

Results of competition:

Engineering solutions to enhance agrifood production – Collaborative R&D

Total available funding for this competition was £13m from the Biotechnology and Biological Sciences Research Council, the Department for Environment, Food and Rural Affairs and the Technology Strategy Board.

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
BerryGardens Growers Ltd (lead) Chelsea Technologies Group Limited East Malling Research East Malling Services Limited G's Fresh Limited Househam Sprayers Limited Norman Collett Limited	Hand-held imaging fluorometer for measuring and optimising spray deposits	£946,246	£662,264
Project description - provided by applicants			
<p>A hand-held device that measures spray deposits on crops, so that they can be rapidly quantified by spray operators in the field, will be developed. This will enable spray operators to determine and optimise sprayer performance eg according to crop structure, growth and weather conditions, as well as quality-assure spray applications and check for off-target contamination. Spray deposits from best-practice spray applications will be benchmarked in a wide range of UK horticultural crops at different growth stages.</p> <p>Business opportunities are: 1) sales of the device to the mass market of spray operators, consultants and researchers in the UK, then worldwide. 2) improving sprayer performance for the UK producer and marketing organisation partners in the project, whose grower members are leading UK horticultural producers. They will set new standards of best practice for spraying UK horticultural crops, and this new technology will readily transfer throughout agriculture and horticulture.</p>			

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Big Bale Company (South) Limited (lead) Harper Adams University	The industrial research and development of a bale-handling and logistical management tool that will work in line with a Controlled Traffic Farming system	£822,144	£577,271
Project description - provided by applicants			
<p>The proposed project is seeking funding to aid with industrial research for a bale-handling and logistical management tool that will work in line with a Controlled Traffic Farming (CTF) system. It will be designed around the Big Bale Transtacker and will apply automation, Global Positioning System (GPS) tagging and location technologies, as well as route-planning algorithms, to the development of an automated machinery system for collecting and transporting straw bales within CTF-managed arable fields.</p> <p>At present there is no machinery available that can economically remove cereal straw from CTF-managed fields. This is one of the biggest barriers preventing significant numbers of farmers from adopting CTF, as they stand to lose £57.25/ha rather than make £73.52/ha profit if they cannot sell their straw. Research suggests that if a solution to this problem were found, arable farmers could adopt CTF and see their cereal yields increase by 10 – 15% and their cultivation costs reduce by 60 – 70%. The project is to research and develop an innovative technological solution to address this problem, thereby creating new markets both in the UK and abroad.</p>			

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Cascade Technologies Limited (lead) BerryGardens Growers Ltd Cranfield University East Malling Research	Non-invasive photonic sensors for detection of latent fungal infections and internal rot or disorders in fruit	£1,031,009	£738,001
Project description - provided by applicants			
<p>This project aims to develop a new form of non-invasive, real-time quality control system to improve production efficiency in agrifood industries. A new type of optical-based analyser will be developed, which will be able to differentiate between healthy fruit, and fruit with internal disorders such as rot or latent infection.</p> <p>The proposed instrument will be easily integrated into existing packaging line systems, and aims to provide early detection of infected or spoiled fruit, so that this fruit can be marketed early or discarded to prevent the further spread of infection. Overall, this type of quality control will result in a new method of crop management, increasing production efficiency and yields, and therefore benefiting the UK and worldwide markets.</p>			

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David Ritchie (Implements) Limited (lead) Harbro Limited InnoVent UK Limited Scotbeef Limited SRUC WM Morrisons Supermarkets PLC	Beef Monitor	£1,315,319	£855,471
Project description - provided by applicants			
<p>This project aims to develop a non-intrusive system which will allow beef finishing units to identify the optimal time to market finished cattle. The system will combine innovative animal handling, automated weighing, image capture and analysis software to provide real-time objective feedback on animal condition, market value and optimal time to take to market.</p> <p>Optimising cattle finishing times allows farmers to achieve maximum marketable yield and profit, by reducing variable costs such as feeding and bedding, and by improving the efficiency of capital resources such as animal housing. Further benefits accrue by reducing the requirement for farm visits by supply chain customers. Environmental impact will be from a reduction in animal greenhouse gas (GHG) emissions through faster finishing times, reducing resources used, and reducing the requirement for farm visits by abattoir staff.</p> <p>The consortium includes David Ritchie (Implements) Ltd, The Harbro Group Ltd, InnoVent UK Ltd, Wm Morrison Supermarkets Ltd, Scotbeef Ltd and SRUC.</p>			

