of a rational fertilization.

These basic principles cannot be abandoned, although practical recommendations depend on the context and regulations against pollution.

Proper planning is basic, in all growing systems, as well as integrating fertilization into a conservation farming concept.

LIFE LIBERNITRATE AWARENESS PROGRAM; MODULE 2: THE NITRATE DIRECTIVE AND VULNERABLE ZONES. HOW TO ADDRESS THE PROBLEM OF CONTAMINATED WATER.

LINK TO POWERPOINT MODULE 2

SLIDES MODULE 2

SLIDE 1. THE NITRATE DIRECTIVE AND VULNERABLE ZONES. HOW TO ADDRESS THE PROBLEM OF CONTAMINATED WATER.

Presentation of the module by the trainer.

SLIDE 2. WHAT WE WILL LEARN.

Oral lecture:

In this unit you will learn to:

- Comprehend the objectives of the European Union Nitrates Directive.
- The concept of Nitrate- Vulnerable Zones (NVZ).
- Identify whether a plot is in a NVZ.
- Define the basic principles of fertilization in an affected area.

SLIDE 3. THE PROBLEM OF NITRATES.

Oral lecture:

One of the main problems caused by the intensification of yields in both agricultural and livestock production is the contamination of groundwater and surface water (rivers, lakes, estuaries and other inland and surface waters) by nitrates from fertilizers and other agricultural production factors.

SLIDE 4. WHEN DOES THE CONTAMINATION HAPPEN?

Oral lecture:

When does this fertilizer contamination starts?

- Sometimes we exceed the amount to be used in the field, and crops are not able to absorb all nutrients.
- It also happens when they are removed by water or wind from the ground surface before they can be absorbed.

That's why excess nitrogen and phosphates can infiltrate groundwater or be dragged into watercourses. This overload of nutrients causes the eutrophication of lakes, reservoirs and ponds and results in an explosion of algae impairing the development of other aquatic plants and animals, as well as being a public health problem.

There are several alternatives facing these problems: One is to implement costly purification systems with the intention of reducing biodiversity losses in ecosystems. Another is to implement circular economy approaches to preserve natural capital, optimize resources and reduce emissions.

Interview: An expert explaining the problem of the excess of nitrates in a determined area.

SLIDE 5. SITUATION IN EUROPE.

Oral lecture:

In some areas of Europe, contamination caused by pesticides and fertilizers used in agriculture is, in itself, one of the main causes of poor water quality. (Water For Agriculture, European Environment Agency).

At European level, the Commission publishes reports on the implementation of the Nitrates Directive. They show that, although there are slight improvements in reported data in some countries, nitrate contamination remains one of the biggest pressures in place and much effort remains to reverse the situation.

Average livestock densities exceed 2 livestock units per hectare in several European countries and almost all European countries have surplus nitrogen, with excess levels above 50 kg/ha in 7 countries.

In terms of groundwater, Malta, Germany and Spain record the highest percentages of groundwater stations exceeding 50 mg of nitrate per liter. On the opposite side are Ireland, Finland and Sweden, with very low concentrations.

SLIDE 6. "THE HEART OF THE GREEN DEAL". THE FARM TO FORK STRATEGY. WHAT THE EUROPEAN UNION PURSUES.

Oral lecture:

In May 2020, the European Commission published its Farm-to-Fork strategy, which proposes a transition to a **sustainable food system.**

The strategy recognizes that the **excess of nutrients** in the environment is an important source of air, soil and water pollution, which has a negative impact on biodiversity and climate.

The document proposes that the European Commission will take action:

reduce nutrient losses by at least 50%, without altering soil fertility.
reduce fertilizer use by at least 20% by 2030.

These objectives are part of the Union's strong commitment to a **healthier and more sustainable EU food system**, a cornerstone of the so-called European Green Pact.

Video included: EU Farm to Fork Strategy

https://www.youtube.com/watch?v=1tXseroYYFs

SLIDE 7. 2030 TARGETS.

Oral lecture:

The use of pesticides in agriculture contributes to pollution of soil, water and air.

- The Commission will take action to **reduce the use of chemical and more hazardous pesticides by 50%**.

Antimicrobial resistance linked to the use of antimicrobials in animal and human health leads to an estimated 33,000 human deaths in the EU each year.

-The Commission will **reduce the sale of antimicrobials for farmed animals and in aquaculture by 50%.**

Organic farming is an environmentally friendly practice that needs to be further developed.

- The Commission will help the EU's organic farming sector to grow, with the goal of **25 % of total farmland being used for organic farming by 2030.**

A general reduction goal of nutrient losses of 50% is a first step, but it must be remembered that groundwater pollution is a local or regional phenomenon. The full implementation of the Nitrates Directive should ensure that levels are respected in all regions across Europe.

Excessive nitrate levels in groundwater used for drinking water production causes hundreds of millions of euros of extra treatment costs to drinking water suppliers.

Also, the Commission's intention to reduce the excessive use of antimicrobials in animal healthcare, as those may be found back in drinking water resources.

The strategy must not be limited to water quality, but also address water quantity. In light of the Impacts of climate change and increasingly recurring drought, excessive water abstraction for irrigation purposes must be avoided, since it causes local problems to the security of the drinking water supply. Reclaimed water from water waste treatment can be used to irrigate agricultural land in the event of water shortages.

Link:

From Farm to Fork: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_es.

SLIDE 8. HOW. THE EUROPEAN DIRECTIVE.

