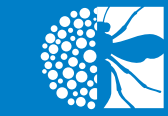

nEUROSTRESSPEP

Developing novel biocontrol agents for insect pests from neuroendocrinology

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University of Glasgow

nEUROSTRESSPEP
Programme Co-ordinator
Professor Shireen Davies
University of Glasgow

The Consortium

The consortium comprises world-leading researchers, European companies, government agencies and knowledge sharing networks, in this unique international collaboration. The project will benefit from the expertise of neuroscientists, ecologists, entomologists, biochemists, chemists, physiologists, commercial companies, as well as communication and dissemination experts.

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Key stakeholder:
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nEUROSTRESSPEP is a Horizon 2020 project, funded by the European Union

nEUROSTRESSPEP explained

nEUROSTRESSPEP is a Horizon 2020 project, funded by the European Union. The consortium of 14 partners, covering the full spectrum from research lab to test field, has the common goal of identifying new, more specific and 'greener' ways of controlling pest insect populations.

The project uses cutting-edge scientific advances on targeted approaches to combat insects that cause severe damage to vitally important EU and global crops. This meets the urgent need for novel, specific approaches to control insect pests in light of the increased prevalence of insect resistance to existing pesticides, as well as forthcoming legislation, which will limit the use of current insecticides. The project develops novel, insect species-specific biocontrol agents based on the use of peptides that interfere with pest insect neurological functions while leaving non-pest species unaffected.

There are two parts to the project:

1. The rational design of neuropeptide hormone analogues for use in crop treatment
2. The employment of genetic approaches to reduce insect pest populations

Initially, these agents will be used to demonstrate laboratory-based proof of principle. They will then be extended to semi-field and forest trials based on user need, employing a market driven approach. These novel agents will target specific pest insects of cereals, horticultural crops, vegetables and forestry.

In addition, these agents will be designed to break down rapidly and therefore will not have any actual or potentially harmful effects on humans or the environment.

Aims and outcomes

nEUROSTRESSPEP aims to develop innovative and specific insect pest control solutions for agriculture, horticulture, and forestry. Novel approaches developed by the project will act to preserve and increase crop yields where insect predation is a challenge while reducing the environmental impact of agricultural production. This will provide a cost effective and efficient way to control insect pests, including emergent, non-native and invasive insect species, while more effectively preserving limited natural resources. This will also increase agricultural productivity and improve food quality. By being more selective and thus having a lower environmental footprint, the solutions will address issues related to legislation for chemical control agents, the protection of beneficial insects, insecticide resistance, and environmental sustainability.

The project will deliver:

1. Data and methodology towards the development of novel, ‘green’ insect pest biocontrol products
2. Prototype biopesticides for selective insect pest control
3. Increased innovation capacity and the integration of new knowledge, strengthening the competitiveness of the EU agri-food industry
4. Company growth by developing innovations that meet the needs of European and global markets

25 researchers
are working and training in internationally renowned centres of excellence offering state-of-the-art training not available elsewhere

What we do

nEUROSTRESSPEP is a Research and Innovation project, generating new knowledge and new technologies from fundamental research and exploring the feasibility of these new approaches in the laboratory, under glasshouse conditions, and in the field.

nEUROSTRESSPEP is also delivering training and professional development to its participants. Twenty five researchers are working and training in internationally renowned centres of excellence offering State-of-the-Art training not available elsewhere. This is essential for ensuring a pipeline of knowledge and innovation, thereby leading to the success and growth of the current and future EU economy.

This project is multidisciplinary in nature, including neuroscientists, ecologists, entomologists, biochemists, chemists, physiologists, commercial companies and translational research expertise. This academic-industrial setting supports competitive European research, and facilitates collaborative links between consortium participants and other stakeholders.

Project partners are sharing new knowledge as well as gathering input from future users of this innovative technology to ensure that project outcomes are fully exploited. Project partners present research outcomes at scientific conferences, agricultural and trade shows and events, through a dedicated project website and social media, as well as via targeted one-to-one meetings.

The science & technology

The project is deploying a dual approach - based on neuroendocrinological and genetic approaches - to develop neuropeptide analogues that specifically target selected insects while leaving beneficial insects unaffected.

Hormonal neuropeptides regulate many aspects of insect physiology and development, including feeding, growth, and reproductive behaviour. Understanding neuroendocrine control of physiology, response to environmental stress and behaviour across insect species also provides routes for insect control via development and application of neuropeptide mimics (analogues) for field application. These will selectively disrupt specific physiological processes, and thus reduce survival and reproduction of target (pest) species. Development of such neuropeptide analogues thus allow for novel, environmentally sound strategies for controlling some of the world's most serious insect pests.