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Environmental Monitoring Solutions Limited (lead) Inex Microtechnology Limited Practical Control Limited University of Sheffield	MultiMEMS – Multiplex MEMS for a step-change in nutrient and pollution monitoring in agricultural environments	£1,435,371	£1,018,980
Project description - provided by applicants			
<p>We propose to deliver a mutliplex mass MEMS-based sensor (MultiMEMS) for the simultaneous detection of phosphate and nitrate in agricultural environments. MultiMEMS delivers a step-change capability to the agri-food supply chain to maximise crop production and profitability, and minimise the negative impacts of modern crop production methods.</p> <p>By reducing the levels of excess fertilisers and pesticides, MultiMEMS not only enables crop farmers to optimise expenditure on chemicals to improve yield, but it simultaneously ensures the minimisation of environmental impact by reducing leaching of nitrates and phosphates into water courses and aquifers. The leaching of agriculture-derived compounds into aquatic environments is harmful, not only to fresh water supplies and potable water, but also to aquatic health. MultiMEMS is a versatile and readily deployable continuous monitoring package that enables the minimal use of fertilisers and provides crop protection, whilst enhancing water and soil management techniques by recording and transmitting real-time pollution values, reducing the operational expenditure of nutrients required per crop cycle.</p>			

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Eozone Engineering Ltd (lead) Agriculture & Horticulture Development Board Branston Limited Tong Engineering Ltd The Technology Research Centre Ltd	A novel polymer bead-enabled ozone washing process to reduce the prevalence of potato soft rot in storage - OZONE-BEAD-WASH	£608,909	£433,003
Project description - provided by applicants			
<p>Soft rot, a bacterial infection of potato tubers, leads to large losses for the industry along the storage and supply chain. The current washing processes cannot guarantee the removal of the bacteria in some circumstances, and so this project aims to develop a more effective cleaning system. The new system combines treatment with ozone (an active form of oxygen that is an effective and low-residue sanitiser, frequently used in drinking water treatment systems) with an innovative segregation and soft handling system that is designed to minimise damage to the potato skins and to transport ozonised water to the tuber surface, where it wipes off soils and sanitises more effectively.</p> <p>This industry-led project combines some of the UK's leading companies in the fields of ozone treatment, polymer development, agricultural engineering and potato packing with scientific support from the Potato Council's Sutton Bridge research facility. We aim to be able to reduce soft rot by 50%, which could save the UK industry up to £100m in waste costs.</p>			

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G's Fresh Limited (lead) Delta-T Devices Limited East Malling Research	Precision irrigation of the mushroom crop using electronic moisture sensors	£553,743	£366,328
Project description - provided by applicants			
<p>Application of correct amounts of water to the mushroom crop at suitable intervals is essential in obtaining high yields and quality, and avoiding bacterial blotch disease. Although automated irrigation systems can apply known volumes of water to the surface 'casing' layer, the decision to apply water is subjective, depending on visual observation of the crop and 'feel' of the casing, while the moisture status of the underlying compost remains unknown. This three-year project will be based at an industry-leading mushroom production unit, G's May Farm in Cambridgeshire.</p> <p>The project will utilise new electronic matric potential sensors from Delta-T Devices, which operate in high-moisture substrates and will introduce precise, sensor-controlled irrigation to the two substrate layers in mushroom cultivation. This will lead to improved yields of higher-quality mushrooms, with less crop and water wastage compared with subjective watering systems involving human operator judgement and error. East Malling Research will provide expertise to the project in irrigation technology and mushroom cropping, and quality and disease control.</p>			