Oral lecture:

For decades, the European Union has been aiming to reduce water pollution caused by nitrates of agricultural origin and to avoid further contamination. The Farm Sustainability Tool for Nutrients and the CAP conditionality provisions must ensure that the goals of the Nitrates Directive are fully complied with everywhere in Europe.

The Nitrates Directive (Directive 91/676) is an integral part of the Water Framework Directive (WFD) and it is one of the key instruments in the protection of water against agricultural pressures.

Forces Member States to take the following steps:

1. Control nitrate concentrations and trophic status in different bodies of water.
2. Identify contaminated or water with risk of be contaminated.
3. Designate zones vulnerable to nitrates.
4. Establish codes of good agricultural practice, implemented voluntarily in the Member States.
5. Establish action programs that are mandatory in nitrate-vulnerable areas or throughout the national territory.
6. Review the designation of nitrate-vulnerable areas and action programs at least every four years.
7. Submit to the Commission a status report on the implementation of the Directive every four years.

More recently, the Farm-to-Fork (F2F) strategy delves into proposing regulatory and non-regulatory initiatives, with common agricultural and fisheries policies as key tools to support the new sustainable model presented by the European Commission.

SLIDE 9. THE NVZS. WHAT IS A NITRATE VULNERABLE ZONE?

Oral lecture:

While animal husbanding and industrial or urban discharges are relatively easy to mitigate, as they usually originate from specific sources, leaching nitrates from agricultural sources is considered more difficult to control and prevent.

Therefore, The Directive defines Vulnerable Zones as:

An area of the land whose runoff flows into the affected waters, or which could be affected if no action is taken, by nitrate contamination from agricultural sources.

In the case a vulnerable zone is declared, the Directive is generally aimed at fertilization with manure less than 170 kg of nitrogen per hectare, with Member States being able to establish different amounts in justified ways.

Over the past three decades, dozens of nitrate-vulnerable zones (NVZs) have been designated across the EU, with the aim of making the problem more manageable.

Links (ADAPT TO EACH COUNTRY):

Spain:

These areas will be included in the Register of Protected Areas of the River Basin Management Plan.

MITECO: https://www.miteco.gob.es/es/agua/temas/planificacion-hidrologica/marco-del-agua/Zonas_protegidas.aspx

GENERALITAT VALENCIANA: http://www.agroambient.gva.es/es/web/agua/zones-vulnerables

SLIDE 10. CASE STUDY FOR THE IMPLEMENTATION OF THE NITRATE DIRECTIVE.

Specific EU regulation for Netherlands:

Link: *https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1601888425032&uri=CELEX:32020D1073*

A case study of the Lombardy region (Italy):

Document: Musacchio, A., Re, V., Mas-Pla, J. et al. EU Nitrates Directive, from theory to practice: Environmental effectiveness and influence of regional governance on its performance. Ambio **49,** 504–516 (2020). https://doi.org/10.1007/s13280-019-01197-8

SLIDE 11. MAP OF NVZS IN THE EU.

Oral lecture:

Rather than designating specific areas, Member States may decide to include their entire agricultural territory in **action programs**, as done in countries such as Austria, Denmark, Germany, Ireland or the Netherlands.

In 61% of the European Union's agricultural lands, there are obligations to achieve balanced fertilization. However, there are still areas with potential water contamination that are not included in any Vulnerable Zone. The map of above shows the current area under NVZ and groundwater monitoring stations with average nitrate concentrations greater than 50 mg/L. The criteria used by Member States for the designation of vulnerable zones may include parameters other than the average annual concentration.

SLIDE 11. EXAMPLE: SITUATION IN SPAIN.

Oral lecture:

The European Directive was incorporated into the Spanish legal order by the Royal Decree 261/1996, of February 16, protection of water against pollution from nitrates from agricultural sources.

The Royal Decree and its subsequent amendments lay down the criteria for determining which waters are affected by nitrate contamination and the obligation to designate vulnerable areas.

It also provides that the Communities must develop one or more codes of good agricultural practice, the application of which shall be voluntary in zones declared to be non-vulnerable. Its mission will be to prevent contamination of nitrates of agricultural origin.

We show the map that results from the designations of vulnerable zones by an autoanalyzer (AACs), which are updated periodically.

It should be noted that the measures taken in Spain are still considered insufficient by the European Commission. According to it, Spain must:

- ensure the stability of the nitrate control network,
- review nitrate-vulnerable zones and designate new zones in several regions,
- include all necessary mandatory elements in multi-region nitrate action programs and take additional measures or enhanced actions,
- take additional eutrophication measures across the country.

SLIDE 12. EXAMPLE: SITUATION IN SPAIN.

Oral lecture:

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  review nitrate-vulnerable zones and designate new zones in several regions,
- include all necessary mandatory elements in multi-region nitrate action programs and take additional measures or enhanced actions.
  take additional eutrophication measures across the country.

SLIDE 13: How is a zone designated vulnerable?

Oral lecture:

According to Royal Decree 261/1996, the bodies of water affected must first be determined, the competence of which is designated by the Government of Spain in the case of inland waters of inter-Community basins and the Autonomous Communities in all other cases.

Considering:

- surface freshwater masses with a concentration of more than 50 mg/l of nitrates or with a tendency to exceed the limit.
- freshwater masses, estuaries, coastal waters, and seawater that are eutrophic or have a eutrophic tendency.

Autonomous Communities designate Vulnerable Zones in their respective areas, applying the definition of territorial areas from which runoff or leakage affects or can affect nitrate contamination of the waters considered to be affected.

