Newsletter
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Growing energy crops on contaminated land for biofuels and soil remediation

GOLD - Bridging the gap between phytoremediation solutions on growing energy crops on contaminated lands and clean biofuel production, is a research and innovation action funded by the European Union Horizon 2020 Programme.

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Figure 1: Sampling area is Zhuzhou. Photo credits Dr. Yasir Iqbal (PhD)

1. Introduction to the project

Contaminated land is a global problem occurring as a result of various human activities such as industry, waste disposal, mining and excessive agriculture. It is estimated that in Europe alone there are 2.5 million potentially contaminated sites, of which 14% are expected to be contaminated to a level that requires remediation in order to be safe for future use. The world is also suffering from an unprecedented increase in temperature, which is strongly attributed to the burning of fossil fuels.

GOLD is a new Horizon 2020 research and innovation project, launched in June 2021, that could be the solution to these two environmental and social problems. The project aims to remediate contaminated soils through the cultivation of lignocellulosic crops, which will then be harvested and used as a feedstock to produce sustainable biofuels. Therefore, through the process of phytoremediation, the growth of the correct type of plants and the associated microorganisms, soil contaminants can be stabilised, reduced or removed. Thus, rendering the contaminated lands safe for use, whilst producing a feedstock for clean energy production.

Lignocellulosic perennial grasses such as miscanthus and switchgrass, and annual herbaceous crops such as sorghum and industrial hemp, are the targeted species for this research due to their resilient characteristics, that are tolerant to high concentrations of pollutants such as metals, metalloids and xenobiotics. In addition, as the crops will be grown on contaminated land that cannot be used for food production there is a low risk of indirect land use change (low-ILUC).

The harvested crops will also be processed to produce biofuels from the lignocellulosic biomass.One method will apply high-temperature entrained gasification and the other will be based on autothermal biomass pyrolysis. Both methods will separate pollutants from the biomass, either by stabilising them into a vitrified ash slag form, or by extracting them into a liquid phase.

Discover more on GOLD – Bridging the gap between phytoremediation solutions on growing energy crops on contaminated lands and clean biofuel production by watching this video!

2. Impacts

Three main impacts will be jointly generated by the outcomes of GOLD:

- Create a win-win situation by bringing polluted land back to agricultural production through cost reduction and improved phytoremediation.
- Produce clean biofuels with low ILUC risks from selected energy crops grown on contaminated lands.
- Promote the international collaboration towards the Mission Innovation Challenge 4 on advanced biofuels.

It is also important to add that GOLD contributes to achieving **nine** of the United Nations **Sustainable Development Goals.**