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Househam Sprayers Limited (lead) Farmade Management Systems Limited NIAB	Smart Sprayer – Dose Control	£320,330	£228,664
Project description - provided by applicants			
<p>The project aims to develop an innovative control system for a field crop sprayer that is able to deliver accurate doses across a field with modern, large-scale equipment operating at high work rates. The work will involve quantifying the limitations in current technology, designing, developing and implementing a new control system that involves integrating state-of-the-art hardware with innovative software strategies, testing the system’s performance and validating the benefits, and integrating with farm management software.</p> <p>The project is led by a UK sprayer manufacturer who aims to increase their ability to compete in a world market, has a research partner with expertise in pesticide application, sprayer control and precision agriculture who can provide independent testing and validation and dissemination of results, and a manufacturer of farm management software to ensure integration of the system to maximise uptake.</p> <p>A successful project will ensure major improvements in the accuracy of pesticide delivery, increasing the efficiency of the operation, maximising the performance of plant protection products and reducing environmental impacts.</p>			

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IceRobotics Ltd (lead) Dairy Crest Harper Adams University Kingshay Farming and Conservation	Dairy Animal Sensor Integrated Engineering	£1,739,154	£1,189,648
Project description - provided by applicants			
<p>This project is a collaboration between Harper Adams University and three progressive British enterprises: sensor manufacturer IceRobotics, dairy consultancy Kingshay, and dairy company Dairy Crest.</p> <p>It will develop a comprehensive sensor-based engineering solution that enables dairy farmers to improve the health and welfare of their cows through timely and reliable alerting of health issues concerning individual animals, enabling them to take swift action to address animal health problems before they become more serious. The system will be designed to integrate as far as possible with existing farm systems and equipment, and will be fully accessible via mobile devices and over the internet. As well as system development, the project will involve field testing on research farms, economic validation on commercial herds, and various communication forums and events for the dairy farming community.</p>			

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<p>Mylnefield Research Services Limited (lead) AHDB Potato Council Delta-T Devices Limited Marks & Spencer PLC Soilessential Limited The James Hutton Institute Thomas Thomson (Blairgowrie) Limited Total Worldfresh Limited</p>	<p>Imaging sensor solutions in the soft fruit industry for high-throughput phenotyping and monitoring of abiotic and biotic stresses for premium variety production and maximised yields</p>	<p>£1,070,848</p>	<p>£694,138</p>
<p>Project description - provided by applicants</p>			
<p>New crop varieties that can tolerate abiotic/biotic stresses are essential for maintaining crop productivity in current and future growing environments. Breeding stress-tolerant crop varieties, however, is limited by the precision and throughput of plant phenotyping.</p> <p>This project will develop and apply a novel tractor-mounted platform for precise and high-throughput field phenotyping of plant stress responses of soft fruit crops using IRT and hyperspectral imaging. It is proposed also to assess the value of canopy imaging as an indirect indicator of abiotic and biotic root stresses. Soft fruit crops such as raspberries can experience multiple stresses in field conditions, including poor soil conditions, variable water availability, and attack by root rot pathogens and root-feeding vine weevil larvae. Phenotyping data will be linked to genetic markers to facilitate breeding of productive, stress-resistant soft fruit varieties. This novel high-throughput phenotyping platform will accelerate the development and release of productive high-quality soft fruit varieties that perform well in sustainable reduced input cropping, and is expected to be valuable for routine monitoring of crops and stress diagnosis.</p>			

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OptiSense Limited (lead) Bayer CropScience Limited Food and Environment Research Agency (FERA) University of Hertfordshire	Improved risk prediction for precision agriculture: automated monitoring of pathogen movement	£982,392	£684,095
Project description - provided by applicants			
<p>National survey data shows that fungicide use on wheat continues to increase despite fluctuations in disease pressure, reaching a 30-year high in 2012 (Defra). Septoria tritici is the most significant foliar disease in UK wheat, causing between £43m to £53m in yield losses annually; control is by fungicide application costing £82m annually (GFK Kynetec 2013). Yellow and brown rust are more sporadic, but cause significant losses in bad years; control relies on preventative spraying.</p> <p>This cross-disciplinary project proposes a precision agriculture solution, developing a field-based instrument for detecting pathogen ingress into crops, and reporting results of pathogen presence into a decision-support tool such as CropMonitor in real time. The proposed instrument will provide growers/agronomists with real-time information on inoculum moving into a crop (rather than symptoms), enabling more effective timing and selection of fungicide application, resulting in better control, increasing yield, and improved environmental stewardship.</p>			

