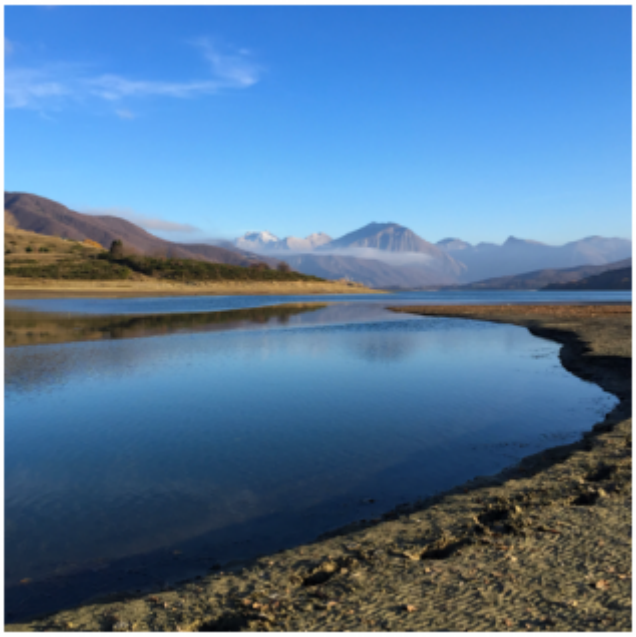
Project UNIZEO

Urea-based nitrogenous fertilizers coated with zeolite: reducing drastically pullution due to nitrogen

surface waters | nitrogen | eutrophication | ground water | fertilizers | water pollution

PROJECT DESCRIPTION



Nitrogen fertilization of crops can have significant environmental consequences in terms of **groundwater and air pollution** due to the release of nitrogenous substances into the environment, which are not completely absorbed by the vegetation. Among the **nitrogenous fertilizers** the best known and most used is urea, as it delivers the largest amounts of nitrogen (N) at the lowest costs.

In this context, the UNIZEO project had the aim of creating and testing a particular fertilizer: **urelite® (European patent n ° 1379558)**, which allows farmers to maintain production and quality levels (at low and competitive costs) and at the same time to protect the environment thanks to a lower release of nitrogenous substances. Urelite® is, in fact, a slowly releasing urea-based nitrogenous granular fertilizer coated with zeolitite (a pyroclastic rock of volcanic origin that contains over 50% of zeolitic minerals in the form of microscopic crystals uniformly distributed in the rock, and subordinate quantities of other silicates and volcanic glass. It is particularly rich in potassium). Nitrogen is released to crops gradually thus allowing to not introduce into the soil chemical molecules which would inhibit the actions of microorganisms and/ or natural enzymes (nitrobacter, nitrosomonas, urease), that play a precise role in transforming fertilizing substances into nutrients for the crop. **The slow release of nitrogen from urelite® is ensured by the complex action of precisely the protective coating of the urea granule made of a natural zeolitite layer containing zeolites**.Among the project aims there was also the demonstration of the technical and economic viability of the new fertilizer's production. To this purpose a **pilot production plant** was constructed with a production capacity of 1.000 tons of product per year. The product, urea-based granules coated with zeolitite, was tested on a large surface, including some agricultural lots and golf courses.

OBJECTIVES

The specific objectives of the project were to:

- reduce use of urea in the tested agricultural lands;
- strongly reduce the surface water, groundwater (nitrates) and air (ammonia gas) pollution;
- lower nitrogen loss in the atmosphere and in circulating water;
- increase crop yields thanks to the use of the new fertilizer;
- raise awarness and better inform farmers on the issue and the proposed solutions.

