A service which predicts the arrival of insect pests is helping gardeners to protect their produce and reduce chemical pesticide use.

Dr Daniel Kudenko from the University of York and Dr Paul Holloway, now at University College Cork, used geographical and temporal data from the Rothamsted Insect Survey (RIS) and large-scale citizen science project The Big Bug Hunt to develop a predictive model of insect migrations. Using this model, the pest prediction service alerts users of predicted outbreaks, enabling them to implement biological control measures in advance.

Gardening app developer Growing Interactive will incorporate the service into their existing Garden Planner app and anticipate a 33-43% increase in revenue.

Data collected via a citizen science initiative has been used to create a pest prediction service to help home gardeners protect their produce and reduce chemical pesticide use.

Using the past to predict the future

While the Big Bug Hunt was running, Kudenko used data from the Rothamsted Insect Survey (RIS)⁶, a long-running National Capability funded by BBSRC, to develop the insect prediction methodology. RIS collects geographical and temporal data about insects across the country, which provides information to farmers, crop consultants and industry to reduce insecticide use. Collaborating with Rothamsted Research provided the team with 30 years of aphid flight data from across the UK.

First the team developed a large-scale citizen science project called the Big Bug Hunt⁵, an international initiative which invites gardeners to report insect sightings. Since its launch in 2015, the Big Bug Hunt has received over 30,000 reports. The initiative has also sparked the formation of an amateur entomologist community through its associated Facebook page, which Dore believes is linked to an increased awareness of wildlife and environmental issues. "Regular newspapers and news channels are now covering insect decline and the plight of bees, so the Big Bug Hunt was perfectly timed," he says. "That interest and coverage is still growing and probably will keep growing as people are becoming more environmentally conscious."

Crowdsourcing data

Dore and Kudenko met at a conference for app developers, where they discussed the idea of a pest prediction service built on machine learning. Together they applied for funding through a Data Exploration initiative led by Innovate UK, securing them £200,000 investment from BBSRC and Innovate UK³⁴. Their project commenced in 2014.

Machine learning saves gardeners’ plants from pests

Gardening app developer Growing Interactive³ collaborated with machine learning expert Dr Daniel Kudenko at the University of York, with funding from BBSRC and Innovate UK. Growing Interactive was established 11 years ago and creates innovative gardening apps to help home-growers plan and grow edible crops, ornamental plants and annual flowers. Their software and apps have over a quarter of a million users, making their apps the leaders in the field.

The new pest prediction service will be incorporated into their existing Garden Planner app², which guides gardeners on the best locations for their plants and sends a to-do list each week. The new feature sends alerts when pests are expected in their area so that gardeners can take action to protect their crops in advance, without using chemical pesticides. "We heard consistently from our customers that pests were an issue," explains Jeremy Dore, founder of Growing Interactive. "They could get everything planned out and grown beautifully, but a week before harvest time a pest could destroy everything, which is devastating."

IMPACT SUMMARY

A service which predicts the arrival of insect pests is helping gardeners to protect their produce and reduce chemical pesticide use.

Dr Daniel Kudenko from the University of York and Dr Paul Holloway, now at University College Cork, used geographical and temporal data from the Rothamsted Insect Survey (RIS) and large-scale citizen science project The Big Bug Hunt to develop a predictive model of insect migrations. Using this model, the pest prediction service alerts users of predicted outbreaks, enabling them to implement biological control measures in advance.

Crowdsourcing data Dore and Kudenko met at a conference for app developers, where they discussed the idea of a pest prediction service built on machine learning. Together they applied for funding through a Data Exploration initiative led by Innovate UK, securing them £200,000 investment from BBSRC and Innovate UK³⁴. Their project commenced in 2014.

First the team developed a large-scale citizen science project called the Big Bug Hunt⁵, an international initiative which invites gardeners to report insect sightings. Since its launch in 2015, the Big Bug Hunt has received over 30,000 reports. The initiative has also sparked the formation of an amateur entomologist community through its associated Facebook page, which Dore believes is linked to an increased awareness of wildlife and environmental issues. "Regular newspapers and news channels are now covering insect decline and the plight of bees, so the Big Bug Hunt was perfectly timed," he says. "That interest and coverage is still growing and probably will keep growing as people are becoming more environmentally conscious."

Using the past to predict the future

While the Big Bug Hunt was running, Kudenko used data from the Rothamsted Insect Survey (RIS)⁶, a long-running National Capability funded by BBSRC, to develop the insect prediction methodology. RIS collects geographical and temporal data about insects across the country, which provides information to farmers, crop consultants and industry to reduce insecticide use. Collaborating with Rothamsted Research provided the team with 30 years of aphid flight data from across the UK.

With this dataset, Kudenko and Dr Paul Holloway (now at University College Cork, Ireland) used machine learning to predict how garden pests might spread, based on previous years’ patterns and meteorological data used machine learning to predict how garden pests might spread, based on previous years’ patterns and meteorological data. "With machine learning, you try to extract hypotheses or facts about the world and the 30 years of aphid flight data from the Rothamsted Insect Survey’s suction trap network was used to develop the pest prediction model. Image: Laurence Livermore, Flickr.

Damage from a cabbage white caterpillar. Growing Interactive’s pest prediction service will help prevent sights like this for gardeners. Image: GrowVeg.co.uk.
Environment from data and experience,” says Kudenko. “In this case we wanted to look at observation data of various garden pests and insects and, together with data about the weather, create a model or hypothesis that would help us to predict where these insects will spread over time in the future.”

The new automated methodology identified which environmental conditions best predict ecological changes, such as insect migration. With this information, the model predicted aphid movements with an average accuracy of 86%, rising to 94% for some species. The York team’s model improved on RIS’s own predictions of aphid first flight patterns and dates by around 20%.

Once the Big Bug Hunt had gathered enough reports, Kudenko then tested the model on other species such as the Japanese beetle, a serious garden pest in the US. The team had a good dataset of Japanese beetle observations from the Big Bug Hunt thanks to Growing Interactive’s US customers, which allowed them to verify that the model worked just as well for other insects.

Using this predictive model, Growing Interactive have developed a traffic light-style warning system for its subscribers. The risk of common garden pests arriving in a user’s area is shown as green, amber or red in their weekly updates, enabling gardeners to use organic control methods, such as protective netting, which often need to be implemented in advance of outbreaks to achieve best results. This will prevent fresh produce wastage and reduce reliance on chemical pesticides, in turn reducing waste and pollution.

“In the last 10 years there has been a huge resurgence of interest in gardening, particularly in organic growing, home gardens, reducing food miles and growing without pesticides,” says Dore. This means a new generation of gardeners is seeking modern and convenient ways to learn about gardening and how to do so in an eco-friendly way. The Garden Planner app and pest prediction service is filling this gap in the market.

Pest prediction systems already exist in big agriculture for corn, soy and wheat crops, but this is the first warning system available for gardeners. The existing Garden Planner app has been used by several hundred thousand people, and the new service is expected to bring a 33-43% increase in revenue to Growing Interactive through increased subscriptions. If successful, Growing Interactive anticipate rolling the service out to small-scale farmers in the future.

The Big Bug Hunt has been so successful that the company intends to run it for many years to come. “When it comes to machine learning, collecting as much data as possible over as many seasons as possible is key to accuracy,” says Dore. “We have been delighted with the enthusiastic response from gardeners around the world, and the partnership with the University of York through BBSRC and Innovate UK has enabled us to make the most of this extensive data.”