

2014



PGRO
Annual Report

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AN INTRODUCTION TO PGRO

Since its formation in 1944, PGRO has provided research and technical services to growers and processors of legume crops in the UK. It is funded by (a) *voluntary* grower levy collected by the merchants and processors who purchase the produce, and (b) contracted trials work commissioned by both commercial companies and government agencies. As a registered charity and company limited by guarantee, it is managed by a Board of Trustees appointed from the National Farmers Union, relevant food processors, and other related industries. This Board meets three times a year and four Board members also form, with the CEO, the Management and Finance Committee which meets to review operational issues every two months. A management team of the four senior members of staff, chaired by the CEO, meets monthly to manage the day-to-day decisions.

Through 2014 the Board took a look to the strategy of PGRO and defined a vision and mission for the organisation in a Strategy document to cover the next 5 years. 2015 - 2019.

The Vision of the Board of Trustees and Mission of the PGRO is encapsulated in the following statements.

Vision

“Our vision is to be the independent partner for applied crop research. To be acknowledged as the primary reference point for all aspects of temperate pulse and vegetable-legume crop production, marketing and economics”

Mission

To pursue the provision of current advice for growers, the realisation of improved crop yield, quality and economics. To facilitate open, accessible, reliable and relevant knowledge exchange. To develop progressive and innovative approaches towards crop research and development. To create and maintain extensive and close links with growers, processors, trade and fundamental researcher communities.

The core beliefs of the organisation are captured in the declared corporate values.

Corporate values

The PGRO exists to support growers, and other supply chain stakeholders in improving the reliability and profitability of crops within its remit. The organisation aims to be as open and accessible as possible in order to ensure that members are able to quickly and easily glean the appropriate information and advice they require. Research will be carried out to a high standard and within appropriate quality criteria such as GEP* and GLP** as necessary and the organisation will do all it can to ensure and enhance a widely held reputation for reliability, independence and being the collaborative partner of first choice. Education in the form of knowledge exchange or knowledge transfer activities forms a core plank of the organisations purpose and is seen as being a critical value for future long term success.

PGRO remains one of the few UK sources of sound, independent technical advice, at a time when food production, quality and provenance have never been more scrutinised, both locally and globally.

2014 LEGUME CROPS IN UK

The winter of 2013/14 was generally wet and mild. The “open” autumn 2013 closed quickly in early November and shut out further opportunities for winter cropping due to water logged soils. Land remained generally unworkable in all but the lightest areas with further rain rather than snow in the very mild winter temperatures. Prepared land received little in the way of frost mould and when the weather turned drier spring temperatures rose bringing a prolonged dry spell. Soil rapidly dried on the surface which with growers unable to travel on the land due to water at depth, eventually created problems for spring crop seed beds and relatively late drilling dates. Some coined the spring one of “diesel and steel”, referring to the amount of tractor work required to beat down a decent seed bed. Peas and beans both suffered in this respect – many crops were drilled into dry cloddy soils with dry seed beds resulting in erratic emergence. This start in many instances followed the crops right through to harvest with a wide ‘in crop’ variation in maturity. Vining pea harvest was strung out as the spring and early summer temperatures fluctuated up and down in catch conditions particularly affecting the rate of maturity progression throughout the season. The warm and wet brought forward stronger pest and disease pressure than had been seen in the previous year and aphid numbers and hence virus and feeding pressure were greater than had been seen for many years.

Both pea and bean crops suffered from the cool wet spring conditions with a significant number of crops suffering severe foot rot problems. Peas are particularly vulnerable to this condition (brought on by a complex of soil borne fungal pathogens) up to 10% of fields were lost completely- it is estimated that annually up to 38% of the crop is lost in this way.

Pest pressure especially from crows is becoming a serious issue for PGRO on trial grounds and must be causing crop losses to commercial growers. On trial areas even vining peas with double layers of bird netting were being penetrated by persistent birds attaching the pods as they filled. Normally combining peas are less affected but in 2014 even these were needed extra protection to bring the trials to harvest.

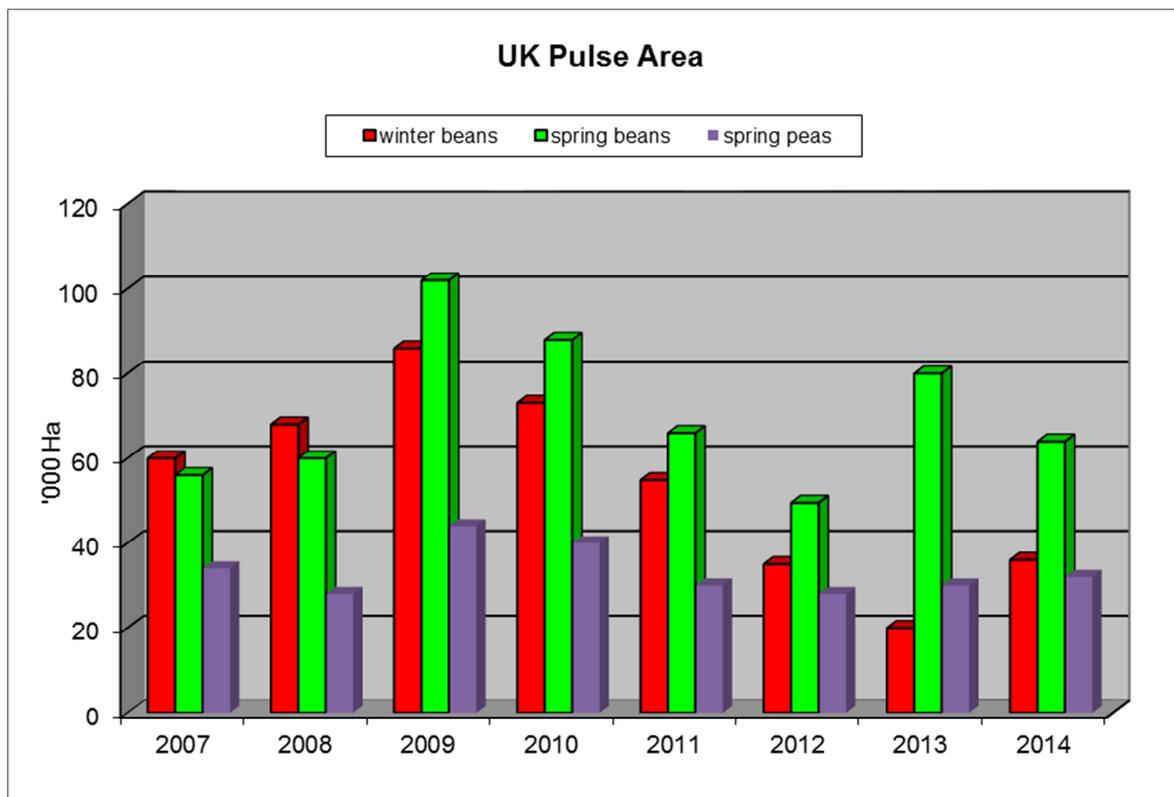
The weather from June through July became warm and dry and there were concerns that crops would not have deep root systems to cope with the dry conditions following a very wet start. Vining pea harvest started early but stuttered to get up to full speed with variable maturity, cropping eventually turned out at around 100% of target with the most northern producers completing vining in early September. Combining pea harvest delivered average yields on the whole with marrowfat peas disappointingly low in Essex. Quality was good but again the dry summer affected yield. Beans yielded very well throughout and came to harvest in the trials as early as the last week in July. Commercially the crops were delayed by a terribly wet and cool August and many crops sat out well into September before being taken as growers took wheat in preference.