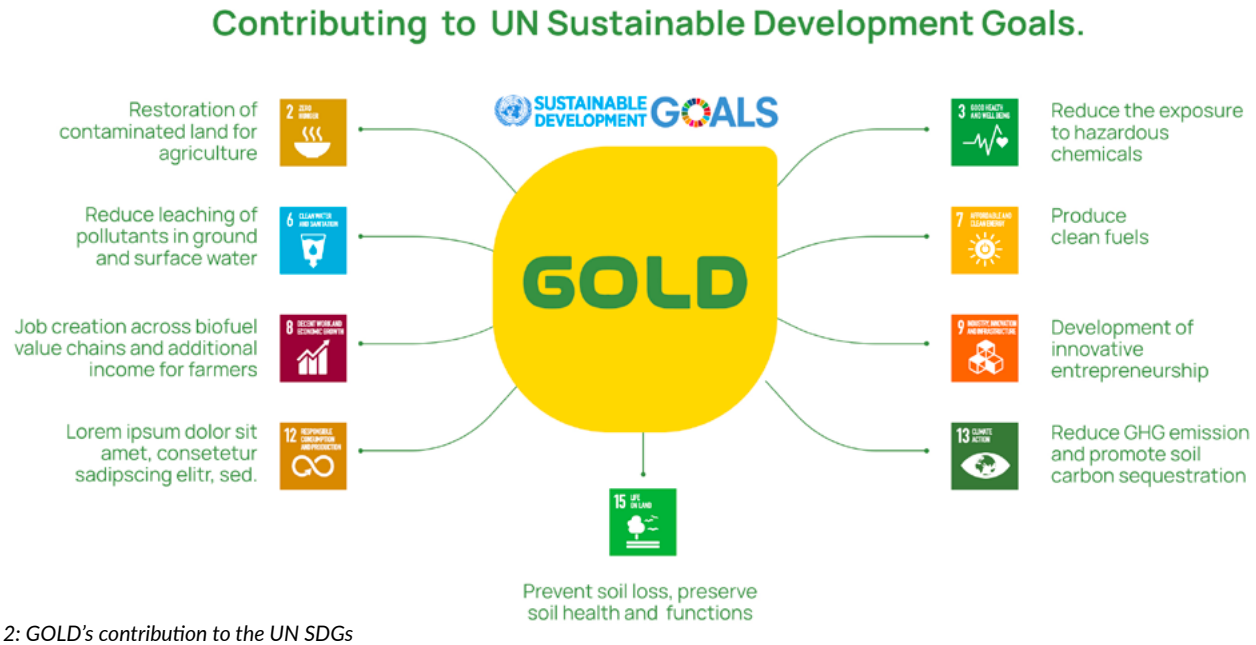

Figure 2: GOLD's contribution to the UN SDGs

3. Getting Started

The aim of the first part of GOLDs research is to optimise selected high-yielding lignocellulosic energy crops for phytoremediation, targeting different classes of soil pollutants, with the specific objectives:

- To compare different phytoremediation practices on contaminated soils polluted with organic and inorganic pollutants when growing selected high-yielding lignocellulosic energy crops.
- To apply the best performing phytoremediation practices on pilot small scale field trials.
- To develop optimised phytoremediation solutions for the selected crops in the form of lessons learnt.

To achieve these objectives it is important to take soil samples from the pilot sites and carry out physico-chemical analysis so that baseline conditions are known. It is also essential to carry out lab scale trials (pot trials) using different plant species to determine the optimal plants to use during the larger scale site trials. Since the most adapt plants are spring crops, and the trials began in September, the pot trials for the European sites will be held in greenhouses. In addition to ensure fair test conditions, all european partners will use the same propagation materials, the China sites will use similar local varieties, and the same commercial products will be used by all partners including the same application methods. During the trial and harvest, measurements and analyses will be collected, compared and critically evaluated in order to select the two best phytoremediation practices per crop for further evaluation in the pilot field trials.

The aim is to select high-yielding lignocellulosic energy crops for phyto-remediation

4. Pilot Sites

Pilot sites across Europe and China have been identified and selected based on the variety of contaminants found in the soils.

- Greece - two sites both are contaminated by heavy metals due to historic and current mining activities.
- North Italy - one site with contamination caused by the discharge of industrial waste.
- France - one site contaminated mostly by lead, zinc and cadmium due to a former smelter plant.
- Poland - one site contaminated with heavy metals, organics and pesticides pollutants due to former mining activities and a former chemical plant.
- China - Two sites contaminated with cadmium and arsenic.

5. Pot Trials in Europe

The pot trials have been successfully established in Greece (AUA and CRES), in Italy (UNIBO), in France (YNCREA) and in Poland (UMCS). Soil from contaminated sites of each country has been transferred and used for the pot experiment. The tested plants are miscanthus, switchgrass, industrial hemp and sorghum and they are treated with mycorrhiza, protein hydrolysates, fulvic/humic acids, singularly and combined.

Figure 3: Pot Trials at YNCREA (left) and AUA (right).
Photo credits YNCREA and AUA

6. Start-Up Of Greenhouse Pot Trials At Unibo, Italy

The UNIBO has set up a greenhouse for GOLD, so far tests on the three species miscanthus, sorghum and switchgrass have been carried out. Plants are grown in 58 pots filled with contaminated soil (heavy metals), and treated with two biostimulants and a mycorrhiza to investigate their phytoextraction/bioaugmentation capabilities.

Figure 4: Greenhouse set-up at the University of Bologna.
Photo credits UniBo

7. Progress at the Chinese sites

Hunan Agricultural University (HUNAU) is progressing well with the first task and has already collected four baseline soil samples from the sampling area in Zhuzhou, Hunan Province. As such the analysis of the samples is underway, and pot trials with miscanthus and switchgrass are underway.

At the Chinese Academy of Agricultural Sciences (CAAS) 21 sorghum varieties have been screened for biomass and phytoremediation potential. With this information the hemp and sorghum seeds, along with the soils, the pots have been prepared for the trials.

Figure 5: Pot trails (left) and soil preparation (right) at Hunan Agricultural University, Changsha. Photo credits Dr. Yasir Iqbal

8. GOLD presented @EXPO 2020 Dubai

Project Coordinator Efthymia Alexopoulou presented GOLD – Bridging the gap between phytoremediation solutions on growing energy crops on contaminated lands and clean biofuel production on October 4th 2021 at Expo 2020 in Dubai during the "EU Green Deal Research and Innovation as a driver towards Climate Neutrality" workshop in the Sweden Pavilion.

Dr. Alexopoulou took part to the third session of the event, where she had the chance to introduce GOLD to fellow researchers and scientists who also presented their own research and innovation projects.
View presentation here.
Watch the recording of the presentation here (GOLD presentation starts at 4:40:00).

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