

LASER FENCE

Laser systems for the prevention of food chain poisoning and minimization of chemical exposure to the environment

LIFE LASER FENCE



Laser Fence project team meeting in Delft, 2017

1. What is LIFE Laser Fence?

LIFE Laser Fence is a project financed by the European Union via the LIFE Environment programme. Four countries have participated in the project: England, Scotland, the Netherlands and Spain. Through the use of laser technology, LIFE Laser Fence aims to control the presence of rodents, birds and other wild animals in crop fields. Reduced chemical use will lead to a decrease in the food chain contamination and in the death by poisoning of different animals species. This technology is effective in preventing the presence of birds in certain areas, and this project has developed the technology for use with different species of mammals.

2. Project motivation

The food and energy demand of the planet has been continuously increasing over the years. Agriculture is the main source of supply for the growing demands of the population. At the same time, and due to the climatic emergency, we live in, it is essential that food production is as productive and sustainable as possible. The control of pests and diseases is one of the main concerns of farmers and the food industry, who are looking for sustainable alternatives in order to reduce the use of chemicals and poisons in the land.





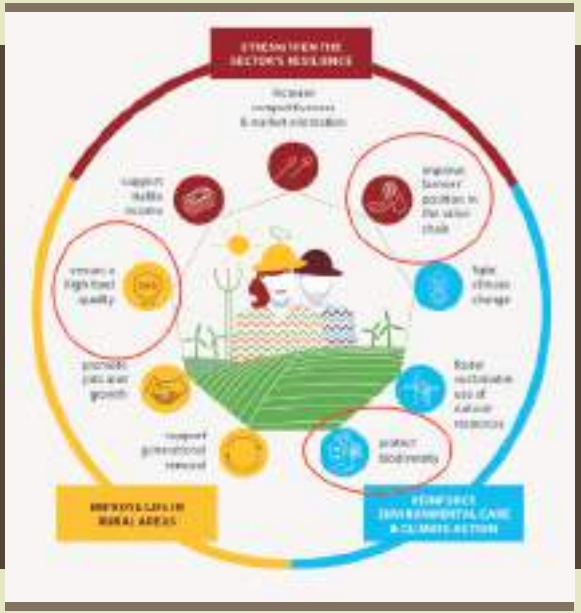
Rabbits can have a devastating effect on soil and vegetation

2.1 Environmental problems

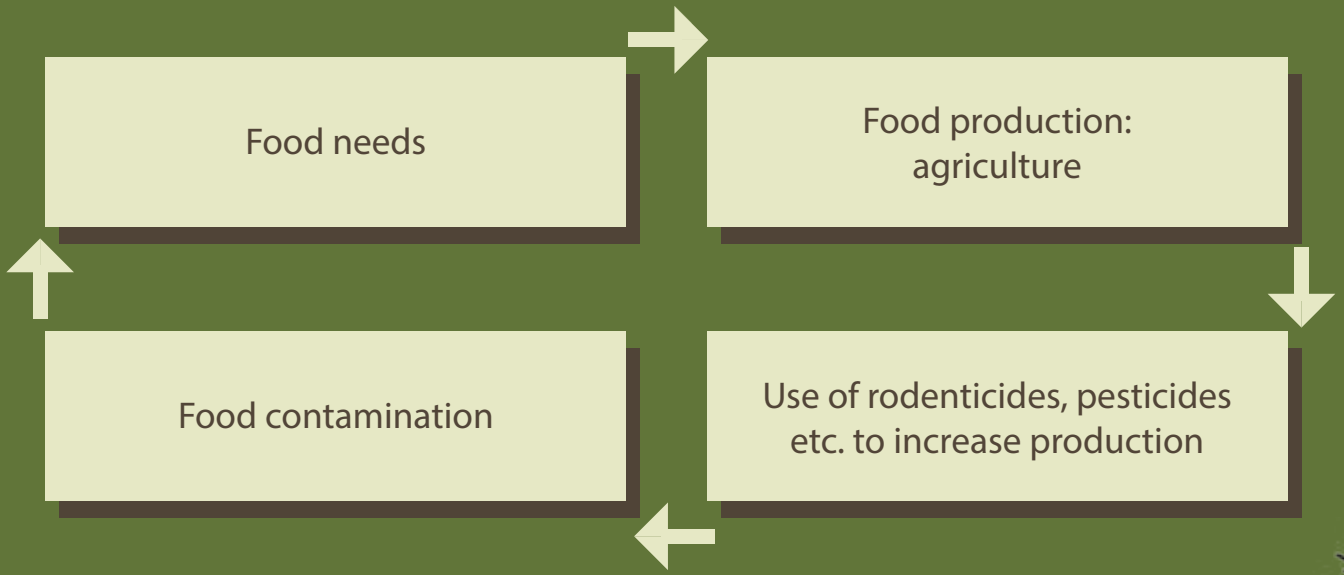
LIFE Laser Fence project fell under the topic of chemicals: it implemented activities that are in line with the specific objectives for environment and health set out in the 7th Environment Action Programme.