With falling commodity prices for wheat and oilseed rape combined with very real economic issues associated with the production of second wheat and very short rotation wheat and oilseed rape cropping practices, there has been a clear and discernable increase in pulse cropping interest. Strong returns from recent pulse harvests, recognition of low production costs, strong market demand for good quality product, enormous rotational benefits (including pest breaks and residual nitrogen) and the excellent entry for first wheat they present has focussed significant numbers of growers back to the opportunity pulses present. Through the early part of 2014 there was much speculation about the likely outcome and impact of the Changes to EU CAP regulations. In early June these announcements were made and they fell favourably for pulses. Nitrogen fixing crops were nominated as qualifying for both crop diversification and Ecological Focus Area status without management restrictions meaning that most growers would be able to meet all of their "greening" requirements by growing crops of peas and beans should they choose. This further stimulated interest in pulses and enquiries at the PGRO soared. The true effect of all this renewed interest will not begin to be realised until crop harvested in 2015.

Commercial pulses generally looked great throughout the season and as time progressed through July promised excellent yields at harvest. August was the wettest month of the year as usual but in 2014 the temperatures were cool and this seemed to serve the bean crop well. Most if not all growers had good yields and the human consumption market was well served. Brisk trading of beans in the autumn saw good levy returns for PGRO in Q3 and Q4 and growers were rewarded for good quality crops with prices that held up throughout the trading period. Although falling from the highs of old crop traded at £260/t in the spring, the new crop remained at over £200/t ex farm despite other tumbling commodity prices. Peas also yielded well and although quality was variable prices for marrowfat peas soared on a very short market staying at or around £350ex or more for the whole of 2014. Good yields of variable quality blue peas put the market into surplus and for later sellers this put pressure on feed pea prices which having reach over £250/t ex in the mid-year ended the year at around £195/t with little buyer interest.

In all however growers of pulses in 2014 had good yields and those who focussed on achieving good quality produce will have enjoyed excellent returns.

Pulse crop area in the UK is thought to have fallen back a little in 2014. A more open autumn was conducive to winter bean sowings which grew at the expense of spring beans. Dry pea sowings are thought to have increased marginally. Trade estimates of the UK crop and historic trends are reflected in the figure below. UK Pulse Area.

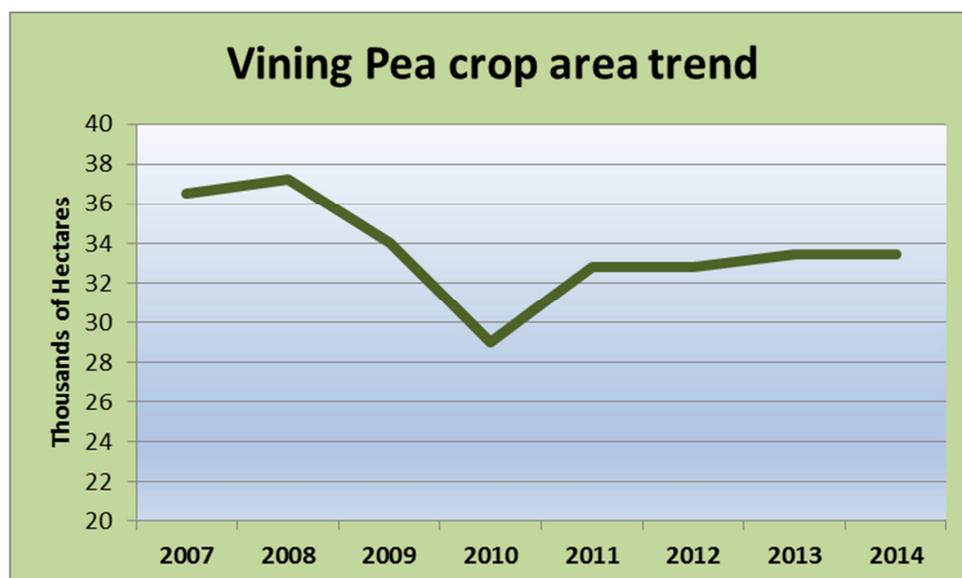


Vining pea crops performed well during the year with little bypassed crop (unlike the previous campaign) and yields were achieved generally in line with forecasts and plans. A welcome and comforting return to more stable financial performance from the crop after a couple of more indifferent less than encouraging seasons for growers.

32,587ha were sown in 2014 (Vining Pea Crop area trend shown in the figure below: data source British Growers Association), representing approximately 128,000 tonnes of crop. This crop area figure was more or less static year on year. A slight increase for 2015 is tentatively suggested for 2015 sowings but will surely remain more or less stable at around 33,000ha.

Changes to CAP reform drove some interest in vining pea area but groups are generally well established and know their markets very well with little opportunity for significant immediate or speculative expansion in crop area. The frozen pea market is relatively mature.

Pressure from alternative crops and land uses remains a significant threat but good crop returns are helpful in this respect, as are the beneficial effects of a legume in the rotation and the qualification of peas as Environmental Focus Area in CAP.



STRATEGIC PROGRESS

The path outlined in the PGRO “Strategic Review 2012-2014” continued with the Review for the period 2015 – 2019 being announced and implemented during the year. The focus continued upon levy funded research supported by supplementary income from research contracts.

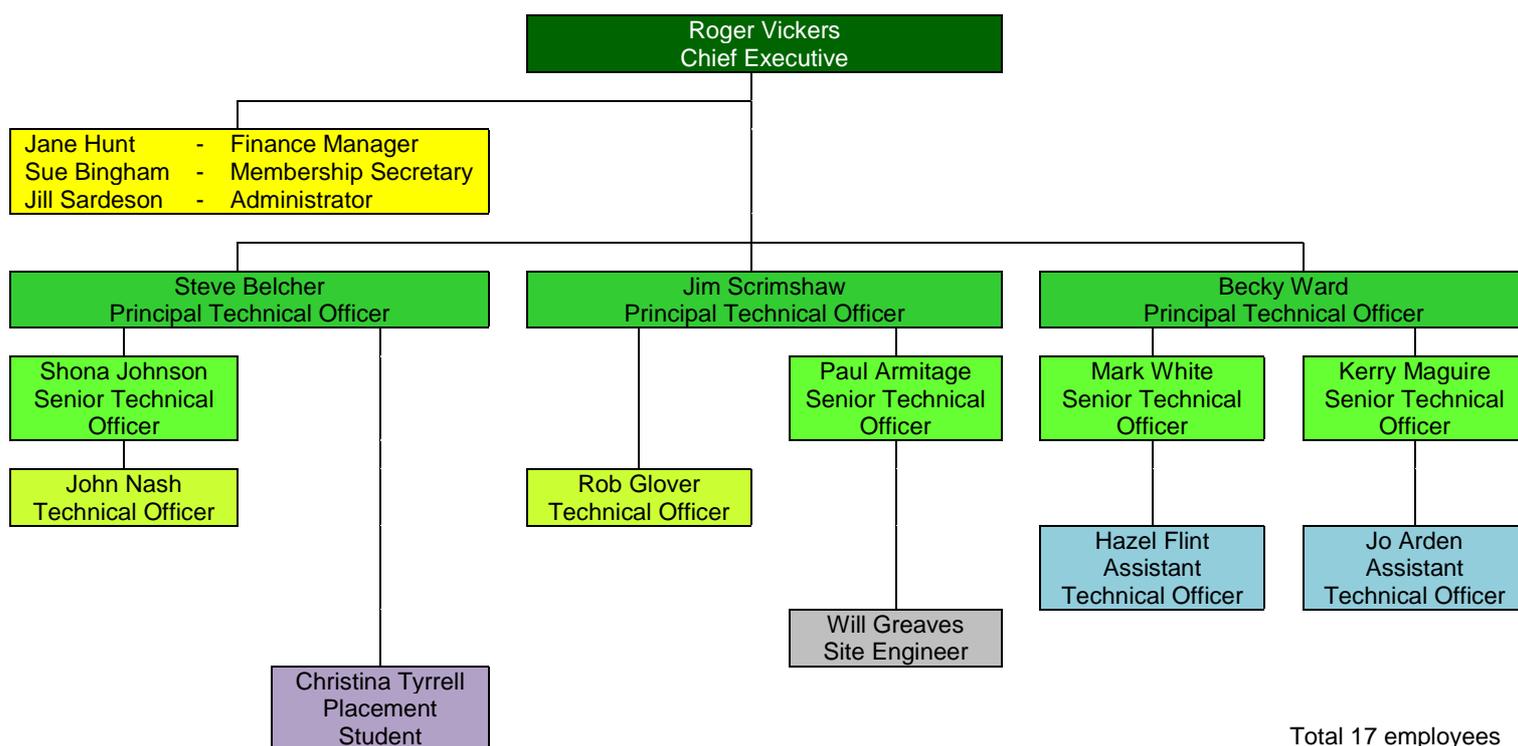
Value for the Levy payers remains core to the PGRO existence and the proportion of funds spent on research and Knowledge transfer compared to levy income remains high. (See pages 6/7).