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Ozone Purification Limited (lead) Chafer Machinery Limited NIAB	Electrolysed Water in Crop Protection (EWCROP)	£1,288,132	£921,442
Project description - provided by applicants			
<p>The EWCROP project will demonstrate an innovative, pesticide-free crop treatment using electrolysed water (EW) to reduce disease and pest burdens on high-value crops, lowering the use of various inputs and energy, and improving crop yields. This is designed to provide a new, non-polluting, carbon and water-reducing mechanism to ensure high crop yields even as traditional pesticides are being withdrawn due to EU legislation, or are becoming ineffective due to pathogen resistance.</p> <p>EWCROP will demonstrate these benefits in high-value horticultural crops such as tomatoes, lettuce and potatoes, but its benefits will ultimately extend to a broad range of glasshouse and field-grown crops. The project will support the whole UK agri-food industry, protecting some of the 3.7 million jobs and £91bn GVA created by this sector. The project will involve partners who are leaders in building and testing an EW production and delivery system combining novel EW production, spray delivery systems and scientifically managed crop experiments and trials. As well as building the EW delivery system, the EWCROP project will evaluate and optimise its efficacy for a variety of crop and pathogen species.</p>			

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RAFT Solutions Ltd (lead) 4c Design Cranfield University Midland Pig Producers Limited Newcastle University	Developing a working prototype for sustainable high-welfare intensive pig houses integrated with renewable energy generation to inform innovative commercial products and services	£1,068,135	£764,477
Project description - provided by applicants			
<p>Working with a collaborative partnership including Midland Pig Producers, RAFT Solutions Ltd, 4c Engineering, Ove Arup & Partners Ltd, and the universities of Newcastle and Cranfield, we will develop a working prototype for sustainable high-welfare intensive pig houses integrated with renewable energy generation. The project will develop new techniques and develop existing information from the USA and from human waste and ventilation management to introduce innovative civil, chemical and mechanical engineering solutions to livestock housing.</p> <p>By the end of this 36 month project, we aim to develop commercial products / services for intensive pig housing to include the delivery of manipulable materials to slatted floor systems for the first time to maximise health and welfare and improve feed conversion rates. We aim to develop the innovative use of circular energy management systems to re-use waste heat for associated businesses eg for herb or salad growing, or for other commercial or residential applications, whilst minimising carbon usage and gas emissions, and lowering odours produced by pig production. Thus intensive, efficient yet high-welfare pig units can be built across the world.</p>			

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Rail Vision Europe Limited (lead) BCP Certis Limited Rothamsted Research	Agrivision Inspector – development of a system for low-cost, remotely managed, automated crop stress monitoring and detection in a protected environment using advanced imaging techniques and analytics	£1,572,072	£1,057,590
Project description - provided by applicants			
<p>The project aims to engineer a high-impact advance in crop stress monitoring through the development of a novel, flexible multi-sensor imaging system (HD video, IR, Fluorescence) for application on a mobile platform (manual or robotic), to automatically detect stresses in crops, initially for tomatoes in a protected environment. It is intended to support growers to improve yields whilst also reducing environmental impact and labour intensity. The project builds on recent research into the use of multi-sensors for the detection of crop stresses and the application of advanced image processing analytics to provide an automated crop stress monitoring solution. Trial units will be developed and outputs displayed.</p>			

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Senova Limited (lead) Aberystwyth University GLW Feeds Limited International Innovative Technologies Limited Oat Services Limited Phytatec (UK) Ltd	Development and application of novel dehulling and stabilisation technology to enhance the value of oats as a sustainable feed for ruminants and monogastrics	£827,663	£551,921
Project description - provided by applicants			
<p>Oats are a high-value livestock feed; however, the use of oats has diminished, being replaced by wheat and barley. The fibrous hull of oats reduces their digestibility and nutritional quality. Current methods of removing the husk from the oats (dehulling) are expensive, as they have been developed to remove the husks to a level (>99.5%) required by the human food sector, and they are a ‘bottleneck’ in exploiting oats for livestock feed. For the animal feed sector such levels of removal are less crucial, and so alternative, less expensive dehulling systems may be feasible.</p> <p>This proposal will develop and apply innovative engineering approaches to the development of low-cost and efficient systems of dehulling and stabilising oat grain, to capitalise on the value of the oat grain as a high-quality livestock feed for ruminants and monogastrics, and deliver commercial return to Senova. Differences in ease of dehulling between oat varieties, and impact of dehulling efficiency on feed value, will be measured. The project will also quantify the economic benefit of using the oat husks, currently regarded as a ‘waste’ product, as a source of platform chemicals, adding value to the production chain.</p>			

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Stockbridge Technology Centre Limited (lead) Cranfield University Manterra Limited	Tru-Nject: proximal soil sensing-based variable rate application of subsurface fertiliser injection in vegetable/ combinable crops	£1,409,227	£965,950
Project description - provided by applicants			
<p>Balancing the need to maintain a secure supply of safe nutritious food, whilst minimising environmental impacts caused during crop production, is a challenge requiring sophisticated solutions. Understanding variation in farmland soils is only part of the battle: precise management of that variation to stabilise crop yield, and reducing fertiliser inputs, is the focus of the Tru-Nject system.</p> <p>The Tru-Nject project is a collaboration between Stockbridge Technology Centre, Manterra Ltd, and Cranfield University. It applies engineering and sensor solutions with satellite image data and unique fertiliser placement technology, to assist farmers in making the best decisions for their business and the land on which we depend. Tru-Nject offers a synergy between multiple sources of efficiency: soil data, satellite data, GPS-autosteering and injection of fertiliser below the soil surface, near the roots of a crop. By injecting fertiliser below ground, reduced levels of nitrous oxide gas released from nitrogen fertilisers may be attained, when compared with spreading fertiliser across the soil surface.</p>			

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Syngenta Limited (lead) G's Fresh Limited Harper Adams University University of Manchester	Selective, autonomous weed control using sensors to direct microdroplets and lasers (Project Hyperweeding)	£889,886	£572,794
Project description - provided by applicants			
<p>Weed control is becoming increasingly difficult, due to herbicide-resistant weeds and restriction of herbicides due to higher regulatory demands. In cereals, herbicide-resistant blackgrass is a severe problem, and weed control in minor crops, such as vegetables, is now extremely problematic as older herbicides have been de-registered. There is an urgent need to examine alternative forms of weed control to allow growers to grow crops profitably.</p> <p>A consortium consisting of Syngenta, Harper Adams University, the University of Manchester and G's Fresh has been assembled to undertake a project that will deliver a system which will address these issues. The planned system integrates sensors for real-time crop and weed detection, with targeted micro-droplet application of non-selective herbicides or use of low-power lasers, to create a new and sustainable weed eradication technique. The technology platform will be applicable to all weeds in all crop types, leading to a step-change in weed control for UK growers and major export opportunities.</p>			

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Telemetry Associates Limited (lead) Berryworld Limited Harper Adams University Interface Devices Limited NPL Management Limited The Shadow Robot Company Limited	AUTOPIC – the use of robotic technology for soft fruit picking	£709,015	£463,982
Project description - provided by applicants			
<p>AUTOPIC is a multi-disciplinary project aimed at mechanising the harvesting of soft fruit through the use of autonomous vehicles and robotics. Partners include Harper Adams University, the Shadow Robot Company, Interface Devices Limited, BerryWorld and the National Physical Laboratory.</p> <p>The project is timely since the use of migrant seasonal fruit pickers is no longer supported by the Seasonal Agricultural Workers Scheme, and in general migration is being discouraged by government policy. This has had the net effect of creating a crisis, with insufficient workers to pick the soft fruit we take for granted in our supermarkets, and potential increased reliance on imports. Further, labour issues are not confined to the UK, so that if the project is successful there will be a significant export market for the project outputs. There are likely to be many benefits from the use of the AUTOPIC autonomous vehicle, and its robotics and we believe that the new technology will be transformative for a new UK industry.</p>			