Innovate UK

Results of Competition: Productive and Sustainable Crop and Ruminant Agricultural Systems

Competition Code: 1808_CRD_HLS_AFTFP

Total available funding is £20 million

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
S & A PRODUCE (UK) LIMITED	Blue Planet	£495,609	£247,804
CAPTURE AUTOMATION LIMITED		£228,074	£159,652
Manufacturing Technology Centre		£309,448	£309,448

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Funders Panel Date: 04/12/2018

Project description - provided by applicants
As a leading British and international soft fruit producer, S&A are seeking to enhance productivity through their growing techniques and development of innovative equipment to produce even better fruit that will delight and exceed the expectations of their customers and consumer. Through developing automated technology incorporating machine vision systems, supported by the MTC and Capture Automation, they will improve crop yield and quality within their existing UK farms and translated across their international operations. BluePlanet enables a collaboration between a leading international soft fruit producer (S&A), a specialist SME, Capture Automation, and one of the High Value Manufacturing Catapult centres (MTC). By working with their partners in BluePlanet, S&A will accelerate and de-risk their time to market for new and innovative equipment and allow them to continue to grow and gain market share from their global competitors. Benefits to the end user / customer will be flavour and consistency of fruit whereas benefit to the farmer will be higher quality, yield quantity, growing environment and plant vigour.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
GARFORD FARM MACHINERY LIMITED	Development and field testing of the next generation of vision-guided weeding systems	£320,210	£224,147
SAGA ROBOTICS LIMITED		£369,164	£258,415
University of Lincoln		£214,496	£214,496

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
The current crop production systems have been reliant on the wide-scale application of herbicides to control weeds. However, this approach is not sustainable due to unprecedented regulatory and environmental pressures which place new emphasis on the development of novel techniques to kill weeds. Precision hoeing equipment is a promising alternative but the current systems cannot achieve the accuracy required to completely remove the weed presence from the fields. This project will develop the next generation of robotic weeding machinery, enabling selective and accurate treatment of specific weeds. The proposed technology is a novel combination of unique precision hoe, guided by a vision system based on multi-modal sensing and state-of-the-art machine learning for precise detection and localisation of the weeds. The system will be re-trainable by the end-user and enable rapid deployment of the system and adaptation for various plant types and environmental conditions. The proposed weeding system will be modularised and scalable so it can be deployed both as a tractor-mounted solution building on Garford Farm Machinery's RoboCrop system and on the autonomous mobile robot Thorvald developed by Saga Robotics Ltd. An autonomous weeder can weed at lower speed and with greater precision while enabling continuous 24/7 operation. In addition, it offers a solution for farmers who grow crops in glasshouses or polytunnels where the traditional implements cannot be deployed. The proposed developments will lead to more efficient weeding equipment resulting in better management of weeds and reduced input use, bringing several economic, social and environmental benefits to food producers, sellers and society.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
B-HIVE INNOVATIONS LIMITED	A novel non-destructive solution to quantify and qualify potato crops during growth to realise maximum marketable yield and help to reduce waste - TUBERSCAN	£375,442	£262,809
Harper Adams University		£128,049	£128,049

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Project description - provided by applicants
Determining the correct date on which to harvest potatoes is one of the most critical decisions potato growers must make. If they lift their potatoes too early, they may be below the optimum size resulting in less than the maximum potential output being produced, if they lift them too late, they may be too large to meet buyer specifications significantly devaluing them. Either way the grower loses potential income. Recent research carried out at Harper Adams University (HAU) has shown that it is possible to use new technologies to non-invasively measure the total biomass of potato tubers in the soil. Other ongoing research at the university has also shown that it could well be possible to process images of potato plants to accurately determine the number of tubers each potato plant will produce. The aim of this project is to develop and test an innovative prototype system to measure and map average potato sizes and potato biomass throughout fields. This will enable early interventions and/or selective harvesting to take place, thereby optimising crop yield and resource use. It is anticipated that this technology could generate an estimated 5 - 10% increase in UK marketable potato production at little or no extra cost, whilst assisting with reducing waste throughout the supply chain.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
DOGTOOTH TECHNOLOGIES LIMITED	Idaeus	£588,242	£411,769
DRISCOLL'S GENETICS LIMITED		£100,381	£60,229
HUGH LOWE FARMS LIMITED		£27,749	£13,874

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Project description - provided by applicants
Raspberries are fragile fruits that require significant manual labour to harvest. The raspberry industry has seen significant growth in production due to consumer demand, but the cost and availability of labour is threatening its economic viability. This project will produce a proof of concept raspberry picking robot that will demonstrate the approach required to alleviate this bottleneck in growth of the sector. Building on the cutting edge developments that Dogtooth Technologies has already achieved in bringing to market a commercial strawberry picking robots, this project will continue to push the boundaries of the application of robotics to the needs of the agricultural sector.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
ARWAC LIMITED	Autonomous Robotic Weeder (in) Arable Crops	£426,400	£298,480
University of Lincoln		£140,620	£140,620