Success in application for grant funded research was achieved in 2014 assisting future income streams.

Investing for the future and with a solid year end performance in sight, the opportunity was taken to invest in capital improvements to the building at Thornhaugh, replacing and insulating the lower flat roof and further improving the organisations IT systems. Significant investments were made in new field trial spraying equipment, transportable 65bhp tractor for land working and disc based tractor mounted drilling equipment, all aimed at ensuring as far as possible, that plot trials replicate farm practice as closely as practicable.

STAFF STRUCTURE & PERSONNEL

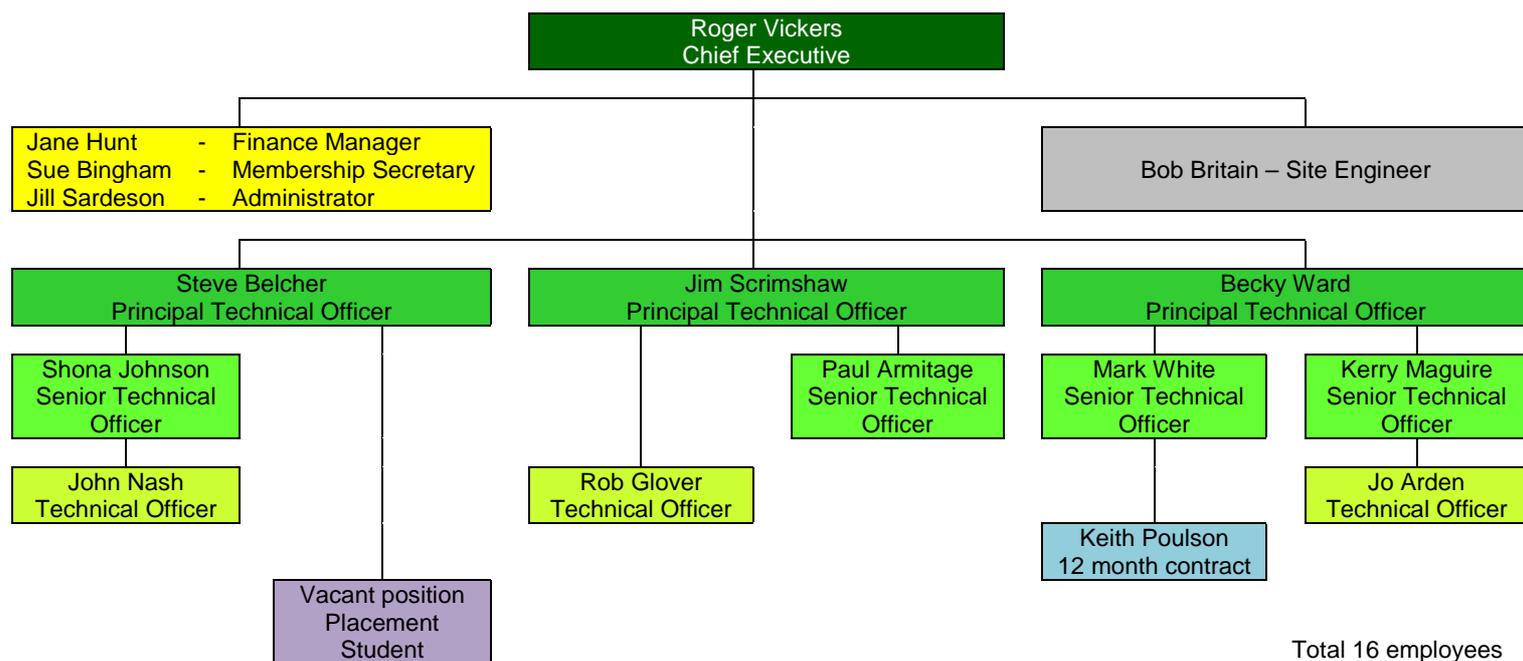
PGRO - Organisation Chart as at 1st January 2014



Total 17 employees

- Christina Tyrrell returned to University after a 15 month placement: part of her BSc studies at Lincoln University.
- Hazel Flint – ATO resigned at the turn of the year.
- Keith Poulson was recruited on a one year contract to assist with peaking project workloads.
- Will Greaves – Site engineer resigned and was replaced by Robert Brittain.
- Jo Arden was promoted from ATO to at the year end.
- Funds from the Geoffrey Gent Bursary scheme were used during 2014 to fund Jo Arden and Hazel Flint in Seed Analytics training and the attendance of Kerry Maguire at the Pulse Symposium in Canada. The bursary had almost £3k remaining at the end of 2014.

PGRO - Organisation Chart as at 31st December 2014



FINANCES

With careful cost control in 2013 a surplus was created and in the early part of 2014 £35,000 was transferred to boost long term investment funds designed for capital growth and income.

The year ended with total income increasing from £1,033k to £1,181k.

The larger 2013 crop increased levy income in Quarters 1 and 2 and the high yields from the 2014 crop combined with strong demand in the human consumption / export markets to North Africa and Egypt, resulted in brisk trading. The resulting levy returns in Quarters 3 and 4 resulted in a strong cash balance at the year end. Total Membership and Levy income increased £48k year on year. That said the proportion of income attributable to these streams fell a further 2% to 46% of income. Levy rates continued through 2014 at £0.95/tonne of produce traded. During the year the Board announced that from June 2015 the levy rate would rise to £0.97/t and would be set at that level for 2 years with the intention of then rising to £0.99/tonne traded for the 2 years thereafter.