In order to safeguard the Union's citizens from environment-related pressures and risks to health and well-being, the 7th EAP shall ensure that by 2020:

The combination effects of chemicals and safety concerns related to endocrine disruptors are effectively addressed in all relevant Union legislation, and risks for the environment and health, in relation to children, associated with the use of hazardous substances, including chemicals in products, are assessed and minimized. Long-term actions with a view to reaching the objective of a non-toxic environment will be identified.



This program aims to substitute the use of hazardous chemicals as part of a broader, strategic approach for a non-toxic environment, thus resulting in the reduction of the impact of chemicals in the environment. Nowadays, the profitability of conventional farming relies mostly on the intensification, specialisation and concentration of agricultural production. This intensive production strategy has led to a growing dependency on chemicals, such as pesticides for pest control, herbicides for weed control and rodenticides for some rodent species, with unexpected negative side effects, for the environment and health, creating hazards for both humans and wildlife. This project seeked to demonstrate that virtual fencing can remove the need for anticoagulant rodenticides.



LIFE Laser Fence investigated how laser technology could be used to install a barrier that prevents the entrance of animals to agricultural areas. The effectiveness of this barrier has been tested with different species: rats and mice, rabbits, badgers, squirrels, deer, wild boars and wolves. Rodents tend to carry diseases that can affect food crops, and larger mammals tend to destroy crops or minimize the availability of grass for cattle. Wolves particularly cause large losses to farmers.

Rats and mice

Diseases that can contaminate food

Deers & wild boars

Crop damage and decrease of grass for livestock

Rabbits

Diseases that can contaminate food and reduction of grass for livestock

Badgers

Diseases that can contaminate food and crop damage

Wolves

Impacts on livestock

***Grey squirrel**

Invasive species in red squirrel territory



The project has engaged with farmers across Europe



Explanatory notice board at trial site



Laser directed towards rabbit



Laser fence in action at various trial sites

2.2 What is the project hypothesis?

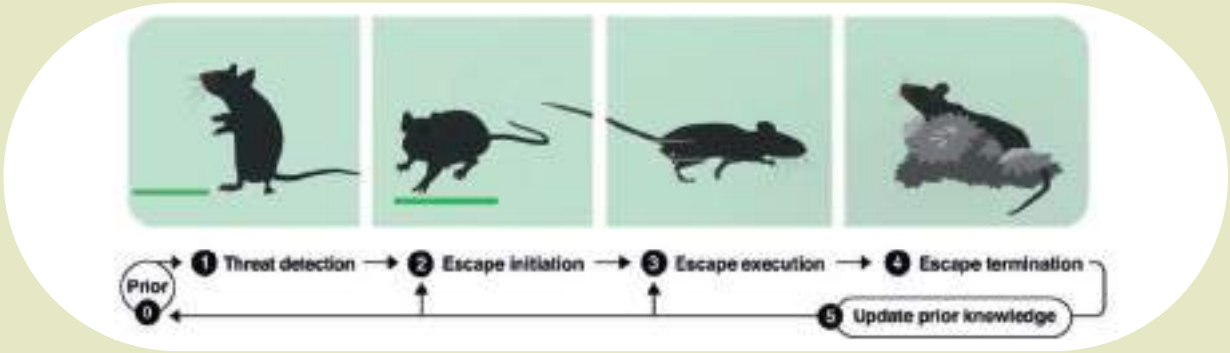
The project hypothesised that it would be possible to avoid the use of anticoagulant rodenticides, in addition to deterring unwanted bird species, rodents, rabbits and other mammal species, using the Agrilaser technology. The basis for this hypothesis is that all mammals have cerebral crossing over of nerve fibres in the brain so that sensory stimulation on one side (e.g. on the side of a perceived threat) will cause a more rapid motor response on the opposing side of the body, moving the animal away from the noxious event. This anatomy was established very early on in mammalian evolution as a driver for survival and is a well-recognised mechanism for instinctive avoidance behaviour.