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Project description - provided by applicants
The project focuses on the development of an environmentally sensitive mechanical weed control system for use across arable farms in the UK. This is to address the widespread issue of the Blackgrass weed within arable cropping land with a view to providing an alternative method of husbandry to spraying with herbicides. The objectives are to optimise crop production and longer term soil quality through the reduced use of herbicides across arable farm enterprises. Field trials will be employed to test the most effective methods of weed destruction and precision digital mapping of fields will be combined with engineered vehicles to provide a sustainable alternative to herbicidal use bringing financial and environmental improvements to the farming economy in the UK. The project is of significant interest due to national scale of the issue in cultivated land. Some 80% of fields surveyed in England show resistance to the predominant selectively targeted treatments commonly employed by farmers to control the Blackgrass weed. This results in yield impact of up to 12% and costs of circa. £300 per hectare in lost yields and additional spraying control costs. (Source: Hicks, H.L et al.) It is for these reasons that it is considered vital that an alternative to the current range of herbicides be developed for widespread use in the UK arable market. The project is a collaboration between industry specialists and the University of Lincoln with a view to deliver a highly researched and technical machine capable of replacing the existing control treatments through the innovation of market leading technologies.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
FOLIUM FOOD SCIENCE LIMITED	Automated detection, and highly targeted and effective treatment and prevention, of bacterial blight infection in major World Food Crops	£823,938	£576,757
RINICOM LIMITED		£380,764	£266,535
University of East Anglia		£66,693	£66,693

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Food security concerns resulting from incurable bacterial blight is one of the most critical environmental and social issues faced globally. 10% of global crop production is lost to disease costing $220 billion annually. The diversity of crop diseases continues to expand, and new strains are constantly evolving. A study has suggested the loss of major crops to bacterial blight amount to enough to feed nearly 9% of the global population, with these figures set to increase further with the prevalence of climate change and continued heavy metal use on agricultural soil. Despite the urgency and scale of the problem, technological advancements to identify, treat and prevent bacterial blight infection in crops is ineffective, with detection largely reliant on manual processes, therefore timely, unproductive with state-of-the-art imaging technologies not widely adopted due to their cost-ineffectiveness and complicated output. Additionally, there are no current chemical or biological treatments that can cure bacterial infection, they simply slow the spread of the disease. Full plant removal is essential to halt the bacterial spread but is very costly. This collaboration of Folium, Rinicom and the John Innes Centre seeks to overcome limitations of current solutions to deliver the first complete solution to both detect and treat Xanthomonas bacterial blight by developing a dual-purpose drone and novel Guided Biotic treatment to be used as a joint solution. This drone can attach interchangeable payloads with a sensor system and delivery system specifically designed during this project work. This approach will offer: Advanced AI driven image analysis to identify Xanthomonas infection Precise location GPS of infection Associated infected area coordinates Specific spot spray of Guided Biotics (employing delivery system) Treatment/protection of diseased plant only by selected removal of Xanthomonas infections Modulation of signalling pathways to abolish bacterial pathogenicity Enhanced product lifetime due to reduced selective pressure to develop resistance Reduced crop waste Increased crop production system efficiency Improved soil and air quality. With support through Innovate UK, a 24-month programme of research is required to deliver an optimised prototype demonstrated in a crop production

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system. If successful, this solution has the potential to truly revolutionise the future of food security with global exploitation potential (capable of preventing 1.6 million tonnes of waste- cumulative by YR5). The project will deliver significant export led growth for Folium and Rinicom, a substantial ROI, increased employment and further opportunity for R&D investment.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
CLARITY BIOSOLUTIONS LIMITED	Development and validation of an at- or in-line, automated diagnostic system for the cattle industry to improve reproduction and metabolics and reduce associated economic losses	£189,215	£132,450
DAVLEC LIMITED		£144,031	£100,822
RAFT SOLUTIONS LIMITED		£113,127	£79,189

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Project description - provided by applicants
This collaborative project aims to automate the existing ReproTel system, to allow it to be (retro-) fitted to existing and new (semi-)automated and robotic milking parlours. This project will drive productivity in ruminant production systems by enhancing decision support with a technology solution and system, and will deliver social, environmental and economic benefits to the dairy industry.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
PLANT BIOSCIENCE LIMITED	Fertiliser on-farm decision tool: Optimising the use and reducing the environmental burden of fertigation	£121,094	£84,766
John Innes Centre		£323,933	£323,933
ZIMMER AND PEACOCK LIMITED		£1,115,862	£781,103