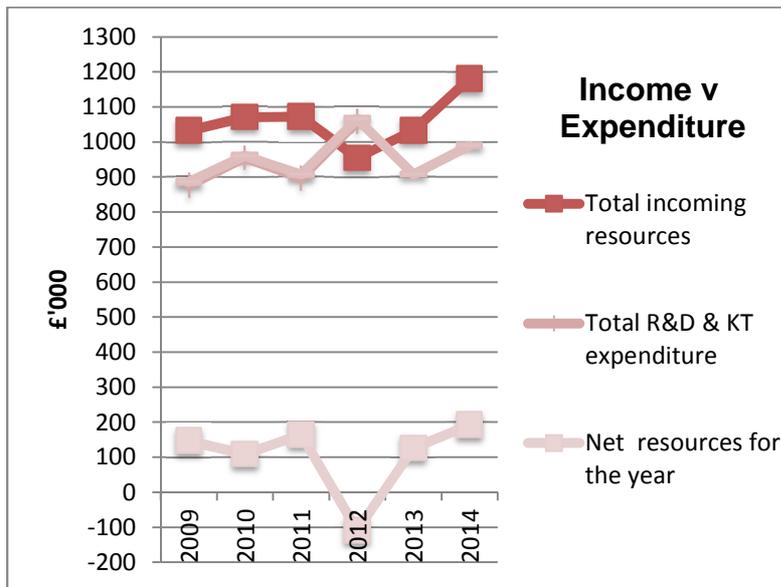
Income received from grant sources also increased in 2014 by £59k to £312k however this again represented a proportional income fall of 2%. Forward projection for this income source anticipates a potential significant fall, with numerous long term projects coming to conclusion over the next couple of years.

On the other hand income from Research and Technical sources (largely the activities of PGRO Research Limited) increased by £73k (4% of the total) with a significant increase in interest in pulse crop input research.

For many years PGRO has operated with ORETO accreditation (Chemicals Regulation Directorate's (CRD) Official Recognition of Efficacy Testing facilities and Organisations) and GEP certification (Good Experimental Practices).

In 2014 income further benefitted from contract work for chemical residue evaluation field trials, following PGRO's MHRA accreditation (Medicines and Healthcare Product Regulatory Agency) for GLP (Good Laboratory Practice) status.

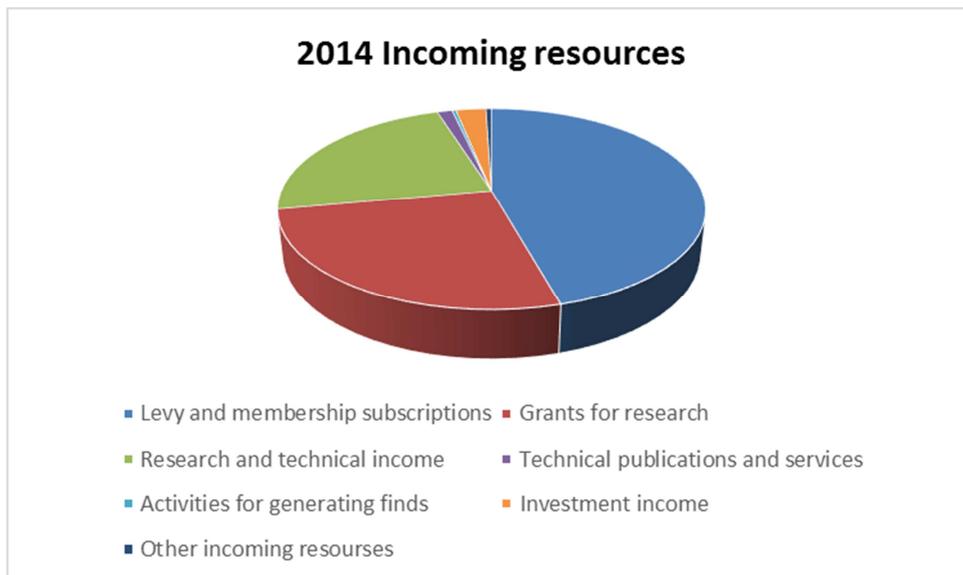
The year ended with net incoming resources of £192k



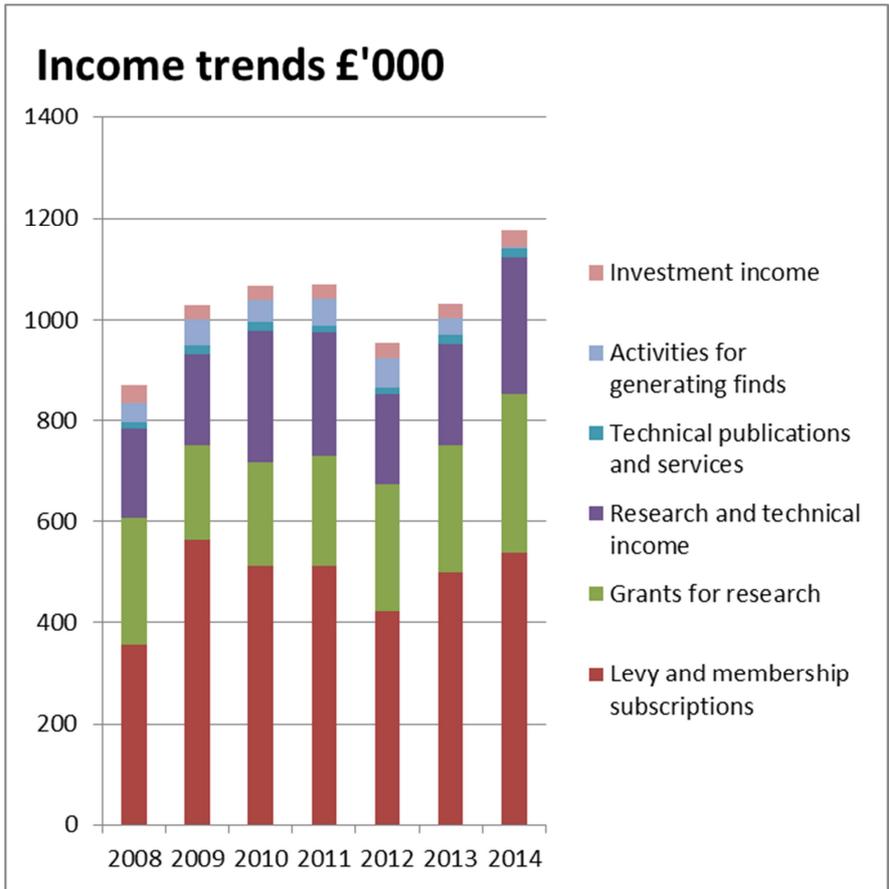
PGRO has no borrowings continuing to operate without debt. PGRO's longer term investments ended the year at £710k, an increase of approximately £35k (the value of funds invested at the start of the year). However despite providing an income of circa £32k, weak stock market performance meant that no increase in capital value was realised.