3. Main objectives

1. A reduction of the impact that chemicals have on fauna by the minimisation of exposure to toxic chemicals through the application of innovative laser systems. Hereby deterring animals intruding into agricultural fields, thus preventing the poison from entering the trophic chain.

2. Calibration and improvement of the functionality of the laser deterrence systems towards animals other than birds in ecologically sensitive areas where nature conservation increasingly conflicts with agriculture and daily economic activities.

3. Cost-efficient and more sustainable agricultural management practices through the incorporation of virtual fences, which are accurate and cheap to monitor farmlands, protected or difficult to reach areas, and over long distances. The project intended to demonstrate to farmers and landowners the positive economics of this sustainable practice due to lower operating costs and an increase in yield.



Source: Dominic A. Evans, Vanessa Stempel, Ruben Vale, Tiago Branco (2019). Cognitive Conrol of Escape Behaviour. Science Direct, 23:4, p.334-348.

LIFE Laser Fence is a sustainability project as it works towards the improvement of environmental, social and economic wellbeing.

Reduction of chemicals in food chain will drive human health improvement

Social

Reduction of expenses on pesticides, rodonticides etc. Cheaper monitoring and control of farmlands

Economic

Reduction of animal losses due to poisoning. Improvement of soil quality and biodiversity increase

Environmental

4. Description of the technical solution

Industrial partner, Bird Control Group (BCG) has developed a novel system for pest mitigation, Agrilaser, which is based upon 532nm laser technology. The system is available in both handheld and fully automated forms, the latter of which is of most interest in this project due to its capacity to continuously deter pests without human intervention. The system is fully programmable to sweep predefined areas (i.e. fields) with a laser beam, and can be configured to avoid sensitive areas (e.g. roads, housing, reflective surfaces, etc.), to operate in certain hours of the day or night, and to avoid areas of conservation interest (e.g. ground nest bird populations).



Assembling an autonomic Laser Fence system

BCG has been successful in demonstrating and applying the concept in a number of situations, including on oil platforms and in airports. While the technology has been highly successful with bird species, this project seeked to extend its relevance further into the agricultural domain. With the support of the project beneficiaries, the project seeks to show that Agrilaser can have relevance beyond avian species and contribute significantly to tackling the issues of agricultural chemical use (i.e. rodenticides) and of crop yield losses. Support comes in the form of development and knowledge (i.e. experimentation and improvement of the laser system efficacy), trials across a range of crop and pest types in different parts of Europe. These results have been compared to get the results of this project.



Commissioning an autonomic laser system



The agrilaser system is designed for harsh conditions

5. How were the trials done?

Before beginning trials, the trial area was analysed using data gathered from drone flights, camera traps and CCTV. This scoping exercise noted the presence or absence of animals during daylight or at night, and the wildlife crossing areas.

Once we know the crop that needs to be protected and the daily activity of the animals is understood, the Agrilaser technology can be established.

Two types of tests have been performed depending on the laser being used:
a) Handheld laser: In order to find the animal and study the response of the laser with the handheld device the operator either walks with the laser and points the laser in front of the animal visible or waits in a strategic area and points the laser towards them with the laser beam. Both strategies have been applied to this project.

b) Automatic laser device. It is installed in the animal crossing areas. The timing of the laser's activity and its pattern of movement are programmed with a computer at the installation time. Camera traps are hidden in the surroundings to analyse the animals' reactions.

Data was collected in the form of videos and images. After the data has been collected, the videos and the field data are examined, and the animal behaviour and laser responses are evaluated.



Autonomic Laser Fence systems



Using drones to monitor animal presence and behaviour

Handheld Laser Fence system in action





A camera is set to capture the response of the animal in a strategic area

6. Places where the trials were carried out

Trials have been carried out in different areas within the four countries that form the consortium.