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Agriculture depends on soil nutrients (primarily nitrogen, phosphorous, and potassium) to optimise plant development and ultimately yield. Soils contain such nutrients naturally, but growing and harvesting crops results in nutrients becoming depleted, leading to plants suffering from nutrient deficiency and decreasing yields. It is therefore crucial for food security and efficient crop production to replace the natural supply of nutrients in the soil to enable the continuous cultivation of crops. These nutrients can be added from a variety of sources - organic matter, chemical fertilisers, and certain plants (as traditionally done by crop rotation) - ensuring maintenance of soil health and fertility, enabling continuous growth of nutritious and healthy crops at high yields. Chemical fertilisers are the most efficient way to supply nutrients to the soil and have the highest cost benefit. Our entire agricultural system depends on the application of fertiliser in one form or another; it would not be possible to maintain the world's population at its current level without it. Especially nitrogen is of prime importance for farmers and food production, as the most important nutrient limiting crop development and yield, and also contributing the largest cost to crop production. However, this nitrogen is rarely efficiently managed; 110 million tons of nitrogen is applied onto fields every year, but only about a quarter of this makes it into plants, partly due to the poor nitrogen use efficiency of crops. Over application of fertiliser results in leaching of this excess into watercourses, and approximately 80 million tons of nitrogen is estimated to flow into the world's waterways every year. General overuse of nitrogen fertiliser and to some lesser extent other nutrients such as phosphate and potassium, causes eutrophication and toxic algal blooms in water systems, leading to death of aquatic organisms from oxygen depletion in the water by the algae. It also promotes denitrification by microorganisms, leading to the release of nitrous oxide, a potent greenhouse gas, into the atmosphere. Production of inorganic fertilisers also requires a large input of energy which further contributes to greenhouse gas emission as well as fossil fuel depletion. This project aims to develop a decision tool that will enable farmers to better optimise the quantity of fertiliser applied to crops, lowering use and increasing the percentage of nutrients taken up by plants and therefore resulting in less nitrogen (and phosphate and potassium) being released into the environment.

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LIBERTY PRODUCE LIMITED	Co-ordinated technology development to provide an optimised and integrated system of leading vertical farming technologies	£177,600	£124,320
CROP HEALTH AND PROTECTION LIMITED		£288,765	£288,765
ECH ENGINEERING LIMITED		£98,023	£68,616
FOTENIX LIMITED		£79,989	£55,992
GROW BRISTOL CIC		£32,251	£22,576
GROWING UNDERGROUND LTD		£0	£0
GROWSTACK LTD		£251,983	£176,388

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GROWUP URBAN FARMS LTD.		£24,103	£16,872
ICENI LABS LIMITED		£164,800	£115,360
Inanovate		£89,694	£62,786
STC RESEARCH FOUNDATION		£59,181	£59,181

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Project description - provided by applicants
Vertical farming (VF) has the potential to revolutionise food production. The industry is experiencing enormous growth, propelled by the increased demand for pesticide-free foods, rising global populations, decreased availability of land and demand for year-round food production worldwide. It delivers numerous benefits versus traditional farming methods including lower water usage, reduced dependence on agrochemicals and the ability to produce high quality, consistent, year-round crop production. Developing the VF sector holds the promise of significant benefits to society and the farming industry. By growing an ever-increasing percentage of the food that we consume in VF systems, pressures on farmland will reduce, and year-round local food production can be enabled while improving the outlook for permanent jobs in the farming sector. However, the industry requires further innovations to reduce operational costs and improve yields to allow it to be commercially viable beyond the production of high-value, niche, crops. VF production systems bring together an array of different technologies, many of which have been adapted from the glasshouse-based horticultural industry. Currently, these technologies have reduced integration and are lacking optimisation for crop yield, quality and control. This project brings together a multidisciplinary consortium of partners, representing a wide range of technologies and expertise, all of whom have significant experience in the VF market. The outcome of the project will be a fully optimised prototype VF growing system. It will offer a high-tech, turn-key solution that will reduce the complexity and costs of building, and adjusting and monitoring for optimal growth conditions in VF production systems. It will provide growers with better control, through data-driven information, and automate responses to changes detected, enabling them to deliver higher quality, higher yield produce, whilst better equipping them to adapt to market demand and reducing the risks of business failures. The technology will facilitate the transfer of scientific knowledge in crop production into benefits for growers. The system will include low-cost LED-lighting, that match ideal growing conditions throughout the plant growth cycle and improved nutrient control and delivery system, for increased plant yield and quality. We will evaluate the feasibility of incorporating vision sensing capabilities at large-scale which can provide valuable real-time feedback on crop health. This, in turn, will allow the development of a decision support system for the automated control of the atmospheric environment. Grower engagement in the development of a single user-friendly control system for control of all operations will be a central outcome.

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PARAGONVET LIMITED	Improving bovine in vitro embryo production through follicular flushing and next generation embryo culture	£339,739	£237,817
Boviteq		£165,838	£0
IMV IMAGING (UK) LTD		£203,372	£122,023
University of Nottingham		£158,229	£158,229

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Significant advances are being made in technologies associated with cattle breeding that seek to improve production efficiency, animal health and welfare whilst minimising environmental impact. These advances are motivated, in part, by the increased global demand for milk and beef, and a public desire that this is achieved in a sustainable manner. This project seeks to develop in vitro embryo production as a tool to facilitate enhanced genetic improvement. Specifically, it will manufacture new equipment to recover more oocytes (eggs) per donor-cow cycle (i.e. via ovarian-follicular flushing) and to create a new generation of improved media for the culture of embryos within the laboratory. Collectively, these technical innovations will increase embryo production efficiency and lead to higher pregnancy rates following transfer. This, in turn, will lead to increased rates of genetic improvement by breeding from only the best cows. Cattle breeders are eager to engage with and utilise this technology in order to improve the health, productivity and efficiency of their herds. This will enable farmers to produce and rear animals more suited to their farming system with greater precision. This will, in turn, reduce demand for resources such as animal feed, fertilisers and pesticides, and a reduction in animal waste and greenhouse gas emissions.

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CAMBRIDGE ANIMAL TECHNOLOGIES LTD	WELL-CALF: precision agricultural solution to improve health and productivity across the dairy-beef sector	£549,486	£384,640
AGRI-EPI CENTRE LIMITED		£48,284	£48,284
CO-OPERATIVE GROUP FOOD LIMITED		£2,131	£0
DUNBIA (ENGLAND)		£168,647	£84,324
PARKLANDS VETERINARY LTD		£24,559	£17,191
SRUC		£209,600	£209,600

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Project description - provided by applicants
This proposed project is focused on developing a precision agriculture technology solution for optimising the production efficiency of the dairy-beef sector, through improvements in health and management throughout life.The product will consist of the following components: 1\. A data collection system integrating different sources of information from across the value chain using novel and advanced sensing and farm records containing the required environment and animal information. 2\. A data analysis platform which will continuously analyse the data sources and provide the appropriate real-time and automated health and performance flags to optimise intervention strategies. 3\. A decision support system to optimise health and management protocols. This will be developed using expert advice from across the supply chain, including veterinary and animal science expertise. The project will develop the first cloud-based decision support platform to support different levels of decision making. This will include farm-level decisions (e.g. health management, nutrition) through to policy and practice decisions at systems level. The project will also develop the first precision agriculture integrated monitoring system specifically designed for calves for the early detection of important diseases such as scour and pneumonia during the rearing period. This will allow for early intervention and optimise treatment and management practices at an individual animal level. The overall aim is to reduce disease incidence and spread, reduce antibiotic usage, improve productivity and optimise efficiency.

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RAFT SOLUTIONS LIMITED	RapiPath: Connecting rapid diagnostic testing with the wider dairy supply chain for improved milk yields, disease surveillance and product assurance	£153,092	£107,164
CIELIVESTOCK LIMITED		£41,573	£41,573
FERA SCIENCE LIMITED		£134,372	£67,186
OPTISENSE LIMITED		£281,951	£197,366
QUALITY MILK MANAGEMENT SERVICES LIMITED		£167,474	£117,232

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Project description - provided by applicants
The use of diagnostics is widely recognised as a powerful tool for improving animal health as well as food hygiene and safety, with a wide variety of diagnostic tests available using a variety of biochemical and physical techniques. However, a common challenge to most diagnostics tools used in agriculture/veterinary medicine is a lack of ability to interface with the entire supply chain, without considerable efforts from the veterinary surgeon or farmer. As a result, massive inefficiencies in logistics, increased wastage and a lack of evidence for key policy making, especially for the dairy industry exist. In this project, the consortium will attempt to a) expand the impact of _currently available_ diagnostic tests, developed by the consortium and designed to help vets choose a suitable treatment outcome, and targetted antibiotic therapy where appropriate and b) create new targeted modules relevant for the dairy industry. By developing a novel hardware and software solution to collate and share diagnostic results, it is hoped that animal health and welfare will be improved and protected, farm productivity maximised through disease reduction and logistical barriers relating to expression of expected milk yield can be overcome.

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IBM UNITED KINGDOM LIMITED	aiScope - AI data platform for smart crop protection	£949,448	£474,724
2 EXCEL GEO LIMITED		£81,408	£48,845
Rothamsted Research		£214,808	£214,808
STFC - Laboratories		£35,416	£35,416
SYNGENTA LIMITED		£48,430	£24,215
University of Sheffield		£203,175	£203,175

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Project description - provided by applicants
This project brings innovative and disruptive technologies together from IBM, Rothamsted Research, The University of Sheffield, 2Excel, STFC-Hartree Centre and Syngenta to transform the crop management market with blackgrass as its first use case. Blackgrass is a weed costing farmers more than £0.58bn/year, however data, management strategies and expertise are fragmented in the agronomy sector, slowing down UK production and competitiveness. This project aims to end this fragmentation through the provisioning of an artificial-intelligence (AI) and Big Data platform approach, where all data and expertise is collated, allowing researchers to create new evidence-based models and offer easy exploitation routes. Our newly-generated blackgrass forecasting models will be served from this platform through targeted apps or integration into existing offerings from agri-service providers. The platform will be built in an open, innovative way to enable collaboration, innovation and ease route to market for generated insights. Such disruptive, data-driven approaches will empower the UK agriculture sector to become world-leaders in the area of smart agriculture.

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HALL MARK MEAT HYGIENE LIMITED	OPTI-BEEF: precision agricultural solution to monitor lifetime productivity and product quality	£399,090	£239,454
AGRI-EPI CENTRE LIMITED		£99,593	£99,593
DAVID RITCHIE (IMPLEMENTS) LIMITED		£255,311	£153,187
HARBRO LIMITED		£85,088	£42,544
HECTARE AGRITECH LIMITED		£124,624	£87,237
INNOVENT TECHNOLOGY LIMITED		£224,184	£156,929
NPL MANAGEMENT LIMITED		£74,944	£74,944
RANDALL PARKER FOODS LIMITED		£78,262	£39,131

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SCOTBEEF LIMITED		£74,525	£37,262
SRUC		£347,308	£347,308

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Project description - provided by applicants
There is currently extensive inefficiency in the UK beef sector. Producers routinely assess the performance of their animals by eye and frequently retain them on farm too long, resulting in animals becoming too fat. This leads to increased variable farm costs, reduced annual capacity of beef finishing units and sub-optimal price paid for carcasses -- for a finishing unit producing 300 animals per year this equates to a cost of £11,400\. Over-fat animals also increase the primary processing costs for abattoirs and have a higher environmental impact per kg of product produced. The price paid to the producer for a beef carcass is also predominantly assessed subjectively by eye. Lack of confidence in the reliability of carcass evaluation makes it difficult to agree quality-based payments that reflect the true value of carcasses. This project aims to develop on-farm and in abattoir technologies to automate and optimise on-farm selection of animals for slaughter and carcass evaluation. The project will integrate automated data gathered across the whole life of individual beef animals (from calf to carcass) to create an enhanced decision support platform to modernise and drive efficiency improvements across the UK beef supply chain.

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Innovate UK

Results of Competition: Productive and Sustainable Crop and Ruminant Agricultural Systems

Competition Code: 1808_CRD_HLS_AFTFP

Total available funding is £20 million

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
PRECISION DECISIONS LIMITED	Hands Free Farm	£655,732	£459,012
AGRI-EPI CENTRE LIMITED		£92,021	£92,021
FARMSCAN AG LIMITED		£670,528	£469,370
Harper Adams University		£504,350	£504,350
N Blacker & Son		£76,016	£53,211

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Hands Free Farm is a collaborative industrial research project aiming to create the technologies required to operate a farm autonomously building on experience, criticism and learning from the Hands Free Hectare. This project will develop swarm robotic skills, smart machines and implements, providing a platform to evaluate technology development and economic studies to build the business case for robotic systems in agriculture. Developing practical solutions that are suitable for use on farm by farmers not software technicians. The project will utilise compact farm equipment to demonstrate the benefit of smaller more precise machines to agriculture and the wider world.

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Innovate UK

Results of Competition: Productive and Sustainable Crop and Ruminant Agricultural Systems

Competition Code: 1808_CRD_HLS_AFTFP

Total available funding is £20 million

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
BURKARD MANUFACTURING COMPANY LIMITED	SpraySaver - Full Automated Broad-spectrum crop Pathogen Spore Detection using DNA and LFD	£342,942	£240,059
H.L. HUTCHINSON LIMITED		£99,173	£49,586
PERPETUUS CARBON TECHNOLOGIES LIMITED		£99,960	£69,972
Rothamsted Research		£184,872	£184,872
RSK ADAS LIMITED		£97,654	£48,827
SPEARHEAD MARKETING LIMITED		£105,541	£52,770
VELCOURT LIMITED		£198,468	£119,081
Warwickshire College		£162,226	£162,226

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Project description - provided by applicants
Today, the majority of farmers spray fungicides prophylactically on crops to minimise risk and insure against disease ingress. Most farmers, or their consultants, spend hours inspecting crops but can't easily predict what incubating (invisible) infection is already in the crop or what may start to develop as a result of increasing pathogen presence in the environment. Weather-based disease forecasting methods have been introduced to predict when to spray crops but often have unreliable results, especially against sporadic diseases. The market opportunity for **SpraySaver** is to transform today's '_**spray-and-pray**_' practices by offering a more reliable and precise scientific method of determining when to spray -- using locally gathered disease pathogen data and risk prediction/decision support models to assess crop disease risk. The added value to farmers is a big reduction in crop spray costs, safeguarded or better crop yields/productivity and greater effectiveness when sprays are applied. **SpraySaver** is the world's first automated field analyser system specifically designed for early detection of crop disease pathogens within crop growing environments. One analyser can monitor a wide geographic area of around 100 Ha (dependant on local environmental conditions) and can be configured to detect multiple crop disease pathogens. Each in-field analyser transmits 4G mobile data for analysis in the cloud. Local pathogen data is analysed alongside local weather data within a disease risk model to determine risks of crop disease infection. Pathogens that will be detected include _Sclerotinia_, which affects oilseed rape and carrots, yellow and brown rust of wheat, _Fusarium_ _graminearum_ of cereals, potato late blight, beet rust, and onion down mildew, thereby covering sporadic diseases of a wide range of crops typically grown near to each other under crop rotation. Analysis outputs at a local, regional or even national level can be viewed on multiple display devices with automatic alerts set at predetermined levels. This ambitious project will develop a better DNA quantification method, develop new assays for specific diseases of onion and wheat, and integrate detection with infection-condition models and economic models to make recomendations for spray regimes. The system will ultimately eliminate today's '_**spray-and-pray**_' practices by offering a more reliable scientific method of determining when to spray -- using locally gathered disease pathogen data and risk prediction/decision support models to assess crop disease risk. Integration of the system as a network will add robustness and reliability to the decision-making process.

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Innovate UK

Results of Competition: Productive and Sustainable Crop and Ruminant Agricultural Systems

Competition Code: 1808_CRD_HLS_AFTFP

Total available funding is £20 million

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
GROBOTIC SYSTEMS LIMITED	Advanced Growth Chamber for Rapid Optimisation of Vertical Farming Systems (AGROVerSe)	£333,630	£233,541
FRAUNHOFER UK RESEARCH LIMITED		£155,950	£155,950
STOCKBRIDGE TECHNOLOGY CENTRE LIMITED		£62,974	£44,082
University of Sheffield		£13,852	£13,852

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
To meet the demands of a growing population, and to minimise the environmental cost of farming, there is an urgent and profound need to maximise the efficiency of crop production. Vertical farming, where crops are grown hydroponically indoors under artificial lighting and under precisely controlled environmental conditions, is a method of crop production that promises to be many hundreds of times more productive than traditional farming, and with less of an environmental impact. However, vertical farming today is nowhere near as efficient or productive as it could be, or as it needs to be. Because of this, most vertical farms are unprofitable, and often require more energy than traditional farming to produce the same amount of food. One reason vertical farms are inefficient is that plant growth conditions, including light spectrum, temperature, and nutrition, have not been optimised for every crop. Finding the right plant growth conditions could mean increasing the yield of a crop by 15%, which in some crops could translate to a doubling of profit margins. Because light spectrum, temperature, and nutrition affect plant biochemical processes as well has plant yield, the right plant growth conditions for a medicinal plant grown in a vertical farm could mean the difference between a viable medicine and a wasted crop cycle. Our solution to the problem of weak productivity and profitability in vertical farming is AGROVerSe, the Advanced Growth Chamber for Rapid Optimisation of Vertical Farming Systems. AGROVerSe is a system that lets vertical farmers and agronomists carry out large-scale, multi-chamber, multivariable experiments in order to identify plant growth conditions for maximum crop quality and yield. AGROVerSe is a small, stackable, climate-controlled chamber that carries a number of innovative technologies. AGROVerSe has an advanced hyperspectral imaging system to continuously collect data on plant growth and development. It has a spectrum-tuneable LED lighting system, so that the effects of different light spectra on plant quality and yield can be examined. The chamber has a digitally-controlled hydroponics system, so that precise nutrient dosing can be carried out. Finally, an array of sensors continuously measures and feeds back to a novel HVAC system that precisely regulates temperature and humidity throughout the crop cycle. All of these components are connected together and controlled through a web-based platform, which collects and analyses data, and provides the user with plant growth conditions predicted to maximise crop quality and yield.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Chalcombe	The use of GPS tracking and the LoRaWAN network to improve productivity of grazing dairy cows	£144,762	£101,333
HOOFPRINTS TECHNOLOGIES LTD		£80,608	£56,426
PRECISION GRAZING LTD		£12,181	£8,527
Rothamsted Research		£32,091	£32,091
WD FARMERS		£49,870	£34,909