Net current assets at the yearend were up 36% at £510k. Total funds carried forward were increased from £1.41m to £1.60m

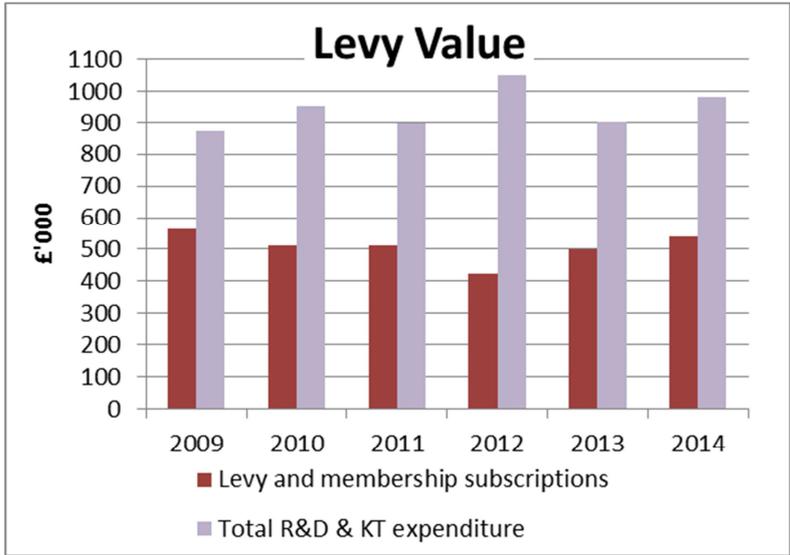
During 2015 the PGRO's Reserves Policy and Investment Policy will be revisited to ensure best value is returned in relation to the objectives of the charity.



The breakdown (above) shows that 2014 levy and membership receipts again provided less than half of PGRO's income during the year. Research contracts and grant income rose again to further compliment and significantly leverage the value of levy. The income stream trends are highlighted in the figure below. (Income Trends)

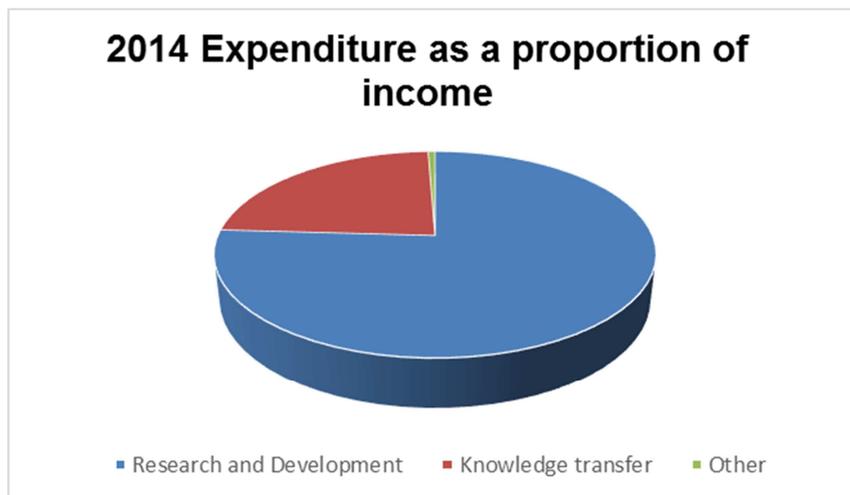
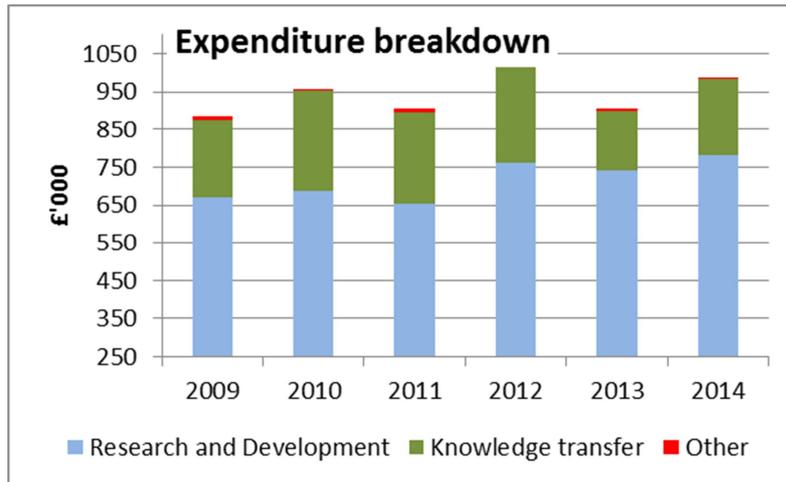


The ratio of the levy to the total spent on R&D continues to illustrate the added value the PGRO generates. In 2014 for every £1 in levy received, approximately £2 was spent on research and knowledge transfer activities.



COMMUNICATIONS AND KNOWLEDGE TRANSFER (KT)

The retention of a PR agency, shared with BEPA, has continued to raise the profile of PGRO with the press and has continued to ensure journalist attention to all our events with subsequent excellent press coverage.



Expenditure increased during the year by approximately £80,000 the vast majority of this was consumed by increased knowledge transfer activities with the remainder spent in funds raising activities for R&D.

The transfer of knowledge gained from research remains a high priority objective, central to PGRO. Considerable effort is made to reach out to levy payers and a significant proportion of total expenditure is allocated to Knowledge transfer annually. In 2014 KT expenditure increased by £70k to 23% of expenditure. However KT activities are notoriously hard to quantify in terms of time spent by staff interacting with growers, advisors, trade and fellow researchers. This means that the proportion of cost spent on KT is always likely to be significantly understated.

The following KT activities can be listed for 2014

- a. Advice and literature was produced throughout the year with much of the technical information made available through the PGRO web site www.pgro.org
- b. Marketing reports were collated in conjunction with BEPA and distributed monthly throughout the year
- c. Eight Crop Updates were issued throughout the season.
- d. PGRO & BEPA presented at the Cereals 2014 event with displays and plots of peas and beans
- e. PGRO exhibited at the 2 day national CropTec event which was attended by staff
- f. 39 Technical updates were produced for the use of growers and agronomists
- g. Pea moth bulletins were moved to an on line service hosted on the PGRO web site
- h. Social media continued to be embraced with significant use and interaction via the Twitter account @pgroresearch for the dissemination of technical messages and topical activity updates
- i. Considerable time and effort is expended in fielding and responding to requests advice by telephone
- j. Pulse road-shows were held at 5 locations in January and February in conjunction with Syngenta
- k. Technical staff contributed to a number of grower/merchant and Ag-chem. meetings
- l. Three issues of PGRO Pulse Magazine were distributed via CPM magazine with a circulation of around 13,000. CPM is thought to be the leading technical agronomy magazine in UK agriculture. The Pulse magazines are a significant vehicle for knowledge transfer to growers
- m. The Pulse magazine was also published on line via www.pgro.org
- n. Vegetable magazine was again produced for the vining pea and vegetable legume industry, directly mailed to growers and grower groups and also published on line via www.pgro.org
- o. The PGRO Pulse Agronomy Guide was completely republished and modernised- released in January 2014 in hard copy it is also available as a download from www.pgro.org
- p. The PGRO Recommended Lists of peas and beans were announced in November and launched to the press at the CropTec event.
- q. The PGRO Vining Growers Guide including the vining pea descriptive list was also updated and modernised - produced and published in November. It is also available as a download from www.pgro.org
- r. Conventional press/media were used extensively to ensure pulses and vegetable legumes continued to received good coverage in a market expressing strong interest in spring cropping.
- s. A PGRO demonstration /open day /trials event was held at STC for vining peas and pulses taking our traditional open day further north to reach a different audience
- t. PGRO supported NIAB at their various regional open days to talk pulses
- u. Student visitor groups from Universities and colleges were hosted at PGRO
- v. Presentations were given at several meetings in Europe as part of participation in EIP and collaborative project events
- w. PGRO supported AICC at their annual conference

RESEARCH & DEVELOPMENT PROJECTS 2014

The two crop sector panels met during the year to discuss and prioritise research needs for processing legumes and pulses.

Research Strategy for Combinable Pulse Crops

In 2013 the Pulse Panel (appendix 2) agreed that it would collate a general plan for PGRO research priorities and would in future meet twice per year (spring and autumn). This started in 2014 Steve Marx (PGRO Trustee- see appendix 1) was elected Chairman of the Panel and Stephen Frances as Vice-Chairman.

The Pulse Panel has drawn up a working document - current at the turn of the year, reproduced in appendix 3.

Research Strategy for vining peas and vegetable legumes.

In 2012 PGRO in conjunction with HDC lead the Processed Legume Industry Panel (appendix 2) in formulating a Research and Development Strategy for Vining Peas, Green Beans and Broad Beans. That strategy is being used for the direction of Levy sponsored projects at the PGRO for the period 2012- 2015 and is reproduced in appendix 4.

SUMMARY OF 2014 PULSE LEVY SPONSORED PROJECTS

1. VARIETY EVALUATION

The autumn and winter were generally mild and gave very little frost mould. Soils remained very wet into the spring and patience was tested in waiting for them dry. Once dry, moisture disappeared rapidly, particularly in the East and some crops suffered establishment problems. The spring continued to be warm. Summer was a little cooler than expected, but frequent rainfall gave rise to some very high yielding crops.

a. PEAS

Overall trial yields (5.1t/ha) of peas were marginally up on the 5 year (5.02t/ha) average. Six trials went through to harvest, with yields ranging from 6.55t/ha in Hampshire to 4.21t/ha in Hampshire. Prophet had a particularly good year, which has lifted its yield ranking.

There were no changes to the white pea category with Salamanca, Mascara and Gregor all remaining fully recommended. Similarly, large blues, Crackerjack, Prophet and Daytona remain with a full recommendation. Campus continues into P2 recommendation giving another strong yield performance. Along with Prophet, it is the joint top yielding variety on the List and has a very good rating for standing ability (8). New to the List for 2015 is Bluetooth (LS Plant Breeding). Yields fall just short of the best and combines a reasonable agronomic package with better than average downy mildew resistance. Maple peas Mantara and Rose continue with a full recommendation while Rainbow moves to P2 recommendation. Mantara maintains a yield advantage over Rose and Rainbow is a little behind Rose. The marrowfats group in general did not perform as well as previously. Sakura, Neon and Genki remain fully recommended varieties. After a poor performance in 2014, a decision on the full recommendation of Bibao was deferred and the variety remains provisionally recommended.

b. WINTER BEANS

Many winter bean crops grew very tall in 2014. Some of these brackled, where the stem snaps at some point above ground level. This occurred late in the growing season and yields did not appear to be affected. Generally winter beans yielded very well. 2014 trial yields (5.89t/ha) were 33% higher than the 5 year (4.42t/ha) average.

Of the pale hilum types, Wizard and Honey remain fully recommended varieties. Tundra tops the winter bean yield rankings and continues into P2 recommendation. Two new winter beans, Thor and Saracen, both from Limagrains UK gain a 1st year (P1) provisional recommendation for 2015. Yields were a little higher than fully recommended Wizard, but lower than Tundra. Both have relatively short, stiff straw. In the black hilum (feed bean) category, Clipper and Arthur remain fully recommended varieties and Buzz continues into the P2 category.

c. SPRING BEANS

The spring bean Recommended List of 2010 contained just one fully recommended pale hilum bean, Fuego. Five years on, the 2015 List contains seven varieties in the same category, all of which are fully recommended. 2014 trial yields (5.68t/ha) were 25% higher than the 5 year average (4.53t/ha). Some good information on downy mildew was obtained this year.

As already mentioned Boxer, Fury, Fuego, Pyramid and Babylon all remain Fully Recommended varieties. Gaining Full Recommendation status for 2015 are Vertigo and Fanfare. Yields are not quite as spectacular as on the 2014 List, but both are still high yielding. Vertigo is the top yielding variety, significantly out-yielding Fuego, while Fanfare is a little behind Vertigo. Downy mildew for these varieties has improved (5) compared to Fury (6), Fuego and Pyramid (5) and Babylon (7). Tic bean Maris Bead also remains fully recommended.

2. **SCOTTISH PULSES** (with SRUC)

Spring beans

Variety trialling was suspended for 2014 and SRUC conducted a spring Optibean trial, giving a greater geographic spread to the trials. Growth was very vigorous and yields were very high from this site. Maximum yields were obtained from lower plant populations than seen in the previous trials grown in Cambridgeshire / Lincolnshire. The trial will be repeated in 2015.

3. **VARIETAL SUSCEPTIBILITY OF COMBINING PEAS TO DOWNY MILDEW (*Peronospora viciae*)**

As part of the series of trials to assess the relative susceptibility of combining peas to downy mildew, two disease observation trials were carried out by PGRO in conjunction with those carried out by NIAB. Twenty one varieties in the Recommended List trial and four varieties in the NL series were planted at Holbeach, Lincs and Chatteris, Cambs. Data with those from NIAB were collated to provide a rating for the PGRO RL for combining peas.

4. **PULSE CROP GENETIC IMPROVEMENT NETWORK (PCGIN)** (With JIC and NIAB)

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 therefore assist with the more sustainable development of the arable sector. The network has created stakeholder groups to interact within the network and to provide links with the EU research community. PCGIN is managed by JIC, PGRO, NIAB and Defra with input by the commercial sector. 2014 was the final year of funding.

The objectives are to identify key phenotypic and performance characteristics within peas and beans, to develop genetic maps in pulse crops to provide novel germplasm and marker traits for commercial development of varieties.

The final report of PCGIN was prepared and is available from John Innes Centre.

In 2014, 13 recombinant inbred lines were evaluated against parental lines and Prophet as the yield standard.

A proposal was submitted to DEFRA to continue PCGIN and if successful funding would be applied retrospectively to 2015 trials.

5. **WEB BASED FORECASTING SCHEME FOR DOWNY MILDEW IN SPRING BEANS** (with FERA, York)

The automated system at FERA was available for forecasting downy mildew monitoring from 15 sites from April until late June. Updates about the infection risk at each monitoring site were posted weekly on the Spring Beans page on the CropMonitor website (www.cropmonitor.co.uk).

6. **BRUCHIDCAST** (TSB supported project with PGRO, R-RES, Syngenta, Frontier and OECOS)

The project comprises the following:

- a. *Field trapping:* Growth stage development and temperature data continued to be collected at trial sites. Data were analysed for 2014 and all preceding years of the project.

- b. *Crop damage* - Surveys of crops from across the UK were carried out and damage analysis showed most occurred to crops in the East and South, with minimal damage in northern crops.
- c. *BruchidCast* - A forecasting model was constructed using met data from regions across the UK. It was launched on the Syngenta website in 2014. In conjunction with this a series of trapping sites were managed by PGRO to monitor insect populations from south to north. Willing growers are sought to host trap sites into the future.
- d. The project finished in September 2014 with a Stakeholder launch meeting in the autumn.

7. MINIMISATION OF NITROUS OXIDE INTENSITIES IN ARABLE CROP ROTATIONS
(LINK supported project with ADAS, SAC and partners)

The project ended in June 2014. Residue and N application trials were completed through to 2014. Data analysis is being carried out by ADAS. A full report will be available in autumn 2015.

8. MANAGEMENT OF DOWNY MILDEW IN SPRING BEANS

In the fourth year, one trial was established to manage the disease using a variety with moderate resistance (Fuego) to disease. Seed treatment was compared with a foliar spray programme. Data are being analysed for 2014. In 2013 disease pressure from downy mildew was very low and no significant differences were seen between treatments.

9. OPTIBEAN
(TSB supported project with NIAB TAG, Wherrys and industrial partners)

The project is in its third year and aims to optimise inputs for field beans whilst maximising outputs. PGRO work involved agronomy studies to assess the yield response to time of sowing and plant populations of both winter and spring beans. In addition, a series of trials examining the response to fungicide applications for chocolate spot and aphicide applications for pea and black bean aphid were carried out. At a further 10 sites, soil SNS were determined following beans and oilseed rape as a comparison and N uptake of the following winter wheat were assessed. Results are currently being analysed.

A third agronomy component is being undertaken by NIAB TAG spray applications unit in examining the potential for inter row weeding using a guided weeder and glyphosate.

Bean feeding studies are being carried out by meat, poultry and fish producers and a LCA for bean feed is being constructed by North Energy Ltd.

The genetic basis for yield stability is being studied by NIAB

10. LUPINS FOR UK AGRICULTURE AND AQUACULTURE
(TSB supported project with IBERS, NIAB TAG and industry partners)

2014 was the final year of this three year project investigating the potential for lupins for use in poultry and fish production. It was based on breeding lines developed by IBERS from the LISA LINK project. PGRO evaluated a range of commercial varieties in a trial at Thornhaugh to test for alkaline tolerance and other agronomic factors. All varieties were harvested and samples collected for feed analyses values. The project is due to conclude in January 2015 with a stakeholder meeting in Aberystwyth. A Lupin agronomy guide was produced and published via the PGRO web site. www.pgro.org

11. NOVEL COMPUTER VISION TECHNIQUES FOR FOOD QUALITY ANALYSIS – IDENTIFICATION OF BRUCHUS RUFIMANUS (BEAN SEED BEETLE) DAMAGE IN FIELD BEANS (VICIA FABEA) FOR EXPORT FOR HUMAN CONSUMPTION
(PGRO, Lincoln University, Frontier Agriculture (SAF-IP))

This project investigated the potential of novel computer vision technology to identify blemishes in bean seed, including bruchid damage. The aim was to provide information for the development of a hand-held measurement tool. PGRO led the project with Lincoln University as the science partner, conducting a feasibility study to test the system. The project was a single year project ending in September 2014. The study considered other uses for the technology following the end of the project, and possibilities for further research.

12. PROTEIN CONTENT VS. YIELD IN LEGUMES: RELEASING THE CONSTRAINT
(SAF-IP with Wherry and Son, JIC and other industry partners)

The project investigates the relationship between protein content and yield in pulses. It will produce novel genetic stocks with improved traits, breeding tools and associated marker systems, together with knowledge of screening and characterising mutants. The project will provide advanced understanding and know-how for breeding high-value legume protein crops.

13. LURE- AND-KILL TECHNOLOGY TO MANAGE BEETLE PESTS (*Sitona lineatus* and *Bruchus rufimanus*) OF FIELD BEANS AND PEAS
(AgriTech project sponsored by Innovate UK, PGRO, BASF, Rothamsted, OECOS & Exoset)

Our innovative AgriTech project, led by the PGRO, is developing a “lure-and-kill” approach to manage beetle pests of peas and beans. Currently blanket sprays of insecticide are used against these damaging pests. The pea and bean weevil (*Sitona lineatus*) attacks the nitrogen fixing root nodules and the bruchid beetle (*Bruchus rufimanus*) severely reduces saleable quality of beans by burrowing holes in them. Instead of controlling these pests with sprays in a crop which is hard to penetrate, our vision is to make the pests come to us by formulating a killing agent together with a pheromone or plant volatile attractant. This will improve targeting of control measures and provide a much needed new solution following the occurrence of pyrethroid resistance in the pea and bean weevil. We are collaborating with BASF and Exosect who have a natural enemy of beetle pests (an insect fungal disease) and electrostatically charged powder formulations that stick to the body of the insect. Rothamsted Research has identified an aggregation pheromone specific for the pea and bean weevil which attracts both sexes and floral attractants for the bruchid beetle. These will be formulated with the insect fungal disease and put into inoculation stations in the field that we will develop with another project partner, Oecos. The project started in Oct 2014.

PROJECT SUBMISSIONS REQUESTING PARTIAL PUBLIC FUNDING

Applications were submitted for collaborative TSB / Agritech Catalyst funding:

- a. To investigate the remediation of the causes of Pea Sickness
- b. Precision Assisted Technology for pulses

Applications were submitted to HDC for funding of investigations into:

- a. To evaluate glasshouse and microbiological methods as possible techniques for detecting *Aphanomyces euteiches* in vining peas
- b. To evaluate the effects of soil phosphate levels on rhizobial populations in vining peas
- c. Pea Downy Mildew race diversity in the UK
- d. Vining pea variety evaluation extension

SUMMARY OF PROJECTS FUNDED BY PGRO VEGETABLE LEVY, HDC AND OTHER PUBLIC FUNDING IN 2014

Project title	HDC No.	Start	End	Progress	Sponsor
Vining pea variety evaluation (petit pois and standard peas) – Descriptive List	NA		On-going	Trials complete for 2014. Descriptive List produced Nov 2014. PM and DM included in evaluation.	PGRO levy/ Seed companies
Vining peas – extension of variety evaluation trials (Holbeach)	FV340a	01/03/11	28/02/15	Trial complete for 2014. PM and DM included in evaluation. For continuation the proposal was submitted at the end of 2014.	HDC
Snap peas – evaluation of varieties sown at appropriate commercial timings (plus herbicide sensitivity trial)	FV419	01/04/13	31/03/14	Trial complete for 2013. Report produced March 2014.	HDC
Minimising Nitrous Oxide Emissions in Arable Rotations	NA	01/07/09	30/06/14	Field trials complete. Report due from ADAS by end of project in 2015.	Defra Link/ PGRO Levy/ Industry contribution
Quality Determinants in Pea Seeds	FV351	01/01/10	31/01/14	Project ending in Jan 2014. Data to be disseminated by JIC and PGRO.	HDC/ PGRO levy/ Industry contribution/ Defra Link
Determination of critical soil P levels in vining peas	FV380	01/07/10	31/12/14	In conjunction with NIAB report produced due 2015	HDC
Field and broad beans - A novel monitoring and forecasting system for the integrated management of bean seed beetle (BruchidCast)	NA	01/10/10	30/09/14	Into final year of monitoring and trials. Traps now almost at commercial stage. BruchidCast was made available by end 2014 in time for the 2015 crop season.	TSB/ PGRO levy/ Industry contributions
Herbicide options in vining peas	NA		On-going	Trials complete for 2014. Report to be completed	Industry/ PGRO levy
Vining and podded peas – control of volunteer potatoes by vision guided spot spraying	FV307b	01/04/13	31/03/15	Trials completed for 2013. Report due for first year. Second year trials 2014 completed.	HDC
Vining peas – downy mildew control using foliar sprays	NA	01/04/13	31/12/13	Trial complete 2013. Report submitted to LIP. Trial continued in 2014.	PGRO levy
Perennial field margins with combined agronomic and ecological benefits for vegetable rotation schemes	FV334	01/12/08	01/12/13	Trials complete 2013. Report completed by STC during 2014.	Defra Link/ PGRO levy/ HDC
ABSTRESS	NA	01/01/12	31/12/16	Project in first year of trials. Looking at biotic and abiotic stresses in legumes, of specific interest <i>Fusarium</i> and drought in peas.	EU FP7/ industry contribution

ABSTESS is an EU FP7 project with partners across Europe. It aims to use different tools to study the effect of drought and *Fusarium* stress on the pea crop both at the genetic and field level. Breeding material with tolerance to both of these stresses will be developed. Experimental conditions have been established for the two stresses on plant material to enable the study of the plant metabolome. Experiments are underway to determine the genetic and metabolomic markers for the stress. These markers can be used to identify breeding material with greater tolerance to *Fusarium* infection or drought. PGRO has been undertaking knowledge transfer in the first 18 months, in Roadshows, Cereals 2014 and open days. PGRO began field work in 2014. This involved evaluating varieties from member countries to assess *Fusarium* tolerance or resistance. There were three replica trials in Spain, England and the Czech Republic with comparison of the data across Europe.

ADDITIONAL PROJECTS

There are a number of other projects which are not included in this strategy with which PGRO is associated.

They were funded by the HDC and are listed as follows.

1. VINING PEAS

FV 58: Pea midge: pest monitoring and development of synthetic pheromone to aid control

FV 90: Vining peas: threshold for control of pea aphid (*Acyrtosiphon pisum*)

FV 63: Vining peas: seed transmission studies with pea seed borne mosaic virus

FV 72a: Peas, broad beans and green beans; evaluation of air assisted spray application technique

FV 90a: Determination of pea aphid thresholds in vining peas

FV 192: Vining peas: monitoring and control of silver Y moth (*Autographa gamma*)

FV 58a: Vining Peas: monitoring and control of the Pea Midge (*Contarinia Pisi*)

FV 154c: Vining peas – evaluation of new varieties sown at appropriate commercial timings

FV 231: 3D Farming: making biodiversity work for the farmer (LINK)

2. BROAD BEANS

FV 91: Broad beans: effect of foliar diseases on yield

FV 72a: Peas, broad beans and green beans; evaluation of air assisted spray application technique

FV 347: Bio pesticide product gap analysis and evaluation to support development policy for bio pesticides for use in integrated vegetable crop production

3. OTHER BEANS PROJECTS

FV 72a: Peas, broad beans and green beans; evaluation of air assisted spray application technique

FV 175: Runner beans: development of pre-emergence herbicide treatments

FV 252: Dwarf green beans: strategy for the control of pod rot by *Botrytis cinerea*

FV 354: Dwarf green beans: Evaluation of Rhizobium inoculant for nitrogen fixation

4. GENERAL PROJECTS

FV 334 Perennial field margins with combined agronomical and ecological benefits for vegetable rotation schemes

FV 347: Bio pesticide product gap analysis and evaluation to support development policy for bio pesticides for use in integrated crop production

CP 61: Cross-crop benefits: developing crop combinations to promote conservation biological control in horticulture (HDC Studentship)

PGRO LABORATORY SERVICES

The plant clinic received 63 plant samples which required laboratory work for identification or diagnostic purposes as part of the PGRO advisory service. Pea moth spray date predictions were made available through an online web service and 8 Crop Updates were issued by email. Seed and soil testing continued as a fee paid service, maintaining the number of samples of seed for testing from overseas producers. 1019 samples were tested in the period August 2013 – July 2014, of which 50 were soil.

PGRO continued to operate the tenderometer standardisation service with 50 tests in the year.

CONTRACT TRIALS

As well as running the levy and grant/ award funded programmes of research and development, PGRO also carry out a number of privately funded trials and projects which include variety evaluation and agrochemical screening in the field, glasshouse and laboratory. PGRO is GEP accredited and officially recognised by CRD to carry out efficacy trials with pesticides for agricultural and horticultural crops. Whilst this work continues each year, the volume fluctuates and "Research and Technical Income" from these activities can vary from year to year. During 2014 PGRO achieved GLP accreditation giving wider opportunities for contract research, with 2 GLP studies carried out in the spring period.

ACKNOWLEDGEMENTS

The Organisation is grateful to the many seedsmen and agrochemical manufacturers for the provision of considerable quantities of seed and agrochemicals.

The assistance and co-operation of Mr. Brian Redrup of Velcourt who manages the arable land at Walcott Estates where the PGRO home based trial ground is sited and the owner, Mr. Darby Dennis is gratefully acknowledged. The cooperation of Mr Michael Sly of Park Farm, Thorney is also acknowledged in allowing part of his land for PGRO off-site pulse trials.

The help of the growers for provision of additional outside trial sites, and of the many commercial concerns and individuals too numerous to mention by name, is hereby also gratefully acknowledged with thanks.

Appendix I

PGRO BOARD OF TRUSTEES

Secretary – R.G.VICKERS [§]

P.E. BARRETT	Askew & Barrett (Pulses) Ltd.
P.J. RIX	Dunns (Long Sutton) Ltd.
A.G. BURY	Frontier Agriculture Ltd.
C. STOWE	Princes Ltd.
S.W. BUMSTEAD [§]	Ouse Bank Farm, Great Barford, Bedford. NFU
S.J. FRANCIS [§] (Chairman until June)	The Old Farmhouse, Church End, Old Leake, Boston.
J. FENTON [§] (Vice Chairman from June)	Springwell House, Elmswell, Driffield, N. Yorkshire
M.HAYWARD [§]	Swaythorpe Growers Ltd.
M.R. LEGGOTT [§]	The Limes, Holland Fen, Chapel Hill, Lincoln
R.T.THOMAS	Whatoff Lodge, Quorn, Loughborough
S.P. MARX [§]	1, The Courtyard, Stamford, Lincs
J.A.YOUNG	Birds Eye Ltd
J.HALLETT ***	British Growers Association Ltd.
P.J. SMITH	Wherry & Sons Ltd.
W.A. van der HAVE ^{+ §} (Chairman)	Limagrain UK Ltd.

*** Mr James Hallet stepped down from the board following his resignation from the BGA and was replaced by Professor M Gooding (Institute Director at IBERS) at the AGM who subsequently attended the Board meeting in November 2014

Appendix 2

INDUSTRY PANELS

PROCESSING LEGUMES INDUSTRY PANEL

S. Ashton	Penguin Foods Ltd
W. Bradley	Green Pea Company Ltd
C. Brewster	Horticultural Development Council
M. Brown	A.P. (East Anglia) Ltd
R. Corfield	Aylsham Growers
K. Costello	Princes Ltd
S. Dawson	National Farmers Union
R. Fitzpatrick	Holbeach Marsh Cooperative
S. Francis	Fen Peas Ltd
I. Grant	Bishop Farm Partners
J. Grant	J.W. Grant & Co
M. Hayward	Swaythorpe Growers Ltd
M. Heading	A. & E.G. Heading Ltd
R. Hirst	Anglian Pea Growers Ltd
E. Jadin	Ardo
P. Langley	Sandfields Farms Ltd
A. Leatham	Scottish Borders Produce Ltd
A. Lee	A.L. Lee & Sons
M. Leggott	West Fen Peas Ltd
A. Lenson	Wootton Marsh Farms Ltd
T. Mudge	BGA Ltd
N. Murray	W.P. Bruce
R. Pinder	Raymond Caudwell Produce
K. Taylor	K.H. Taylor Ltd
J. Thompson	Beeswax Farming (Rainbow) Ltd
P. