

# Summary of PGRO R&D project activities Crop year 2019

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# Summary of PGRO R&D project activities

## Crop year 2019

Outputs from projects are reported in the PGRO journals and on the PGRO web site as and when appropriate. They are further disseminated through various means including presentations, reports industry conferences, trade meetings and seminars throughout their duration and after their conclusion.

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### **Yield Enhancement Networks – peas and beans – co-funded by PGRO and industry (L2020-7 and L2020-8)**

The Yield Enhancement Network – or YEN – connects agricultural organisations and farmers who are striving to improve crop yields. The pea YEN and bean YEN are not competitions, they are grower to grower learning programmes through coordinated widescale benchmarking and sharing. The YENs are open to any interested individual or organisation, commercial or academic. The YENs are run entirely with industry sponsorship and membership fees. There are currently five crop specific networks; Cereal YEN, Oilseed YEN, Grass YEN, Pea YEN and Bean YEN.

Pea crop entries were monitored throughout the season, including crop growth stages, images, root samples, grab samples for yield, quality samples and crop nutrition tests. All work was carried out to a simple but detailed protocol to maintain consistency between crops. A stakeholder meeting was held on 10 December 2019 to review outputs.

Seven field bean crops were monitored by PGRO throughout the season, with an additional 13 grower entries. Evaluation included soil nutrient analysis, soil measurements for moisture, temperature, VESS and compaction, crop growth stages, tissue nutrient analysis, grab samples for yield and quality samples. Monitoring was carried out by PGRO employees and growers and results are being analysed. A stakeholder meeting was held on 15 November 2019 at PGRO to review outputs. Further information about pea YEN and bean YEN can be found at <https://www.yen.adas.co.uk/about> or at [www.pgro.org](http://www.pgro.org).

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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### **Variety evaluation of vining peas (G2020-1, AHDB FV462), combining peas and field beans (L2020-10)**

Full Pulse Recommended List (RL) tables for 2020 were available following CropTec on 27 November 2019 at [www.pgro.org](http://www.pgro.org). As part of the series of trials to assess performance of pulses, disease observation trials were carried out by PGRO in conjunction with those carried out by NIAB to evaluate downy mildew susceptibility. Ratings are reported in the RL.

The production of the PGRO Descriptive List of Vining Peas is derived from a series of trials beginning in year 1 with a Preliminary Trial and then continuing in years 2 and 3 in Main Trial. Varieties included petits pois (grown on a light silt soil) and standard peas (currently grown at Nocton, Lincs). These trials were funded by seed companies and PGRO levy. Between 2012 and 2018, to provide data from contrasting soil types, all varieties in the standard pea main trial at Nocton were also grown in South Lincolnshire on a silt soil (funded by AHDB-Horticulture) and data were used to provide a descriptive list of standard peas for silt soils. For 2019, AHDB-Horticulture funded a variety trial, where the site and varieties were chosen by representatives of the vining pea grower groups and members of the Legume Panel. Varieties included standard and petits pois types.

NB: FV462 Horticulture Strategic Centre for Vegetables: In 2019, a proposal was accepted for funding under the AHDB call for proposals relating to '31510062: Horticulture Strategic Farms – Innovation Hub - To undertake a programme of work designed to identify and deliver practical, adoptable solutions to address a range of technical and cultural issues identified by growers'. This call included variety trials for vining peas, onions, carrots and Brassicas. Add-on trials were included to demonstrate/investigate priority topics relevant to each crop species. In line with current Legume Panel priorities, the following topics were selected for inclusion in the add-on program for peas: Vining pea varietal tolerance to downy mildew; efficacy evaluation of bio-controls and biostimulants to control *Aphanomyces euteiches* and *Peronospora viciae*; distribution of the bean seed fly. Project duration is 3 years.

Addresses strategic priorities 1, 4, 5 and 6.