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
British milk yields per cow have increased by 50% in the past 20 years (AHDB, 2018). Whilst grazed grass is a cheap, sustainable, high quality feed current grazing systems do not support these increased yields so cows are fed supplements or even housed them over the summer to ensure higher feed intakes. Such actions increase feed costs and environmental problems such as slurry disposal. Our vision is to develop a system that will collect cow behavioural data in real-time and use artificial intelligence techniques to determine when best to allocate additional pasture to grazed herds resulting in higher intakes and more milk production from grass. To date there has been a market failure in such applied grassland research as there are few established companies in the sector who would financially benefit from promoting such work. This innovate project will use cow behavioural data to track grazing intensity and determine when best to automatically allocate additional grazing. This will increase milk production from grass and lead to more cows to be grazed more of the time helping to meet society's desire that dairy cows should be grazed at grass. Small collar-mounted sensors with track the cows using GPS signals and monitor their grazing behaviour through accelerometer data. A small proportion of cows in the herd (5-8%) will wear the collars throughout the grazing season and the collected data will be sent via a low power wide area network (LoRaWAN) to the internet. The LoRaWAN system (2015) has a 10 km range so it can receive data from all fields on a farm and has a low power requirement so that small batteries can be used to power the sensors over a full year. It has been used in the urban sector but not in lowland agriculture. We will track cows to determine when they move to and from the milking parlour and to monitor their grazing activity in the fields. Group grazing behaviour will be used to determine when best to allocate extra grazing. A signal will be generated to trigger a field gate to open, allowing the herd access to fresh pasture. Over time the system will build up a database of where the cows have grazed which can be used to quantify the productivity of each field. This information will improve and support pasture management decision making such as the need to re-seed grazed pastures.

Innovate UK

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
SAGA ROBOTICS LIMITED	The First Fleet. The world's first fleet of multi modal soft fruit robots	£806,201	£564,341
BERRY GARDENS GROWERS LIMITED		£199,639	£99,820
FOTENIX LIMITED		£130,598	£91,419
University of Lincoln		£487,044	£487,044

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
The UK soft fruit market is now worth well over £1.3 billion at retail sales values (Source: Kantar) per annum. The UK grows over 160,000 tonnes of fruit and employs 32,000 seasonal and, typically, migrant pickers. Approximately 50% of the total production cost is for labour. The soft fruit industry is extremely concerned with the both the availability of picking and husbandry labour and labour cost inflation. The impact of Brexit is already affecting labour supply and the opportunities to pass on labour cost inflation are weak and challenging. The soft fruit sector is a UK success story and there are still opportunities for expansion and to reduce fruit imports. However, it is very clear that to thrive the industry needs to drive every possible means to improve to labour productivity. Robots for soft fruit production clearly offers great opportunity in the sector. Here we will develop the world's first fleet of multi-modal robots that can carry out a wide variety of tasks in the field. Strawberry production is a complex task, and several different tasks need to be performed throughout the season. This is the first project that reflects this, in that we aim to develop robots that are completely autonomous that can carry out several different tasks in the field. We will build on current research by Saga Robotics, Berry Gardens and the University of Lincoln (UoL), complimenting the team for the first time with the inclusion of the University of Oxford and NIAB. Saga have already demonstrated world leading picking performance (in terms of vision system accuracy and picking speed) for their fruit picking robot. The system will then be integrated into the world leading Thorvald robotic platform that has been developed by Saga with UoL. In addition, we will develop a wide range of other tools that will be integrated with the robots. The robots will autonomously pick up the tools from a tool changer, and they will also charge and dock autonomously. This is a much-needed project that will transform robotic strawberry production from the laboratory bench to a commercially relevant system. The world-wide market for these machines and IP is very significant.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
YAGRO LTD	A commercial intelligence platform to optimise farm productivity	£773,682	£541,577
J V FARMING LIMITED		£4,782	£3,347
PARKER FARMS LIMITED		£11,257	£7,880
R.H.TOPHAM & SONS LIMITED		£7,630	£5,341

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Farming is facing long-term pressures on economic performance. Intense retailer price pressure and challenging weather patterns are pushing record numbers of farms out of business every year. They face even more uncertainty through brexit and potential impacts on global markets, labour, and financing. Such challenges threaten the livelihoods and social fabric of the UK's rural communities. Yagro is a team of farmers, entrepreneurs and technologists, with a mission to connect agriculture to drive a more financially sustainable farming sector. Our story began in 2015 and, since then, we've been travelling all over the UK to meet farmers and their suppliers to learn more about the challenges they face.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
J D COOLING SYSTEMS LIMITED	CoolBerry 2: Innovations for in-field cooling of soft fruit	£150,898	£90,539
BERRY GARDENS LIMITED		£104,991	£52,496
SCORPION VISION LIMITED		£52,494	£36,746
University of Greenwich		£131,910	£131,910