LJMU

4 trial sites in UK

- Rats and mice
- Rabbits
- Badgers

GWSDF

1 trial site in UK

- Rats and mice
- Rabbits

BCG

1 trial site in Germany

- Deers & wild boars
- Foxes

Angel Camacho

3 trial sites in Spain

- Rats and mice
- Rabbits
- Birds

Volterra

1 trial site in Spain

- Deers & wild boars
- Foxes
- Wolves

IRIS

1 trial site in Spain

- Deers & wild boars
- Foxes








7. Results

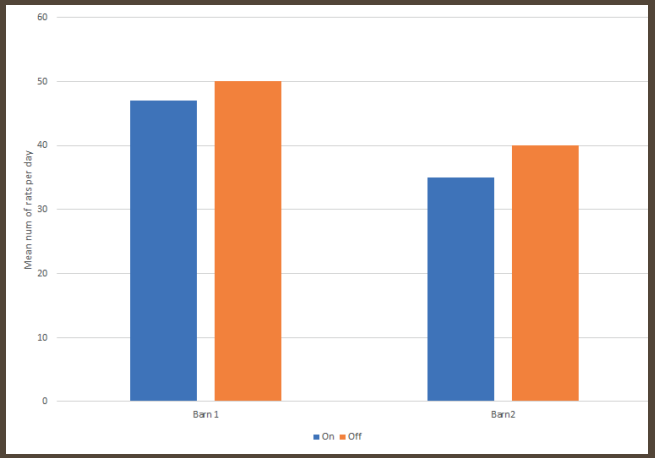
The results obtained vary depending on the area in which the tests have been performed and the animal that has been studied. This section describes some key trials. They were conducted on the partner sites and are grouped by target species.

Three main responses have been observed:

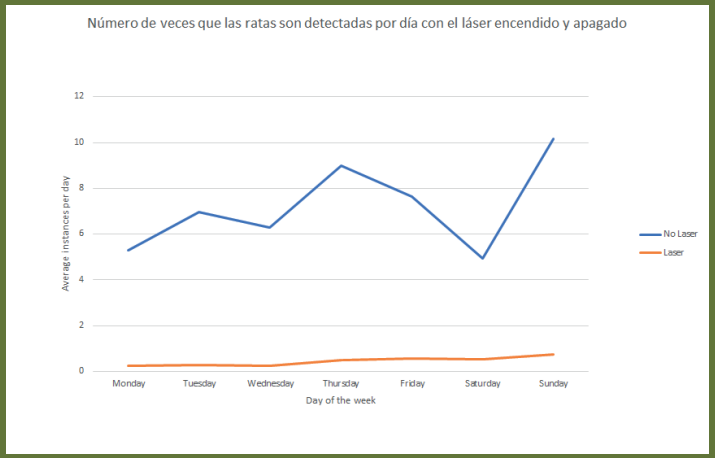


Rats and mice

GWSDF has performed tests with the automatic laser. During the months of the experiment, a reduction in activity has been seen in rats, although these values have not been statistically significant.



The tests performed in Angel Camacho farm show a quite low response to the laser, about 5%.



LMJU has observed a lower activity of the rats when the laser was on.

Rabbits

LJMU has tested with the rabbits in Bickley Hall. The analysis of the videos suggests:

1) Grass height data indicates a temporary reduction in grazing activity with laser exposure
2) The presence of the laser beam appeared to create more activity, less resting and less foraging, particularly at night – the rabbits were unsettled by the presence of the laser
3) Rabbits were more likely to ignore the laser during daylight
4) Interaction rate remains low



Protecting farm buildings from animal incursion

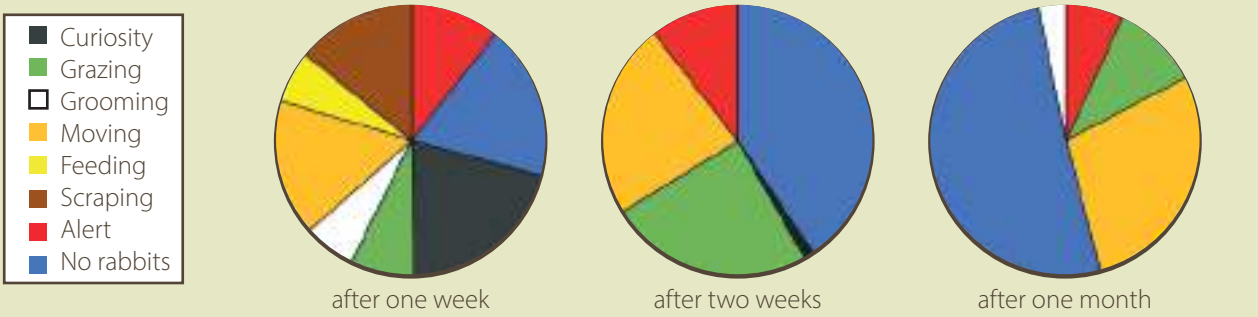




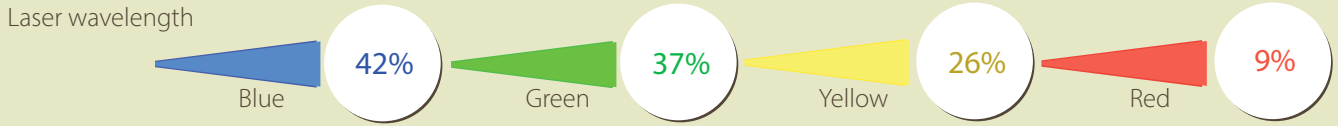
Trials on rabbits in Cucanoche farm

Here we have behavioural responses to the 250mW green laser beam at Bickley Hall Farm at the start of the trial in July 2017. When the laser treatment is applied over long periods of time, less rabbit activity can be observed, this happens gradually. `

Rabbit behaviours in camera trap videos autonomic Agrilaser installation with beam on 11 pm to 6 am



GWSDF obtained promising results. The dispersion percentage of different laser beams were:



However, in Angel Camacho trials, much lower responses were found for the green, blue and yellow, 5-10%. Autonomic trials were conducted on sunflower plots to see if the laser had an impact on the yield. At harvest in September, no significant difference in yield could be determined.

Badgers

Badger tests have been developed by LMJU. Two types of tests have been carried out:
a) Preparing a bait to which the animal goes and is targeted with the laser
b) When the animal is moving in an open field

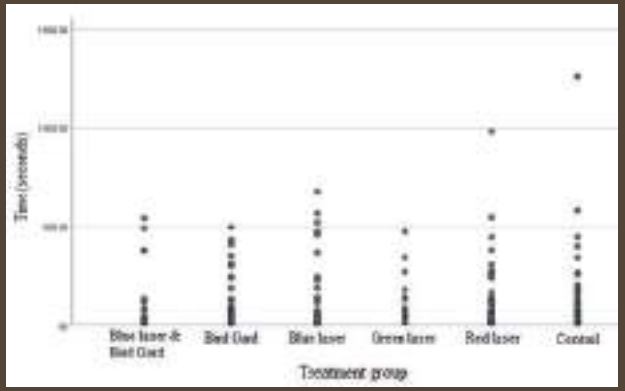
The impact of the laser on badger movements depends on the perceived risk/reward for the badger. The laser has been much more effective when the badgers were not close to the bait and felt more exposed. Since the bait does not occur naturally and was specifically designed to attract badgers to an area, the effectiveness of the laser to remove badgers in a natural environment and on farmland would be quite high.

Grey squirrels

Grey squirrels' reaction to the laser have been tested at the Welsh Mountain Zoo. This invasive squirrel species is occupying the ecological niches of the red squirrel leading this species to a drastic reduction in its population.

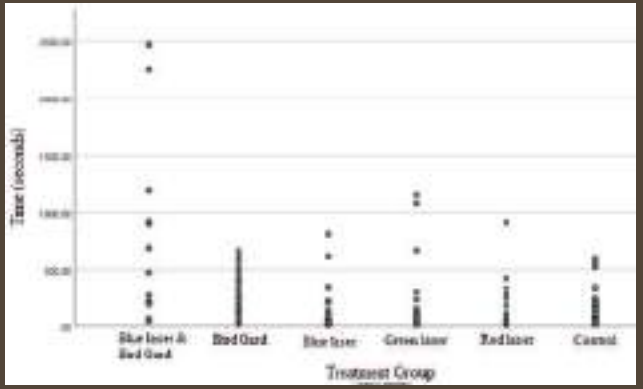
For this species, tests have been carried out with hand lasers of different wavelengths. This graphic shows the time it takes for an animal to leave the bait stations when the laser is activated. Control and the red laser are those that have a longer visit time, this may indicate that squirrels are not sensitive to red light.

The graph shows the time it takes for squirrels to return to the bait station. The highest return times are given with the combination of the blue laser and a random sound generator (Bird Guard).



A scatter plot of time taken (seconds) to leave bait by grey squirrels for each laser treatment group

A scatter plot of time taken (seconds) for grey squirrels to return to the bait station for each treatment group



Deer and wild boar

The trials with deer and boar have been very difficult to carry out since both animals are very skittish and it is not easy to see them. Trials with them have been very complicated and their reactions are complex to analyse.





Laser trials with deer



8. Dissemination

During the project, a significant number of dissemination and communication activities have been carried out in order to let people know about the project. The main objective of these activities was to show the great environmental problems that many of the chemicals that are used in agriculture are causing, as well as to demonstrate that there are more environmentally, socially and economically more advantageous solutions.

• Dissemination of results in different events, to at least 2400 people within the European Union.

• High participation in events and conferences on issues about the decrease of pesticides in agriculture, the use of new technologies for pest control.

• Events to inform the local population within the agri-food sector.

• Organization of a technical seminar in Seville and Final Conference in Liverpool aimed at an audience with technical and scientific knowledge.

• Active participation in international fairs (Red Squirrel Union Knowledge Fair, Pest Tech), where they showed Agrilaser technology in mammals.

• 2 scientific articles have been written based on the results obtained in the project.

• 2 press releases were made with a great media impact internationally.

• The digital platforms have been actively reaching around 8,000 visits both on social networks and on the website.

• Creation and publication of videos about project activities. A YouTube channel has been created so that everyone has access to the results that are being obtained with the laser.

• Meetings and contacts made with different actors (more than 180 people) involved in different LIFE projects.









9. Conclusions

• It has been observed that, for almost all animal species studied, the greatest effect caused by being approached by the laser is not that they run away from the area, but that they do not return to it. In the long term will result in a minimal impact of the animals on the crops that are intended to be protected with Agrilaser technology.

• The amount of herbicides and pesticides used in crop fields and their impact on birds can be reduced.

• The loss of pasture has decreased due to a reduction of animals returning to a plot where a laser has been perceived.

• The CO2 emissions caused by the generation of pesticides would be decreased and there is an increase in carbon sequestration due to the improved state of the soil and vegetation.

• The interest and knowledge of both farmers and the general public of the damage caused by pesticides in both the environment and human health; and the importance of seeking sustainable alternatives to these products, has grown.



10. The LIFE Programme



This Project is co-financed by the European Union through the LIFE Programme.

LIFE is the EU´s financial instrument supporting environmental and nature conservation projects throughout the EU as well as in some candidates, acceding and neighbouring countries. Since 1992, LIFE has co-financed some 4,600 projects, contributing approximately 6 billion euros to the protection of the environment.

LIFE15 ENV/UK/000386 **LASER FENCE**

Laser systems for the prevention of food chain poisoning and minimization of chemical exposure to the environment LIFE15 ENV/UK/000386

Total project budget: 3,135,928 Euro
EU financial contribution requested: 1,777,985 Euro

(Duration: 01/09/2016– 30/06/2020)

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11. Partners

Liverpool John Moores University. Project coordinator. Work in different trial sites, data gathering and results analysis.

Bird Control Group. Providers of Agrilaser technology. Improvement and adaptation of laser technology to the project.

Grupo Ángel Camacho. Includes Cucanoche, Eoloarroz and Cuartezola trial sites. Data gathering and result analysis in Spain.

Game and Wildlife Conservation Trust (GWSDF). Trial site focus on conservation activities at their demonstration farm in Aboyne. Data gathering and result analysis in Scotland.

IRIS. Drone flights, animal monitoring. Trials in Spain.

Volterra. Technical asistance of trials in Spain. Coordination and dissemination of results.