A complementary approach includes the development of male insects that have been genetically altered so that they are unable to produce biologically active neuropeptides under specific conditions, leading to reduced fitness or death. If the wild population is inundated by these modified male insects, with the aim of mating with wild 'normal' females, resultant offspring will contain the defect and can thus be controlled in the same way as the male parent. Many genetic pest management tools have a conditional expression system or sensor operably linked to an effector molecule, in pest insects this is often a lethal effector.

Both approaches can be effectively deployed across multiple target pest species and will not affect beneficial insects.

Making a difference

Society requires farmers to produce sufficient food at an affordable price, this is becoming increasingly challenging with the existing and growing pest and disease pressure, and reduced availability of regulated pesticides. At present, we lose at least 20% or our world productivity to insect attack. Currently, 108 insecticides are authorized in the EU, of which 93 insecticides were approved in the last ten years. From these, 89 will expire in the next ten years, 72 within the next five years, while 43 within the next two.[1]

In addition to this, more than 500 arthropod pests worldwide have developed resistance to insecticides in the last 50 years.[2]

The overall costs of discovery and development of a new crop protection product increased from €115m in 1995 to €215m in 2014. This is likely due to greater complexity in the data requirements of regulatory bodies, although could also be indicative of the time requirement to satisfy regulators.[3] These factors represent a serious global threat to plant protection in agriculture, horticulture and forestry.

The European Directive 2009/128/EC aims to achieve the sustainable use of pesticides in the EU by reducing the risks and impacts of pesticide use on human health and the environment. The directive also aims to promote the use of Integrated Pest Management (IPM) and alternative approaches or techniques, such as non-chemical alternatives to pesticides. This project addresses the needs of the European farming sector by developing alternative approaches to insect pest control which will also be relevant for emergent, non-native and invasive insect species. The key initial

20%

At present, we lose at least 20% of our world productivity to insect attack

beneficiaries will be growers in the three key sectors - agriculture, horticulture and forestry. nEUROSTRESSPEP will have a real societal impact by developing solutions for food and timber production, and the environment. Consumers are increasingly aware of what is in their food and there is a growing movement to limit the use of all chemical interventions.

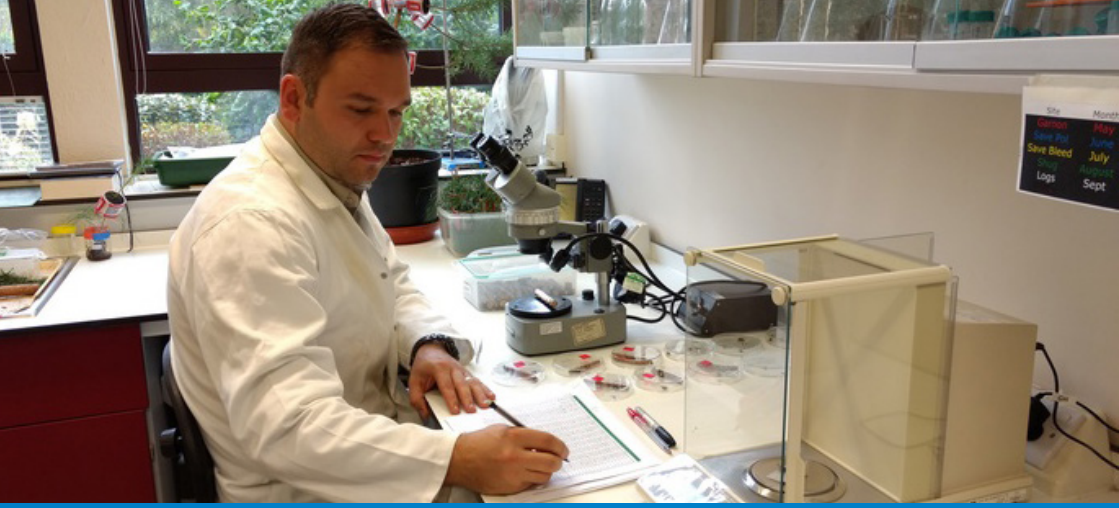
Sustained interaction between the general public, farmers, growers, policy makers, scientists, and industry will help fill gaps in our knowledge, and in doing so, will influence effective policy design.

nEUROSTRESSPEP will strengthen the competitiveness and growth of companies by generating new foundational knowledge, new paradigms concerning pest management, and communicating both this knowledge and market needs up and down the agri-food innovation value chain. The breadth of specialist input assembled in nEUROSTRESSPEP is far beyond the resources of any individual company. The exploitation of this expertise will allow industry to benefit economically from the technology, while enhancing their R&D and technology base.