PROJECT PHASES

The main project activities concerned:

- **design of the pilot plant** for the production of zeolite-coated urea fertilizers and selection of raw materials to be used for the fertilizers (in particular zeolitite and clay);
- **construction of the pilot plant**, whose operation foresees the following phases:
  - **storage** of raw materials (urea, zeolitite, clays);

  - controlled **grinding** of zeolitite;
  - **extraction** of raw materials from the silos;
  - **transfer** to the dosing and feeding phase of the coating system;
  - **drying**, in an appropriate dryer, of the zeolite-coated urea granules; and their dimensional classification;
  - big-bag **packaging** and subsequent storage in warehouses.
- **test in the pilot plant and experimental production of the urea-based nitrogenous fertilizer** coated with zeolitite;
- 2-year demonstration experimentation on a wide variety of crops (corn, rice, wheat, barley, potatoes, vines, orchards) and a golf course in order to measure and demonstrate the effectiveness of the product and its environmental benefits. The results obtained by applying the new product on the selected lands were also compared with the results achieved in other monitored lots on which the farmers had used the usual fertilization procedure. Fertilization plans have been customized according to the practice and the crop type (corn, wheat, rice, golf, fruit).
- **characterization of the final product** for the fine-tuning of the production process;
- **monitoring and evaluation of the results** in terms of environmental benefits, technical viability and profitability for farmers;
- **dissemination of the activities and results** achieved among groups of possible users such as: farmers, scientific communities, national and European institutions; and **networking** activities.

PROJECT RESULTS

The project has shown that the use of urelite® can contribute - at low costs - to the improvement of the quantity and quality of agricultural production while safeguarding the environment. A total **of 56 farms**, most of which were cereal crops without breeding, and **7 golf courses** were involved. The surface used was of **approximately 1.528,31 hectares**.

For the detailed monitoring of production, crop nitrogen removal and nitrogen leaching in the soil, 13 companies (crops of wheat, corn and rice) and 2 golf courses were selected among those involved in the experimentation. For each farm/ type of crop/ soil, specific fertilization plans have been drawn up to regulate the distribution phases of the fertilizer. In summary, the main results achieved were:

- **construction of the pilot plant** for the production of urelite® with a production capacity of 1.000 tons/ year. The new fertilizer is obtained starting from zeolitite powder and prilled urea (fine granular urea); the urea grain is coated with zeolitite powder in an appropriate machine (granulator plate). Once the granule is obtained, the product is dried, screened, cooled and then stored in big-bags of 500 kg.
- **fulfilment of all requirements regarding the** product's characteristics (regularity of the granules size, 1:1 weight ratio between prilled urea and its coating, consistency and cohesion, regularity of the coating, and 95% - 5% ratio between the coated and uncoated grains in the production lots).
- **production of 550 tons of urelite® in 2013 and 500 tons in 2014** (corresponding to the quantities required in the experimental phase);
- **up to 30% reduction of N,** compared to conventional fertilization, without affecting the wheat, corn and rice harvest in the two years of experimentation, **thanks to the use of urelite®**. In the large-scale experimentation the reduction was of 38,7% for the wheat, 59,3% for the maize and an average of 24,5% for rice crops;
- **increase in the production of some crops**. Wheat: average production increase of 7,4% in the 2nd year of urelite use (up to + 21%, 5 tests); corn: average production increase of 2,3% (up to + 16%, 4 tests). In large-scale trials the average production resulted increased by 2,45 quintals/ ha for wheat; and 26 quintals/ ha for silage maize. An **improvement** was also recorded in the **quality of the fruit** (color, consistency, lasting conservation);
- **lower nitrogen concentrations in the experimental soils after the second year of harvest**. This data means also a reduction of the risk of nitrate leaching in the groundwater and in the atmosphere.
- **reduction of ammonia emissions** thanks to the fertilization with urelite, i.e. reduction of nitrogen supply;
- **improvement**, in terms of color and persistence, **of the quality of the turf of the golf courses;**
- **creation of a network with other European projects** (ZeoLIFE, GreenWoolf, Crops for better Soil, OperationCO) dealing with issues related to sustainable agriculture, with the aim of developing new synergies;
- **better knowledge and increased awareness** about the water and air pollution caused by nitrates from agricultural sources and about the advantages deriving from the use of urelite.

The results achieved and the methodologies adopted are described in the Reports indicated below, while further documents are available in the Pubblications section of the project website:

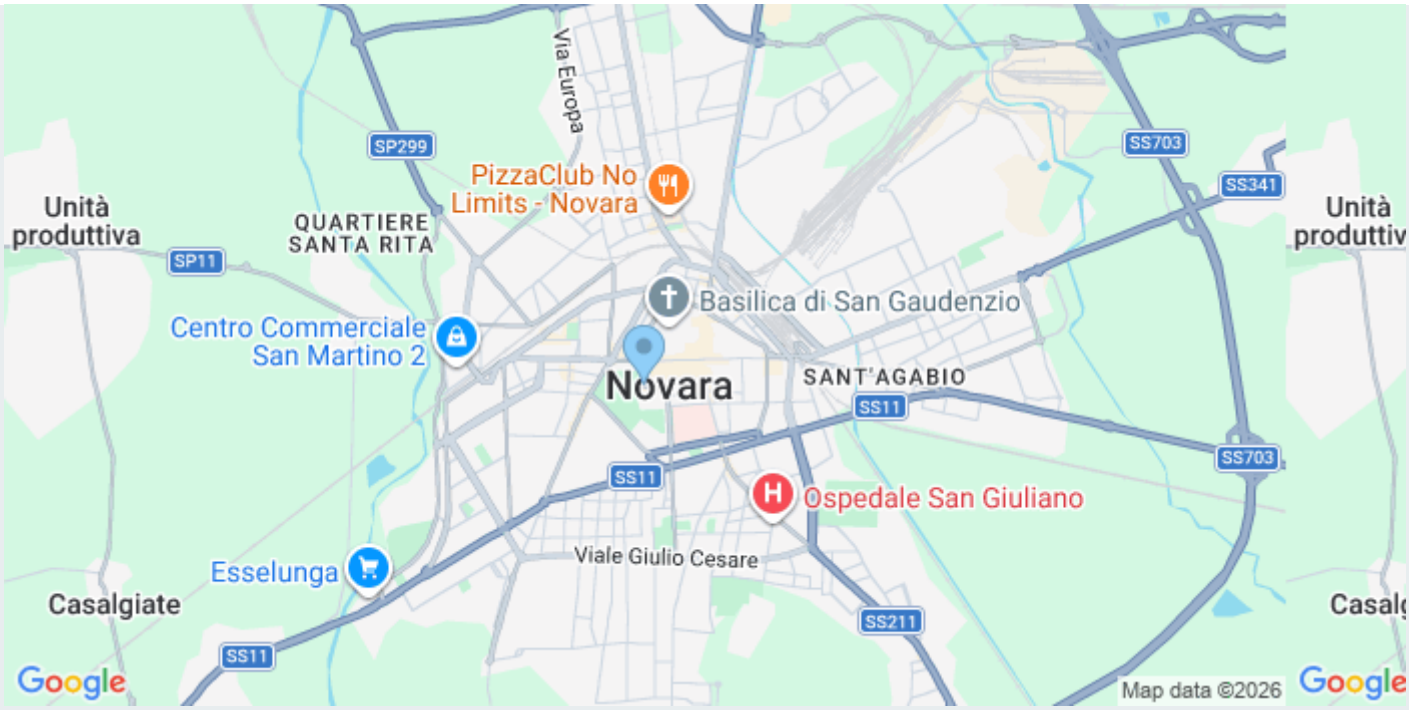
- Monitoring protocol describing the methodologies used during the experimentation phase;

- Manual for use of UNIZEO product which describes the product's characteristics and its using methods as well as provides practical information concerning the best agricoltural practices of the new fertilizer's use;
- Technical evaluation report on the results of the experimentation which collects the results of the experimentation.

Furthermore, it is to be noted that the results achieved by the project can contribute to the achievement of some EU objectives, such as water protection from pollution caused by nitrates from agricultural sources (Directive 91/676/EEC), improvement of the air quality (the lower nitrogen content of the fertilizers reduces the emissions into the atmosphere) and the conservation of soil as well as improvement of its quality (less nitrogen residues in the soil).

Finally, advantageous influences on other environmental sectors such as landfills and urban waste water treatment can also be highlighted.

The UNIZEO project has been included in the EC publications "LIFE and Climate change mitigation" and "LIFE and air quality" .



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Acronym
UNIZEO

Number of reference
LIFE10 ENV/IT/000347

Reference Programme
LIFE

Beneficiary Coordinator
Minerali Industriali S.r.l.

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EU contribution
1.110.878

Call Year
2010

Start Year
2011

End Year
2015

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Region
Piemonte

Description

Piemonte, Lombardia