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Removal of field heat from perishable produce is critical for quality and storability. This project will develop and test a mobile field based Cooling-rig, initially for soft fruit, that will enable growers to rapidly remove the field-heat from produce immediately after harvest to below 5°C. Currently, in-field cooling options are not used in the UK. Existing technology is available in the USA, but utilises direct expansion cooling, has low energy efficiency and lacks precision, therefore increasing moisture loss. By taking the cooling technology to a higher level of sophistication, the development of the Cooling Cell will have a major impact on retaining optimum fruit quality, increasing shelf-life of fruit and reducing losses in the supply chain incurred due to weight loss, bruising and disease development. While the focus will initially be on soft fruit, the technology will then be expanded to include stone fruit and fine vegetables. The project will start by building test Cooling-Cells to optimise the process in terms of rate of cooling, and control of humidity to minimise moisture loss, which can be a major problem during cooling. Tests will also be carried out to determine whether moisture loss can be reduced further by using pressures elevated above atmospheric during cooling. The design and composition of packaging will also be optimised to improve the rate and efficiency of cooling, thereby reducing energy usage. The prototype cooling rig will be developed with growers to ensure that it is appropriate for the logistics of complex field harvesting logistics. It is envisaged that the final Cooling-rig will accommodate several pallets of produce (up to six in total) in segmented chambers. Cooling will be delivered individually to the three pairs of chambers allowing pallets to be cooled immediately after harvest and removed via a temperature cooled van to the pack-house to minimise temperature fluctuations in the supply chain.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
SOILESSENTIALS LIMITED	A retrainable, smart-camera, vision system for agriculture - SKAi, the SoilEssentials KORE Artificial Intelligence platform	£385,304	£269,713
DEIMOS SPACE UK LIMITED		£223,365	£111,682
PEACOCK TECHNOLOGY LIMITED		£118,815	£83,170
SCOTTISH AGRONOMY LIMITED		£25,608	£17,926
University of the West of England		£137,960	£137,960

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Project description - provided by applicants
There is an urgent agronomic (reducing the amount of plant protection products applied to crops), environmental (pollution reduction), economic (lowering the cost of food production) and political (continuing public pressure for a reduction in ag-chem use) need to modernise and update agrochemical applications to crops from the traditional practice of applying a uniform rate across the whole crop to a much more targeted approach. SKAi aims to satisfy this need by building a smart camera and artificial intelligence platform for use by farmers, agronomists and agrochemical applicators. This platform will be integrated into the existing KORE ([www.koresolution.com][0]) precision agricultural platform to extend its functionality to allow the support of in field smart cameras using image transfer and machine learning. Using this system, we hope to dramatically reduce the total amount of crop protection products applied to crops in the UK and worldwide. [0]: http://www.koresolution.com

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
UBIQUTEK LTD.	Scaling electrical weed control across different crop types and weeding platforms	£437,285	£306,100
SFM TECHNOLOGY LIMITED		£56,488	£39,542
SMALL ROBOT COMPANY LIMITED		£492,486	£344,740

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Need for weed control growing as world's population increases. Herbicide market under significant pressure because 1) weeds are increasingly becoming resistant to herbicides, 2) regulators have started to ban their use because of health and environmental concerns, and 3) costs of litigation against herbicide manufacturers are increasing. Electricity is a scalable and sustainable alternative to herbicides and addresses the fundamental shortcomings of herbicides, thermal, and mechanical methods. This project will create prototype weeding solutions for new crop types.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
DUNBIA (NORTHERN IRELAND)	CONCEPTION TO CONSUMPTION: aligning farmers to consumers using modern data, decision support and precision agriculture techniques.	£2,002,616	£1,001,308
BREEDR LIMITED		£487,408	£341,186
DELOITTE LLP		£479,401	£239,700
SRUC		£859,600	£859,600

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
Dunbia, a leading Beef and Lamb processor in the UK, together with our suppliers (farmers) and consortium partners (SRUC, Breedr & Deloitte), will drive significant improvements in production efficiency and productivity growth within the beef sector by over £500m in 5 years. Currently, there is a great degree of variability in the beef supply chain. This is largely due to a lack of consistent and accurate data collection and subsequent analysis leading to unacceptably high disease levels, poor business performance, and huge variability in product quality. The consortium proposes to radically drive agricultural productivity and environmental sustainability within the beef supply chain. The solutions developed in this project will allow the consortium to be a first mover in the UK and indeed globally. These solutions will involve multiple interventions across multiple segments of the supply chain. The platform developed will facilitate supply chain integration, and will deliver an economically and environmentally sustainable commercial beef supply chain.

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