1 EU-Pesticides Database. Accessed via http://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.selection&language=EN on 9 February, 2018

2 CropLife International, April 2007. Insecticide Resistance Action Committee. Resistance Management for Sustainable Agriculture and Improved Public Health. Accessed via http://www.irac-online.org/documents/irac-croplife-irm-booklet/

3 Phillips Mc Dougall, March 2016. Agrochemical Research and development: The Cost of New Product Discovery, Development and Registration and Industry R&D expenditure in 2014 and expectations for 2019. Accessed via http://www.ecpa.eu/sites/default/files/R-and-D_report_2016_FINAL_revised_2016-04-13.pdf on 9 February 2018



Next steps

nEUROSTRESSPEP is a four-year Horizon 2020 project (1st June 2015 to 31st May 2019) with the ultimate aim of progressing developments from the laboratory to the field. Our partners cover the full range of expertise, from world-leading neuropeptide specialists, to SMEs, to field trial specialists and end-user consortia. By the end of the programme, we aim to have new, rationally designed and selective peptides in field trials.

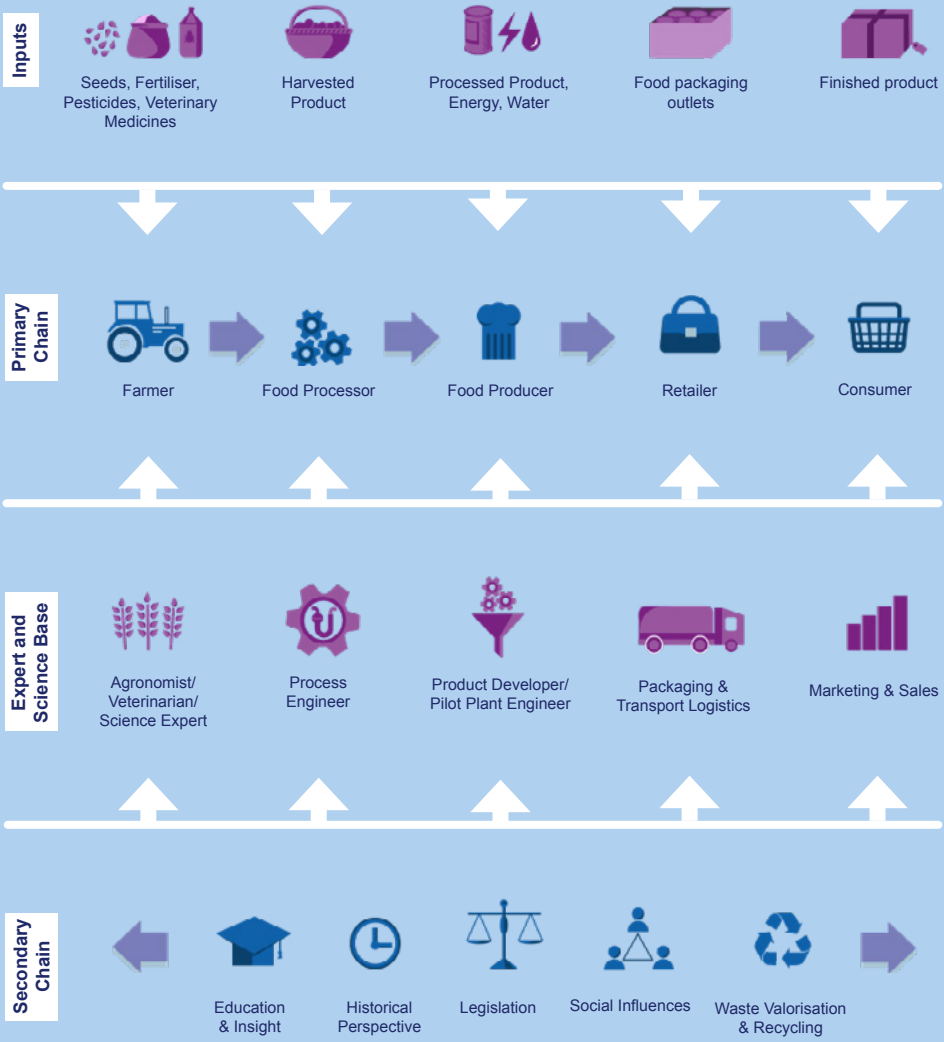
Project partners are seeking to engage with representatives of the entire agri-food supply chain (growers and producers, agrochemical companies, scientific community, consumer groups, NGOs, regulatory bodies, media and publicity channels) to share new knowledge, as well as gather inputs from the future users of this innovative technology. This will ensure maximal exploitation of project outcomes.

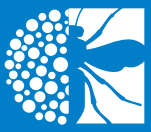
Key challenges to successful commercial exploitation include:

- Intended markets (crops, countries, regions or priority)
- Acceptance and intended use by growers
- Acceptance by consumers
- Regulatory issues
- Understanding other potential barriers to adoption

nEUROSTRESSPEP has established a project User Group representing a variety of stakeholders in the agri-food supply chain, and has identified key named contacts at all relevant organisations. The group will conduct a number of activities to better understand opportunities and barriers to the successful exploitation of these novel approaches.

Agri-food supply chain©KTN





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