As we have mentioned, the designation of NVZ is always being updated, as we see in the enclosed areas through the European Commission, its reports consider that the efforts made in Spain, as we mark for the case of Aragon, as in other European countries, are still insufficient to control nitrate pollution.

SLIDE 14. How do I know if my farm is in VZ? (Spanish example).

Oral lecture:

Geographic information on vulnerable areas can be found in the GEO Portal IDEE (space data infrastructure) maintained by the Ministries of Agriculture and Ecological Transition.

In addition, to find out if my farm is in a vulnerable zone, I can access to the SIGPAC (Sistemas de Información Geográfica de Parcelas Agrícolas) viewer page on the FEGA (Fondo Español de Garantía Agraria) website, where I can identify an enclosure and the information of a plot.

To visit:

Visor SIGPAC

http://sigpac.mapama.gob.es/fega/visor/

SLIDE 15. Recommendations for achieving goals.

Oral lecture:

Affected farmers should develop fertilization plans that take into account all nitrogen inputs in the crop, such as nitrates in irrigation waters or the remains of previous crops, etc., in order to avoid providing excess nitrogen in crops.

Among the mandatory rules in Vulnerable Zones, it is to **complete a fertilizers' recordkeeping of plots** and, of course, take into account the **Code of Good Practice (https://unece.org/fileadmin/DAM/env/lrtap/Publications/Ammonia_SR136_28-4_HR.pdf)** applicable to each territory.

In addition, other recommendations for concerned farmers are:

1. Analytical monitoring of the fertilization program.
2. In arable crops, perform crop rotation comprising legumes, green fertilizers plus the application of manure allowed.
3. Apply conservation farming practices.
4. Preferably, when using direct planting techniques and minimal labor, microgranular fertilizers can be used in addition to traditional fertilizers. It promotes the homogeneous growth of crops and are designed for localization and use in lower doses. **Interview/Case study of slow release fertilizer on tree crops-Video demo**
5. Learn the characteristics of irrigation water to calculate the dose of the fertilizers that are used. Fertigation is an interesting alternative. **Video demo. Interview to an expert about the benefits of fertigation.**

SLIDE 16. SOME CAP'S ECO-SCHEMES TO IMPROVE EFFICIENCY AND SUSTAINABILITY.

Oral lecture:

In the framework on the new Strategic Plans for the Common Agricultural Policy, new eco-schemes will be supported. The following eco-schemes are interesting examples of this policy. You can find further information for proposals in one Member State by clicking in the link:

Link: https://www.mapa.gob.es/es/pac/post-2020/estrategia-de-intervencion.aspx

SLIDE 17. LEGAL FRAMEWORK (SPANISH EXAMPLE).

Oral lecture:

The EU has developed a solid legislative framework for each country:

In this slide we summarize the main legal rules to be taken into account with regard to vulnerable areas, with reference to Spain and, by way of example, of the Valencian Community.

Documents:

Directiva 91/676/CEE, relativa a la protección de las aguas contra la contaminación producida por nitratos utilizados en la agricultura.

Real Decreto 261/1996, de 16 de febrero, sobre protección de las aguas contra la contaminación producida por los nitratos procedentes de fuentes agrarias (BOE 61, 11.01.1996). BOE= Boletín Oficial Español (Spanish Official Bulletin).

Orden 10/2018, de 27 de febrero, de la Conselleria de Agricultura, Medio Ambiente, Cambio Climático y Desarrollo Rural, sobre la utilización de materias fertilizantes nitrogenadas en las explotaciones agrarias de la Comunitat Valenciana (DOGV 7.03.2018). Official Journal of the Community of Valencia

Decreto 86/2018, de 22 de junio, del Consell, por el que se designa municipios como zonas vulnerables a la contaminación de las aguas por nitratos procedentes de fuentes agrarias en la Comunitat Valenciana (DOGV 5.07.2018).

SLIDE 18. CONCLUSIONS: FARMERS NEED SUPPORT.

European Green Deal: This Strategy concludes to zero pollution ambition, climate change goals and circular economy strategy.

Farmers need support in this complex transition phase. The F2F Strategy rightly points out that the Common Agricultural Policy (CAP) is the tool for it.

SLIDE 19. SUMMARY.

Oral lecture:

In this lesson we have seen the concept of **areas vulnerable to nitrate contamination**.

Its designation is a consequence of the Nitrates Directive which improves the quality of aquifers.

The designation of vulnerable areas is updated, depending on the fulfilment of the objectives of the policy.

This designation requires the taking into account the Code of Good Practice, which aims to make available to the agricultural sector the necessary information to carry out a rational agricultural activity.

TO LEARN MORE.

Further readings:

Huygens, D., Orveillon, G., Lugato, E., Tavazzi, S., Comero, S., Jones, A., Gawlik, B. and Saveyn, H., Technical proposals for the safe use of processed manure above the threshold established for Nitrate Vulnerable Zones by the Nitrates Directive (91/676/EEC), EUR 30363 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21539-4 (online),978-92-76-21540-0 (print), doi:10.2760/373351 (online),10.2760/984729 (print), JRC121636.

Guía Práctica de la Fertilización Racional de los Cultivos en España

https://www.mapa.gob.es/es/agricultura/publicaciones/01_FERTILIZACIÓN(BAJA)_tcm30-57890.pdf

https://www.mapa.gob.es/es/agricultura/publicaciones/02_FERTILIZACIÓN(BAJA)_tcm30-57891.pdf

LINK TO POWERPOINT MODULE 3.

SLIDES TO MODULE 3

SLIDE 1. DETERMINATION OF NITROGEN IN THE SOIL.

Presentation of the module by the trainer.

SLIDE 2. WHAT WE WILL LEARN.

Oral lecture:

Improving nitrogen fertilizers saves its costs and reduces water contamination by nitrate.

In this lesson you will learn the basic principles for a correct diagnosis of the need for fertilization to optimize crop nutrition and avoid economic and environmental problems.

SLIDE 3. NITROGEN'S BALANCE.

Oral lecture:

The Nitrogen balance assesses the supply of Nitrogen by soil and demand for cultivation. It is one of the most accepted methods to quantify nitrogen dynamics in the floor-plant system and simulates processes of gains, losses and transformations of the element in the system, as we see in this scheme.

In many crops, soil mineral N (mainly nitrate) is one of the most important terms.

An important step for a better nitrogen fertilization is the measurement of the nitrate content in the soil at the beginning of cultivation.

However, to most farmers, soil nitrate analysis does not compensate economically.

Increased performance can be expected if precise fertilization recommendation strategies are developed to assess whether N balances are positive or negative.

Video: How does Nitrogen balance in soil?

SLIDE 4. WHAT IS BALANCE PLANT NUTRITION?

Oral lecture:

Plant growth is dictated by the limiting factor and not by total resource available. One nutrient alone cannot ensure the yield. The balance between the nutrients is essential to ensure yields according to the potential of the crops.

Link: *https://www.fertilizerseurope.com/fertilizers-in-europe/balanced-plant-nutrition/*

SLIDE 5. WHAT IF THERE IS TOO MUCH NITROGEN IN PLANTS?

Oral lecture:

- Saturating the soil with high nitrogen levels **DOES NOT** improve plant growth.
- Excess nitrogen causes **fast foliage growth**, so other plants development suffers.
- High nitrogen mixtures **increase soil's mineral salts**, so growth leaves can be burned.
- Extra nitrogen leaches out of the soil causing **groundwater pollution**.
- **You can lose money!**

Interview: Expert talking about the consequences on excess of nutrients in soil.

SLIDE 6. How to calculate and optimize nitrogen fertilizer requirements?

Oral lecture:

In the past two decades, it has been increasingly considered that plant nutrient needs in many countries can best be provided through an integrated use of diverse plant nutrient resources. An integrated plant nutrition system (IPNS) or integrated nutrient management (INM) enables the adaptation of the plant nutrition and soil fertility management in farming systems to site characteristics, taking advantage of the combined use of organic, mineral and biofertilizer nutrient resources to serve the concurrent needs of food production and economic, environmental and social viability.

This is an example of the nutrient content of some crops, taken from the guide for integrated nutrient management (FAO Fertilizer and Plant nutrition Bulletin).

Document:

Plant nutrition for food security; A guide for integrated nutrient management:
http://www.fao.org/fileadmin/templates/soilbiodiversity/Downloadable_files/fpnb16.pdf

SLIDE 7. Crop needs in Spain.

Oral lecture:

Nitrogen requirements vary with cultivation and production.

Nitrogen needs of different crops for "typical" productions can be obtained in publications such as "Guía práctica de la fertilización racional de los cultivos en España" (ADAPT TO EACH COUNTRY).

Nitrogen needs depend on species, variety, potential yield and the quality of the harvest.

And throughout the growing cycle the needs are different:

In winter cereals it is more important in the tillering stage and stem elongation, while in tree crops the needs are maximum during flowering and ripening of the fruits.

Interview: A farmer talking about the importance of a fertilization program.

SLIDE 8.

Italy:

Just clarify each country has its own guide.

SLIDE 9. FORMS OF NITROGEN ABSORPTION.

Oral lecture:

The form of nitrogen absorption by plants is mainly in nitric form: nitrate ion (NO3-) and in ammoniacal form: ammonium ion (NH4+). Most plants grow better if they have access to both forms.

When both forms are present, the preference for one or the other will depend on the species, the development of the plant, its physiological state and the properties of the soil.

In most cases the nitrate content in the soil is much higher than ammonium.

It is important to distinguish between nitrate and nitrogen itself. Nitrate is: NO3 - (i.e. in addition to N has oxygen) and has 22.6% nitrogen.

The form of nitrogen can be distinguished between Nitric Nitrogen (in the form of nitrate) and Ammoniacal Nitrogen (in the form of ammonium). Basically, mineral nitrogen tends to match the sum of nitric N and ammoniacal N.

Video: Nitrogen absorption in plants.

SLIDE 10. IMPORTANCE OF SOIL ANALYSIS.

Oral lecture:

Soil analysis is a fundamental tool for determining the soil potential of a locality, region, or parcel.

When it comes to soil fertility assessment, the term "chemical soil analysis" is inappropriate, because what's being analyzed it's not the whole extent of the soil profile/horizon but the material collected in its shallowest layers.

Correct soil sampling is a major factor in soil fertility assessment, as it is impossible to analyze the entire volume and/or weight of a soil's arable layer.

SLIDE 11. SOIL DIAGNOSTIC STEPS.

Oral lecture:

To achieve a good fertility test or diagnosis we must correctly pass the following "steps":

- field sampling.

- accurate chemical analysis.

- interpretation of the data.

SLIDE 12. SAMPLINGS.

Oral lecture:

The most widespread methodology for nitrogen diagnosis is based on the determination of the N-nitrate content in soil.

Fertility diagnosis begins with taking a good **soil sample**.

When and how often should soil sampling be performed?

It will depend on the purpose of the analysis. If the objective is to fertilize a crop, the sampling should be as close as possible to the planting date; if the objective is to know the evolution of the fertility of the plot, then sampling should always be carried out at the same time of the year.

General recommendations include:

- Take samples with drills at not less than 20 points (ideal 50).
- At each point, sample layers from 0 to 30 cm and 30 to 60 cm.
- Mix samples of the same depth.
- Avoid sampling on parcel edges, where there have been piles of food, rolls, soil, etc.; places with erosion problems, or animal concentration sites.
- Once the sample is extracted, it is sent as soon as possible to a lab enabled for processing.

Video: Short video of field sampling.

SLIDE 13: ANALYSIS.

Oral lecture:

Chemical analysis is the second step, and the methods to be used are sought to be simple, fast, and inexpensive.

The selection of the method is based on previous studies of the relationship between the amount of nutrient removed by an extractant and the amount of nutrient absorbed by the crop.

The extraction involves adding a chemical to the soil sample. The extraction releases nutrients that are adsorbed into the soil particles. Some extraction methods are best suited for specific soil conditions. Therefore, different laboratories can provide different results for the same soil sample.

The end result when implementing the appropriate methodology is an indicator or estimator of availability of a given nutrient.

What objectives should this estimator meet?

- Provide an index of nutrient availability in the soil.
- Predict the probability of response to nutrient aggregate.
- Provide the basis for a fertilization program.
- Contribute to the care of the environment.

What information does soil analysis give us?

Once the soil sample has been analyzed, the laboratory informs us of the result. We could say that we have two groups of variables reported in a soil analysis:

- variables that estimate the availability of nutrients in the soil.
- variables that estimate the "productive quality" of our soil.

Soil analysis may be restricted to characterization, including texture, organic matter, pH, P, Ca, Mg, K, Na [Sodium]) or a complete analysis incorporating trace elements, electrical conductivity and sulfur.

The results are often expressed in units of ppm or meq/100g. Ppm refers to mg/kg.

Video: Accurate chemical analysis soil samples.

SLIDE 16. SUMMARY.

Oral lecture:

The N balance method makes it possible to accurately quantify the need for N of fertilizing, especially when N losses can be considered negligible.

However, despite the accuracy in determining the need for fertilizing, the variability found in many areas does not make it possible to establish a single dose of fertilizer for every year.

It is advisable to know the inorganic nitrogen in the soil at the time of planting, as well as the N that is mineralized during the growing season to improve the diagnosis and optimize the dose of fertilizer to be applied.

Soil assessments are necessary to develop fertilization strategies that enable the efficient use of nitrogen and minimize environmental risks.

Successful sampling, soil analysis and correct interpretation are required to achieve benefits.

LIFE LIBERNITRATE AWARENESS PROGRAM; MODULE 4: GOOD AGRICULTURAL PRACTICES (GAPS).

LINK TO POWERPOINT MODULE 4.

SLIDES TO MODULE 4.

SLIDE 1. GOOD AGRICULTURAL PRACTICES (GAPS). CONDITIONS OF THE NEW CAP.

Presentation of the module by the trainer.

SLIDE 2. THE CORE OF GLOBAL SOIL PARTNERSHIPS.

Oral lecture:

In agriculture, the trend towards greater intensification has been accompanied by a significant increase in the use of both nitrogen and phosphorous fertilizers.

This led to excessive amounts of nitrates and phosphates in waters and to eutrophication of these waters.

As part of its efforts to achieve the 2030 Agenda for Sustainable Development, the United Nations' Convention to **combat desertification** have developed the concept of Land Degradation Neutrality, to encourage an optimal mix of measures designed to avoid land degradation.

FAO has established the Global Soil Partnership to promote sustainable soil management as a means to achieve **food security** while protecting the environment.

The Partnership has produced **Voluntary Guidelines for Sustainable Soil Management**. Their role is to guide strategic and context-specific decision- making on soils to address major threats, such as the imbalance of nutrients and nutrient cycles, and the pollution of soils.

The International Code of Conduct for the Sustainable Use and Management of Fertilizers is an important tool for implementing these Voluntary Guidelines, with special regard to nutrient imbalances and soil pollution

Links:

United Nations: Convention to Combat Desertification:

https://www.unccd.int/actions/achieving-land-degradation-neutrality

Food and Agriculture Organization of the United Nations:

http://www.fao.org/global-soil-partnership/about/why-the-partnership/en/

Intergovernmental Technical Panel on Soils:

http://www.fao.org/3/ca5253en/ca5253en.pdf

SLIDE 3. THE PATH TO THE GREEN ARCHITECTURE:

Oral lecture:

European Union countries are following international guidelines, such as the Ammonia Framework Code, designed by UNECE, to support national advisory codes of good agricultural practice and control ammonia emissions.

The EU, under the Common Agricultural Policy (CAP), is also helping to reduce the pollution of waters by nitrates, through a variety of measures which include enhanced conditionality, eco schemes and good management practices.

A new green architecture of the CAP is being defined and represents the framework of good practices that will be examined in this unit.

Document:

Framework Code for Good Agricultural Practice for reducing Ammonia Emissions:

https://unece.org/fileadmin/DAM/env/lrtap/Publications/Ammonia_SR136_28-4_HR.pdf

SLIDE 4. THE NEW CAP.

Oral lecture:

The CAP's strategic plans for the new programming period are based different levels of measures that will help agricultural systems to ensure sustainable use of land and limiting climate change

There will be:

- Mandatory rules, defined by a new and enhanced conditionality.
- Voluntary actions, given by Pillar I's eco-schemes and Pillar II's environmental measures.

We will examine the mandatory and voluntary approaches.

Link: *https://ec.europa.eu/info/news/new-way-working-future-farming-2020-may-20_en*

SLIDE 5. NITRATES DIRECTIVE AND CODES OF GOOD PRACTICES.

Oral lecture:

First of all, a part of the mandatory framework, we can consider the EU's Nitrates Directive, introduced in 1991 with two main objectives:

- reduce water pollution by nitrates from agricultural sources

- prevent further pollution.

As seen in previous units, the directive is managed by EU countries and involves:

- monitoring water quality in relation to agriculture

- designation of nitrate vulnerable zones

- establishment of (voluntary) codes of good agricultural practice and of (obligatory) measures to be implemented in action programmes for nitrate vulnerable zones.

For nitrate vulnerable zones, the Directive sets 170 kilos as the maximum annual limit of nitrogen from livestock manure that can be applied per hectare.

Codes of Good Agricultural Practice cover such activities as:

- application periods

- fertilizing near watercourses and on slopes

- manure storage methods

- spreading methods and crop rotation

- other land management measures.

SLIDE 6. ACTION PROGRAMS UNDER THE NITRATE DIRECTIVE.

Oral lecture:

Action programs must include:

- obligatory measures concerning periods of prohibition of the application of certain types of fertilizer,

- capacity of manure storage vessels,

- limitations to the application of fertilizers (on steep slopes; to water-saturated, flooded, frozen or snow-covered ground; near water courses); as well as

- other measures set out in Codes of Good Agricultural Practice.

Several EU countries have been granted a derogation to apply an amount of nitrogen from livestock manure higher than 170 kg/ha/year, justified on the basis of objective criteria so as to not jeopardise the attainment of the objectives of the Directive.

SLIDE 7. MANDATORY RULES IN THE NEW CAP.

Oral lecture:

In the new CAP, it is mandatory for farmers that receive support to respect the EU legislation on minimum obligations directly related to climate issues.

That includes an enhanced conditionality, which is applied under two areas:

Statutory Management Requirements (SMRs) or legislative requirements.

Good Agricultural and Environmental Condition (GAEC), which is the obligation of keeping a range of standards related to soil, the protection and maintenance of soil organic matter and water protection.

Note that **"Statutory Management Requirements"** also apply to farmers not receiving the CAP support.

SLIDE 8. STATUARY MANAGEMENT REQUIREMENTS ON WATER QUALITY.

Oral lecture:

On Water quality, the two SMR are given by the Water Directive and the Nitrate Directive:

- SMR 1: Directive 2000/60/EC establishing a framework for Community action in the field of water policy, as regards mandatory requirements to control diffuse sources of pollution by phosphates.
- SMR 2: Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources.

SLIDE 9. GOOD AGRICULTURAL AND ENVIRONMENTAL CONDITION TO WATER AND SOIL.

Oral lecture:

The GAEC to be applied for water and soil are shown here.

For example, number 5 for water obliges to buffer strips along water courses, and number 6 on soil considers tillage management and slope consideration.

SLIDE 10. FROM MANDATORY TO VOLUNTARY.

Oral lecture:

The Green architecture of the CAP is completed by eco-schemes and Pillar 2 agro-environmental and climate measures.

Eco-schemes are mandatory for the Member states and voluntary for farmers who wish to receive an additional payment funded by the CAP.

Pillar 2 measures are voluntary for both Member States and farmers and target specific actions that address long-term impacts.

SLIDE 11. THE "ECO-SCHEMES" FORESEEN BY THE NEW CAP.

Oral lecture:

The "ECO-SCHEMES" foreseen by the new CAP:

- are a new way of spending Pillar I funding on the environment and the climate. **In 2021 the eco schemes will be part of Pillar I**.
- They represent commitments above baseline (SMR and GAEC requirements stem) and different from Pillar II management commitments.
- Member states have flexibility over content of eco-schemes.
- Target areas in which Member States have particular challenges (e.g. emissions or nitrates or biodiversity).

Document: IEEP (Institute for European Environmental Policy): CAP 2021-27: Using the eco-scheme to maximise environmental and climate benefits: https://ieep.eu/uploads/articles/attachments/4791a221-8525-4410-848f-8fb84f5a621a/IFOAM%20EU_Eco-scheme_Report_Final.pdf?v=63718564537

SLIDE 12. A TARGET TO ECO-SCHEMES: "PRESERVING OUR SOIL TO PROTECT OUR FOOD".

Oral lecture:

Possible examples of eco-schemes applied to protection of soils:

- Rotation beyond GAEC 8, with the inclusion of species particularly beneficial. Member States can advise.
- Maintenance of organic farming
- Perennial cover in orchards
- Catch crops beyond GAEC and Nitrate Directive requirements
- Maintenance of zero-tillage

SLIDE 13: EXAMPLE OF PILLAR II ACTION FOR SOIL CONSERVATION.

Oral lecture:

For soil conservation, examples of actions to carry out under Pillar II framework are:

- Knowledge transfer, farm advisory.
- Investment for lighter tractors.
- Use of Decision Supporting Systems (DSS) module in the FaST (Farm Sustainability Tools) for optimal soil management.
- Management commitments, e.g. burying crops and residues, anti-erosion landscape features.
- Management commitment for intercropping, sequential cropping.

SLIDE 14. FAST.

Oral lecture:

The Commission has developed a Farm Sustainability Tool for Nutrients (FaST) whose use will become the conditionality condition number 5.

According to this condition, Member States shall establish a system for providing the Farm Sustainability Tool for Nutrients.

The Commission is developing support with the design of that Tool and with data storage and processing services requirements.

SLIDE 15. A MUST: MANAGEMENT MEASURES.

Oral lecture:

Instead of attempting to achieve specific objectives with single measures, it may be more effective to use a bundle of related **management measures** to enhance the delivery of the specific objective.

At the same time, good practices can facilitate impacts on several environmental and climate objectives.

SLIDE 16. SUMMARY.

Oral lecture:

The EU is committed with international conventions and codes to promote sustainable soil management.

The new Green architecture of the CAP supplies a framework on good practices for fertilizing and soil management.

Apart from the Nitrogen's Directive, the CAP is defining a new conditionality and voluntary actions given by eco-schemes and climate actions.

There is, therefore, a battery of tools that support farmers on water and soil conservation.

TO LEARN MORE.

Further readings:

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

https://ec.europa.eu/environment/water/water-nitrates/pdf/nitrates_directive_implementation_report.pdf

A sustainable Common Agricultural Policy for our future
https://youtu.be/SXhtT7yoX9E

LIFE LIBERNITRATE AWARENESS PROGRAM; MODULE 5: FERTILIZATION PROGRAM.

LINK TO POWERPOINT MODULE 5

SLIDES MODULE 5

SLIDE 1. FERTILIZATION PROGRAM: A NEEDED STEP FOR SUSTAINABLE CULTIVATION.

This module aims to give some tips for the realization of a good fertilizer program.

SLIDE 2. WHY IS IT SUPER NECESSARY?

Oral lecture:

Farmers are required to comply with directives that reduce nutrients in soil and water, which include the Nitrates Directive and the Water Framework Directive, so individual fertilization plans must be very precise and respectful.

The development of individual fertilization programs will adjust the actual contribution of nutrients to crop needs, minimizing their losses and impact on the environment.

The strategic plans of the new CAP (2021-2027) where public support will be linked to eco-schemes with improvements in fertilization practices.

A part of the eco- schemes, farmers, to receive support, will have to respect Standard Management Requirements (SMR). That's why fertilization programs are so necessary.

SLIDE 3. A FERTILIZATION PROGRAM.

Oral lecture:

A fertilization program will take into account the nutritional value of products reused by the farmer: Organic fertilizers and residues will be applied first and nitrogen fertilizers will be used as a supplement.

Nitrogen interacts with other **macronutrients**: phosphorus, potassium, sulfur, and micronutrients, which are necessary to detect the appearance of deficiencies. **A balanced fertilization program should ensure the correct dose of each nutrient.**

The most appropriate and efficient fertilizer will be selected. The dose will be calculated based on the content, chemical form and time that may elapse until the plant absorbs it, considering the soil characteristics, climate and nutritional needs of the crop.

Fertilizer applications will be carried out according to the calendar of nutrient absorption by the crop. Fractional applications may be necessary, especially in winter crops, to maximize nutrient absorption and

prevent losses.
In irrigated crops, several contributions should be made throughout the cycle before the irrigation is applied.

The fertilizer will be applied accurately, using the most appropriate technique: sprinkled, pulverized or localized. Fertilizer machines shall be calibrated and the product, with good physical quality, shall be applied to facilitate uniform distribution in the field.

The fertilization program should be reviewed if the weather conditions become extreme or the growth and development of the crop is interrupted.

SLIDE 4. A GOOD PRACTICE FOR THE PROTECTION OF THE WATER CYCLE: WHAT YOU MUST CONSIDER.

Oral lecture:

To carry out a good fertilization program, we must keep in mind the following recommendations of the Code of Good Agricultural Practices that help the farmer to produce in the most efficient way:

- AVOID the less appropriate times to fertilize.
- AVOID the application of fertilizers on sloped land.
- AVOID the application of fertilizers in soils that are flooded, frozen or snowy.
- RESPECT conditions for fertilization on land near watercourses.
- KEEP capacity of manure ponds, including measures to prevent water contamination by runoff and percolation to aquifers.
- FOLLLOW procedures for the homogeneous application of mineral or organic fertilizer.
- APPLY soil management, including crop rotation systems that maintain an adequate proportion of plots dedicated to permanent crops relative to annual crops.
- MAINTAIN a minimum plant cover area during rainy periods, which absorbs nitrogen that could cause water contamination.
- ESTABLISH fertilization programs, farm by farm, and a record of the fertilizer used. **For each plot, there is a program.**

SLIDE 5. THEREFORE… HOW IS A FERTILIZER PROGRAM DESIGNED?

Oral lecture:

The implementation of a fertilizer plan should consider:

- **The level of existing nutrients in the soil**; it is recommended to periodically do an **analysis of macronutrients** (P2O5, K2O and organic matter).
- **Plant growth and nutritional status**: determined by foliar analysis. It is recommended to do this periodically according to the crop studying that there are no obvious nutritional problems to correct. The fertilizer must adapt to the different production and quality levels required by the sector.
- Production-dependent **annual extractions of nutrients**.

- **Soil characteristics** that determine the mobility of nutrients and absorption capacity by the plant. The supply of nutrients will be carried out primarily through the ground and foliar fertilizers will be reserved for cases of obvious deficiencies, which need a punctual corrective.

- **Other** mean contributions like **irrigation water**.

The fertilizer program must be made for each plot that meets agronomic conditions, with the same characteristics of soil and climate. This is known as the Unit of Homogeneous production (UHP)

SLIDE 6.

Oral lecture:

Organic fertilizers or minerals will be NOT applied at times that may pose direct contamination to the crop about to be harvest.

Interview: Farm expert or university professor about what to do and what not to do, for example in citrus crops. **Recommendations for sustainable fertilization.**

SLIDE 7. AN EXAMPLE FOR CITRUS IN SPAIN:

Oral lecture:

Recommended N fertilizer rates provide enough N for tree expansion while producing maximum economic yields of high- quality fruit. The chosen N rate will depend on soil characteristics, yield potential, and tree needs as indicated by leaf analysis interpretation.

A specific dose of N is needed for different varieties, ages of the citrus orchard, and type of fertilizer and technique (Table):

SLIDE 8. FERTIGATION IN CITRUS.

Oral lecture:

In the case of fertigation, the advances included in the management of localized irrigation allows a larger division of the fertilization and, on the other hand, a distribution of the specific product to each variety, and even each plot of the holding.

An indicative distribution of the monthly dose of citrus fruits expressed as a percentage of the total UF to be applied during a vegetative cycle (Table):

SLIDE 9. SOIL ANALYSIS IN CITRUS.

Oral lecture:

Fertilization program must include a soil analysis.

The solid interpretation can be used to make decisions regarding soil pH control or fertilizer application.

The plan must include guidelines on how to react if soil conditions are not adequate.

Document:

2020-2021 FLORIDA CITRUS PRODUCTION GUIDE: Nutrition Management for Citrus Trees: https://edis.ifas.ufl.edu/pdffiles/CG/CG09100.pdf

SLIDE 10. MODEL OF A FERTILIZATION PROGRAM FOR TREE CROPS.

Oral lecture:

As told before, to provide a reasonable dose of fertilizer to citrus we must first consider the amount of nutrients consumed by the crop annually in addition to the efficiency or proportion of elements that the orchard takes advantage or the adequate time when fertilizers are applied.

Generally, the relationship between the applied element and its use by the crop is not linear, so the dose increases, its efficiency decreases. This response indicates that efficiency should be calculated for the dose considered agronomically optimal for a crop with certain cultural practices.

For the most commonly used fertilizers, recommendations can be obtained based on planting age, cup diameter, planting density and production, for example.

The conditions of each site require technical advice.

MORE INFO

Recommended reading:
ECO-SCHEMA 5: PRECISION AGRICULTURE PLAN DE GESTIÓN DE NUTRIENTES: https://www.mapa.gob.es/es/pac/post2020/ecoesquema5agriculturadeprecisionplandegestiondenutrientes_tcm30-552839.pdf

PRACTICAL TRAINING BY MODULES

*The student has the opportunity to follow up on the topic through a **case study** proposed by each module, with the option to rely on the additional material of the program.*

PRACTICAL CASE	MODULE	SUPPORTING MATERIAL
Propose a problem connected to a cultivation system in your own country and propose a technological solution with your own research.	**Fertilization.**	*Include module references*
Video tutorial of "How to know if my farm is in a VZ". An expert could do a 2-minute max polymedia. This lesson could be a case study.	**The Nitrate Directive and Vulnerable Zones.** *Slide 14*	*Include module references*
What happens in practice? Case of money loss.	**Determination of Nitrogen in the soil.** *Slide 8*	*Include module references*
Find the legislation of your country that provides guidelines for nitrate good practices.	**Good Agricultural Practices (GAPs).**	*Include module references*
Fill a table for a tree crop in your country and define net annual needs for different stages of the growing cycle.	**Fertilization program.** *Slide 9*	*Include module references*
Elaborate a fertilization program for a proposed crop. Point out the critical aspects that farmers should take into account.	**Fertilization program.** *End of the module*	*Include module references*

ADDITIONAL REFERENCES:

These are some examples of interesting additional references which will be modified according to each country.

Sustainable Crop Production Intensification (FAO)
http://www.fao.org/ag/humannutrition/24965-02419ce9af950e3d018a71a63485f4a6f.pdf

Closing the mineral cycles at farm level at Good practices to reduce nutrients in the North-Brabant region (Netherlands)

https://ec.europa.eu/environment/water/water-nitrates/pdf/leaflets/Leaflet_North_Brabant_EN.pdf

Water: The Commission in calling on Spain to protect its waters from nitrate pollution.

https://ec.europa.eu/commission/presscorner/detail/en/inf_20_1212

Example of Italy:

Norme tecniche di produzione integrata 2020

https://www.regione.piemonte.it/web/temi/agricoltura/servizi-fitosanitari-pan/norme-tecniche-produzione-integrata-2020

REGIONE CAMPANIA Assessorato Agricoltura "Disciplinari di Produzione Integrata" Le norme tecniche generali Agg. 2020

http://www.agricoltura.regione.campania.it/disciplinari/norme_generali_2020.pdf

REGIONE LOMBARDIA: Disciplinari di produzione integrata

https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/servizi-e-informazioni/Imprese/Imprese-agricole/servizio-fitosanitario-regionale/uso-sostenibile-dei-prodotti-fitosanitari/disciplinari-produzione-integrata/disciplinari-produzione-integrata.2020

www.lifelibernitrate.eu