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**Improvement of soil health using cover crops in peas – co-funded by EIP-Agri (via the Rural Payments Agency), the Green Pea Company and PGRO (L2020-18)**

The objectives were to evaluate cover and catch crops for improving soil structure, organic matter content, nutrient retention and management of soil moisture. In addition, soil-borne pathogen levels were monitored using standard plate tests, with the aim of using molecular tests once developed, to indicate the influence of improved soil structure on soil-borne pathogens over several years. Grant funding is in place until January 2020. An additional evaluation of the influence of vetch in the cover for disease impact was carried out. Reports are available at <https://www.pgro.org/r-d-news/>. Although being carried out in vining peas, results will be relevant to combining peas. Cover crops were established in August/September 2016, 2017, 2018 and 2019. Initial results showed improvements in soil structure following inclusion of cover and catch crops.

Addresses strategic priorities 1, 2, 3, 4 and 6.

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**Downy mildew varietal tolerance screening – funded by PGRO levy (L2020-32)**

This project evaluated downy mildew varietal tolerance at several field sites across the UK. Trials included pea varieties selected by the vining pea groups and from the Descriptive and Recommended List varieties. Seeds were untreated or treated only with thiram. The aim was to determine in which regions of Eastern UK different varieties show better tolerance to downy mildew. A summary of 2019 results is available at <https://www.pgro.org/r-d-news/>.

Addresses strategic priorities 1, 4 and 6.

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**Downy mildew control using foliar sprays in vining peas – funded by PGRO levy (L2020-4)**

Trials have been established for several years to evaluate the efficacy of different products to control downy mildew infection in vining peas, including the screening of new and existing foliar active ingredients. Products tested in 2018 were Amistar (azoxystrobin) +/- Wetcit as the standard fungicide and 6 confidential active substances. Most treatments significantly reduced foliar infection when compared to the untreated plots, but none of the treatments provided statistically significant reduction in number of pods infected. Amistar provided statistically significant reduction of foliar infection compared to untreated plots, although this was not the case when combined with Wetcit.

There were no differences in yield between treatments. Two trials were undertaken in 2019 and some of the new active substances showed promise.

Addresses strategic priorities 1, 5 and 6.

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**Development of diagnostic tests for key footrot pathogens – Co-funded by Innovate UK (132852) and PGRO levy with Warwick University and Nottingham University (L2020-30)**

The project aimed to develop qPCR diagnostic tests for the soil pathogens *Fusarium solani* and *oxysporum*, *Aphanomyces euteiches* and *Didymella pinodella* (previously *Phoma medicaginis* var. *pinodella*). The project started in January 2018 and ended in March 2019.

Following the Innovate UK-sponsored diagnostics project, we focused on the interaction of soil properties, foot rot pathogens and yield loss. The aim was to determine which other factors in addition to presence of pathogens prior to planting peas will determine whether foot rot disease will develop. Soil characteristics like compaction, soil type, pH and organic matter content were monitored in areas of the field that showed disease versus healthy areas. Yield mapping was performed to help determine the impact of foot rot disease development on yield loss. If successful in the first year in collaboration with HMC Peas we aim to widen the project out to include further geographical areas.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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**Bioremediation of *Aphanomyces* infected soils using plant baiting technique – funded by PGRO levy (L2020-17)**

The aim is to investigate the potential to interrupt the *Aphanomyces* disease life cycle using alternative host plants. The selected alternative hosts would, if successful, cause *Aphanomyces* oospores to germinate and the life cycle would be disrupted before they can produce new oospores. This experiment was undertaken twice in the glasshouse in 2019, and unfortunately failed both times. Conditions in the glasshouse over the summer months are unsuitable for the experiment and it will be set up again to run throughout the winter months.

Addresses strategic priorities 1, 2, 4 and 6.

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**Foliar applied active substances for control of downy mildew in field beans – funded by PGRO levy (L2020-3)**

Evaluation of new active substances has been undertaken for several years. Six foliar products/ mixtures were evaluated for efficacy in trials at Stubton in 2018 and 2019. Some products were confidential, and we use these trials to pursue approvals for products for field beans. None of the treatments gave a statistically significant reduction of downy mildew in 2018, although there was an observed reduction in infection when SL567 was applied. Rust infection was reduced by all treatments compared to untreated plots, although this was not statistically significant. Treatments with Amistar increased the amount of healthy green tissue. There were no differences in yield between treatments. In 2019, two applications of Amistar plus Wetcit reduced infection and improved yield in comparison to the control.

Addresses strategic priorities 1, 3, 5 and 6.

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### **Combining pea optimum populations – funded by PGRO levy (L2020-2)**

The variety Crackerjack was included in 2015 to 2018 trials, and Sakura from 2016 to 2018. The recommended target population for marrowfats of 65-70 plants/m<sup>2</sup> remains the same. For three of four years trials Crackerjack gave better returns above 70 plants/m<sup>2</sup>, 2015: 84 pl/m<sup>2</sup>, 2016: 97 - 104 pl/m<sup>2</sup>, 2018: 115-120 pl/m<sup>2</sup>, giving an approximate average over the years of 100 plants/m<sup>2</sup>. Work in 2019 with the blue varieties Daytona and Karioka indicated that optimum returns for both were achieved at 100 pl/m<sup>2</sup>. Further data analysis is being undertaken before existing recommendations are changed. A summary of results can be found in the 2019 winter edition of Pulse Magazine <https://www.pgro.org/downloads/pulse-mag-winter-20191.pdf>.

Addresses strategic priorities 1, 4 and 6.

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### **Intercropping peas to improve standing ability – funded by PGRO levy (L2020-12 and L2020-13)**

Combining peas have a reputation for lodging before harvest and many growers avoid the crop because of this. Lodging can lead to both yield and quality losses and farmers often quote the damage caused to combines from harvesting lodged crops. Wide combine headers do not help in this respect. There are varieties on the Recommended List with good standing ability, but this cannot be guaranteed, unlike spring beans. An intercrop with peas could provide a scaffold for peas and improve standing ability. In addition, intercropping can lead to improvements in productivity and land use efficiencies that are not realised in monocropping situations. A summary of 2018 and 2019 results can be found in the Spring 2020 edition of the Pulse Magazine at: <http://www.graphicgeneweb.co.uk/spring2020-flipbook/mobile/index.html>

Addresses strategic priorities 1, 4 and 6.

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### **Pea and bean weevil control – screening products in field beans (applicable to peas also) – funded by PGRO levy (L2020-24)**

Several active substances are included in trials each year, to evaluate efficacy and support future EAMU approvals.

Addresses strategic priorities 1, 5 and 6.

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### **Bean seed fly (*Delia platura*) management – funded by PGRO levy (L2020-6)**

Bean seed fly (*Delia platura*) affects many plant species world-wide and is an important pest of UK legumes. Crop losses due to bean seed fly (BSF) are reported to be up to 60% due to failure of establishment and seedling damage. BSF has been identified as high priority for UK vining peas, picking peas, green and runner beans, as well as alliums, asparagus and leafy salads, due to increasing incidents of damage and the loss of key insecticidal substances. There are no approved seed treatments available in UK legumes that control BSF, and ground sprays are not always effective. Crops at most risk are those planted in late spring and early summer (from mid-late April onwards), and it is reported that the presence of germinating seeds, with recently disturbed soil and high levels of organic material are the key factors that attract the flies. In 2019 we evaluated several cultivation techniques that may help to manage BSF attack in legumes, including timing of spring cultivations prior to drilling date, drill type and degree of tillage (including min-till and no-till). We also evaluated the effects of cultivation techniques and BSF damage on plant infection with soil-borne diseases, to evaluate the impact of changing cultivation techniques for peas and beans. Trials

were large plot trials using farm-scale machinery with the assistance of grower groups. Preliminary findings showed that the period between cultivation and drilling influenced damage levels in peas, with fields cultivated shortly before drilling in the spring having higher levels of damage to seed and seedlings compared to those that were cultivated in the autumn only or several weeks prior to drilling. A prediction tool to determine timing of peak attack in crops will also be useful to help growers plan cultivations and drilling at high risk sites.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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**SCEPTRE Plus – Evaluation of novel active substances for control of bean seed fly (*Delia platura*) – funded by AHDB (AHDB CP165-SP22)**

Following a review of control and management techniques for bean seed fly larvae (*Delia platura*), carried out by AHDB, PGRO and Warwick Crop Centre in 2018, it was determined that few studies have been undertaken recently. Those that have been undertaken indicated that best control was obtained using insecticidal seed treatments, but that in-furrow insecticide treatments also gave some useful control in some cases.

In 2019, a single replicated trial was conducted near Middleton-on-the-Wolds in the East Riding of Yorkshire to evaluate in-furrow treatments and an insecticidal seed treatment compared to insecticide-free control plots.

In this trial none of the in-furrow treatments were effective in reducing damage to peas by bean seed fly larvae compared with the insecticide-free control. The seed treatment led to significantly reduced damage to seedlings by bean seed fly larvae compared to the insecticide-free plots.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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**AHDB Surveillance approaches, impact and epidemiology of virus diseases to improve management strategies – co-funded with PGRO and FERA Science Ltd. (AHDB FV459, G2020-10)**

Plant viruses are transmitted by vectors including invertebrate, fungal or human. Once a plant is infected with a virus it can't be treated and will form a source of inoculum for other plants. Gaining an in-depth knowledge of the epidemiology of plant virus diseases is the key to effective disease management. The aim of the project is to develop a cost-effective generic approach to allow surveillance of any horticultural crop for the presence of both known and unknown viral pathogens, and to also allow quantification of the incidence of such pathogens. In 2019 twenty pea crops were sampled to provide virus incidence data and to identify fields for focused further study of virus yield reduction/impact assessment. High-throughput sequencing (HTS), also known as Next-generation sequencing, was used early in the sampling process to allow identification of the pathogens present in each field, followed by quantification using ELISA and PCR.

The project has uncovered a well characterised virus, turnip yellows virus (TuYV) a virus common in brassicas, not previously recorded in UK pea crops but recently reported from pea crops in Australia and Germany. The viruses traditionally associated with pea crops, such as pea enation mosaic virus (PEMV), were present in 6 of the 20 crops tested, at levels ranging from <1% through to around 30%. By comparison TuYV was found to be present in 13 of the 20 crops and at levels ranging from 2% to 93% incidence. TuYV causes major issues in oilseeds and brassicas but the impact on pea crops is not yet known. Soya bean dwarf virus was also found at two sites, at levels of around 5% and this is a first record for the UK, though again the virus has been reported from pea crops in continental Europe. Through the project the yield impacts of the viruses identified in the study will be investigated.

Preliminary results for the 20 sites in the first year of the project do show some differences in yield impact between the viruses, but further work is required to validate results and ensure that growers receive the right messages about management of previously unrecorded viruses.

The project started at the beginning of 2019 and continues for 38 months.

Addresses strategic priorities 1, 4, 5 and 6.

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**Bruchid trap crop experiment – funded by PGRO levy (L2020-5)**

Bruchid management has become more difficult in recent years, due to increasing populations and potential resistance to pyrethroid insecticides. Although thiacloprid has been available to use for bruchid management, this has been revoked and will not be available for the 2021 season. As a result of these difficulties, PGRO investigated the potential for trap cropping approaches to help manage the pest. Data from 2015 indicated that when spring beans were planted in sequential sowings, those that were planted earlier suffered higher levels of damage, possibly due to the earlier presence of flowering plants attracting beetles into the plots sooner. It's possible that the beetles laid more eggs on earlier developing plants, with later developing plants suffering less oviposition and subsequent damage. In 2019 a large-scale field trial was conducted, with a strip of earlier sown beans along one edge of the field sown on 29 January 2019 and the main part of the field sown on 25 February 2019. This was compared with a control field sown at the later timing which was in the same geographical area as the experimental field. Preliminary results from this trial showed that the 'trap' area had 47.4% damage to beans, the main part of the field (later sown) had 25.4% damage and the control field had 29.9% damage. These preliminary results give an indication that this approach should be investigated in more detail with greater replication to ensure that a robust recommendation could be given.

Addresses strategic priorities 1, 4, 5 and 6.

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**Bruchid beetle – screening products for best timing and control – funded by PGRO levy (L2020-25)**

A trial was undertaken in 2019 to evaluate the efficacy of lambda cyhalothrin, thiacloprid and a fungal bioinsecticide in programs to control bruchid beetle. Treatments in which Hallmark Zeon was applied before first pod formation, followed by Biscaya at first pod formation, followed by Hallmark Zeon seven days later led to lowest damage levels (30.9%), and the bioinsecticide applied before first pod formation, followed by Biscaya at first pod formation, followed by Hallmark Zeon also gave some control of damage (31.9%). Both treatments led to significantly lower levels of damage to seeds compared to the untreated plots, which had 51.85 % damage, and plots treated with Hallmark Zeon at first pod formation followed by Hallmark Zeon 7-10 days later (47.4%). They did not give significantly better control than other treatments that included either thiacloprid or the bioinsecticide.

There appeared to be a benefit to including a pre-pod application of Hallmark or pre-flower application of the bioinsecticide when trying to reduce bruchid damage. There were no statistically significant differences in yield between treatments. However, two-spray programs along with the untreated were generally lower yielding.

Addresses strategic priorities 1, 4, 5 and 6.



**Fertiliser Manual (RB209), PLANET and MANNER-NPK updates – funded by AHDB, PGRO and BBRO Peas and beans (L2020-21)**

In January 2019, The AHDB Nutrient Management Guide (RB209) was updated to provide further clarity on sulphur management in cereals and oilseeds production. Priorities for review and further research are in place, as per steering group meetings. PGRO has a place on the steering group and in the technical working groups. The update is available as a downloadable pdf document containing basic principles and crop sections <https://ahdb.org.uk/projects/RB209.aspx>. There are currently no changes for legumes.

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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**Biostimulants, bio-control agents and nutritional products in vining peas, combining peas and field beans for legume disease management – funded by PGRO levy (L2020-1)**

New biological products may offer an opportunity to improve management of soil-borne diseases, and the project aims to test a variety of biostimulants, biocontrol agents and nutritional products in field conditions. The project was agreed by the Pulse and Legume Panels and knowledge transfer was part funded by AHDB FV462 Horticulture Strategic Centre for Vegetables. In 2018 and 2019, soil applied products were TFP Pro Soil and Serenade ASO. Seed treatments were Radiate ST, Start-Up ST, Take-Off ST, MultiMax GPA ST and Kick-Off ST. TFP Pro-Tect, Zynergy Na13, Agrihit Foliar Tonic, Phorce and Prestop were foliar applications made on two occasions. In the 2019 foot rot trial, disease development was quite high, foot rot infection did not differ between treatments and the trial was abandoned prior to harvest due to the high foot rot development. The vining pea downy mildew trial had high levels of downy mildew and although not statistically significant, Kick-Off and Start-Up had lower levels of downy mildew than the controls. The vining pea trials were not harvested in 2019.

Based on feedback from the Legume Panel an additional trial testing biostimulant products under glasshouse conditions was performed in 2019. The aim of this project was to evaluate the effectiveness of several different seed treatments on *Fusarium solani* and *Didymella pinodella* infection, nodulation and plant health under simulated 'early season' conditions. Simulating 'early season' conditions was difficult in 2019 due to the very warm spring weather. The *Didymella* trial failed but the *Fusarium* trial (conducted under normal glasshouse conditions that support disease development) identified several seed treatments that lowered infection by *Fusarium*. Reports for these trials are available at <https://www.pgro.org/r-d-news/>.

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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**Improving productivity in pea and bean growing through advanced data analytics, machine learning and artificial intelligence techniques – co-funded by Innovate UK and Hummingbird Technologies, with PGRO as a partner (IUK 104473, G2020-9)**

The project aims to develop a remote sensing software analytics platform for peas and faba beans. The platform will allow growers to better understand the health of crops and aid decision making. Experiments and ground truthing focus on soil health, nutrition and crop growth to stabilise and improve yield and quality in vining peas and field beans. The project started in October 2018 and ends in September 2020. During 2019 data were collected for the following: Soil nutrient analysis; soil structure, texture, temperature and moisture content; compaction; measurements of plant growth; foliar nutrient analysis; disease infection; pest damage; yield and maturity. Large datasets have been generated for each of the three sites and are being analysed by PGRO and Hummingbird Technologies.

Results from 2019 were used to direct trials in 2020. As well as developing tools to aid decision making, the project will help to determine the key factors affecting pea and bean yield and crop growth.

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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**Knowledge transfer partnership No. KTP011104 – vining pea crop development modelling – funded by PGRO and Innovate UK (G2020-10)**

Vining peas must be harvested within a 1 to 2-day window and time between harvest and processing must not exceed 150 minutes. These constraints lead to wastage and processing inefficiencies which will be addressed in this project by predicting yield and quality to enable efficient scheduling of harvest and processing. The associate started in October 2019.

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**Pulse Crop Genetic Improvement Network – combining peas, field beans and lupins – funded by DEFRA and led by the John Innes Centre (G2020-2)**

The network, formed in 2005, is based on collaboration between a strong research base and the UK plant breeding industry to promote development of peas, beans and lupins and assist with more sustainable development of the arable sector.

At a project meeting in October 2019 the disease update reported that there is durable downy mildew (DM) resistance in peas, and new sources of DM and chocolate spot resistance in field beans. There was a stakeholder meeting on 14<sup>th</sup> November 2019 at Belton Woods, Belton, Grantham, Lincolnshire NG32 2LN, to discuss the latest developments within genetic research on UK pulse crops. Please go to the website for further details <https://www.jic.ac.uk/pulse-crop-genetic-improvement-network-pcgin/pcgin-meetings/>.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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**PeaGen - Genetic improvement of pea to replace soyabean in the diets of poultry and monogastric livestock – peas – BBSRC Link with Aberystwyth University (IBERS), Stonegate Holdings Ltd., Gressingham Foods, Moy Park Food Company, Senova Ltd., The John Innes Centre, Dalehead Foods, iDNA Genetics, PGRO and Phytatec UK Ltd. (G2020-6)**

In this LINK project new genetic approaches to enhance the nutritional value (protein and water-soluble carbohydrate) of the pea seed will be developed and applied. The aim is to increase the use of peas as a high-quality feed in animal diets, reducing the UK protein deficit from the import of soya products and delivering environmental benefits to livestock production systems. The project started in October 2017 and duration is 5 years. PGRO carried out multiplication in 2019 and evaluation of the agronomic characteristics of the peas.

Addresses strategic priorities 1, 3, 5 and 6.

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**Fostering sustainable legume-based farming systems and agri-feed and food chains in the EU (LEGVALUE) – funded by EU Horizon 2020 (project no. 727672, G2020-3)**

The goal of LEGVALUE is to develop routes to sustainable and competitive legume-based farming systems and agri-feed and food chains in the EU. The project will assess both the economic and environmental benefits for the EU agro industry to widely produce and use legumes in a sustainable

manner. PGRO is a work package manager for dissemination of findings, as well as a partner to develop farm networks and supply chain case studies. Within this project three UK farm networks have been created to provide further information about the following:

Field beans – benefit of N to following crop

Vining peas – effects of cover crops on soil health

Combining peas – PEA YEN is used in the first instance to start the pea farm network and show examples of best practice – this farm network is still being formed.

Other case studies across the EU are being used to demonstrate best practice and novel interventions for pulses. There are several combining pea networks.

<http://www.legvalue.eu/>

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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**Transition paths to sustainable legume-based systems in Europe (TRUE) – funded by EU Horizon 2020, project no. 727973 (G2020-4)**

The main aim of TRUE is to identify and enable pathways to successful legume-supported production systems and agri-feed and -food chains. PGRO is a partner for dissemination and stakeholder engagement.

<https://www.true-project.eu/>

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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**PGRO PhD program (<http://www.pgro.org/phd-studies/>):**

**Developing novel seed treatments for legumes: Optimising sustainable outcomes in agricultural systems – Co-funded by the University of Stirling, Legume Technology Ltd., PGRO and The James Hutton Institute (P2020-1)**

Successful root nodulation relies upon agricultural soils having a sufficiently high inoculum potential. Intensively farmed soils are often lacking in populations of rhizobia due to the rotation of non-leguminous crops and high application rates of synthetic nitrogenous fertilisers. A strategy to combat this is to directly treat the seed with a concentrated inoculum of rhizobia, which ensures suitably high concentrations of root-nodule bacteria in the rhizosphere of the growing root. Because this technology is suitably advanced, there is the opportunity to optimise this process by combining seed treatments that can simultaneously increase biological nitrogen fixation and induce disease resistance through the addition of plant growth-promoting rhizobacteria (PGPR) and resistance elicitors. The focus of this studentship is to develop novel legume-microbe seed treatments as practical liquid, solid or seed coating formulations, and assess subsequent root nodulation, plant development and disease resistance in peas and faba bean. The PhD started in October 2017.

Addresses strategic priorities 1, 2, 3, 4, 5 and 6.

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**Investigating the relationship between *Aphanomyces euteiches* and yield decline in peas – co-funded by PGRO and Nottingham University (P2020-2)**

The PhD investigates the relationship between *Aphanomyces* and yield in peas and aims to develop molecular techniques for identification of the disease. The PhD started on 1 October 2015 and study continues for 3 years, with a 4<sup>th</sup> year for writing. Soil sampling and testing was carried out in several fields in different UK regions in 2016 and 2017, prior to planting and just before harvest. Sampling was undertaken to determine UK distribution of *Aphanomyces* and factors that encourage disease. Molecular LAMP assays were carried out at Nottingham University and correlated against the plate test developed at PGRO to determine whether the LAMP assay can be used for quantification of *Aphanomyces* levels. Good correlations were shown, and qPCR was followed up to further validate the LAMP assays. A glasshouse experiment was undertaken in 2018 to determine effects of cover crops (including legumes) on *Aphanomyces* infection. Thesis submission is due June 2020.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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**Understanding and mitigating the causes of yield decline in peas – co-funded by PGRO and BBSRC with Warwick University (P2020-3)**

The objectives are to: Understand the components and dynamics of the foot-rot complex as well as associated microbiota in the pea rhizosphere using both conventional and metagenomics approaches; DNA sequence key pathogens and investigate soil microbial communities; Identify green manure / biofumigant crops that can suppress foot-rot. Several pathogens contribute to the foot rot complex and it was identified that least is known about *Didymella pinodella*. The PhD will therefore focus on *Didymella* and its role within the complex. Interactions with the other foot rot pathogens will be investigated. The PhD started in March 2018.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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#### **Stem nematode in field beans – co-funded by industry with harper Adams University (P2020-4)**

The study aims to better understand the crop pest relationship, to establish a more reliable quantification method and to investigate likely control methods, whether biological treatments (such as catch/ cover/ biofumigation) or cropping techniques, to speed the remediation of infested land and bring it back into economic bean crop production. The PhD started in April 2017 and initial trials were carried out at a site known to have a high level of stem nematodes. Results are being analysed. The 2018-19 site selected for trials is known to have a pre-existing infestation of *Ditylenchus gigas* (previously 'giant' race) and potentially *D. dipsaci* (previously 'oat-onion' race) and is based at Harper Adams University.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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#### **Strategies to optimise pollination of the UK field bean crop – funded by PGRO and BBSRC with Cambridge University (P2020-5)**

Beginning in October 2018 the project explores strategies to maximise pollination of the UK field bean crop. Recent reports suggest that pollination service is limiting yields in field beans. We will explore strategies for optimising field bean flowers to provide maximum reward to pollinators for minimum foraging energy expenditure. This will have the dual benefit of increasing pollinator attraction to current crops, thus increasing yield, while also supporting wild pollinator populations, thus increasing future pollinator population sizes. A combination of analytical, molecular genetic and behavioural ecology techniques are being used. Commercial lines will be screened for variation in pollinator-relevant traits and to identify genetic variation of potential use in breeding programmes.

Addresses strategic priorities 1, 4, 5 and 6.

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#### **Bean seed fly (*Delia platura*) – Biology and management (supervised by Rosemary Collier and Becky Howard) PGRO/ Warwick University/AHDB (P2020-6)**

PGRO is co-sponsoring with AHDB a PhD student at Warwick Crop Centre (University of Warwick) that will further investigate the lifecycle of the bean seed fly, aim to produce an accurate prediction model to aid forecasting of peak activity, and carry out further investigation of cultural techniques (cultivations and land preparation) for improved management. The PhD started on 01 October 2019 and the student will work with PGRO to gather more data from field-scale sites.

Addresses strategic priorities 1, 2, 4, 5 and 6.

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#### **Knowledge Exchange**

- a. Advice and literature are produced throughout the year with technical information made available via the web site at [www.pgro.org](http://www.pgro.org).
- b. Marketing reports are collated in conjunction with BEPA and distributed monthly throughout the year.
- c. Pulse roadshows are held across the country each year during January and February. Details are available at <http://www.pgro.org/pgro-diary-of-events/>.
- d. Technical members of staff contribute to an increasing number of grower/merchant and Ag-chem Meetings;
- e. All issues of PGRO Pulse Magazine are distributed through Crop Protection Magazine (CPM).

- f. The PGRO Recommended and Descriptive Lists of vining peas and pulses are published annually;
- g. PGRO has developed an Android and Apple application to replace the printed Pulse Agronomy Guide and Vining Pea Guide. All information from the guides will be updated in the App;
- h. Monitoring services are carried out for bean seed fly, pea and bean weevil, pea moth, silver Y moth and bruchid beetle;
- i. Field visits are carried out on request;
- j. The PGRO legume crop protection training course is held annually at the beginning of the year;
- k. The plant clinic operates all year;
- l. Crop updates are distributed to inform about topical issues throughout the year;
- m. AHDB Aphid News is distributed to members via the PGRO website amongst others.
- n. Telephone consultations remain a very popular contact route for engagement for technical advice.

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## **ACKNOWLEDGEMENTS**

The Organisation remains grateful to the many seedsmen and agrochemical and nutrient manufacturers for the provision of considerable quantities of seed, agrochemicals and plant nutrients throughout the trialling season.

The assistance and co-operation of Beeswax Dyson Farming who own the arable land at Stubton and Nocton where the PGRO home-based trial grounds are sited and the owner, Sir. James Dyson is gratefully acknowledged.

The cooperation of Mr Michael Sly of Park Farm, Thorney is also acknowledged in allowing part of his land to be used for PGRO pulse trials.

The help of the numerous growers in the provision of additional field trial sites and the many commercial concerns, levy collectors, Industry Panel members, Associates and individuals too numerous to mention by name, is also gratefully acknowledged with sincere thanks.

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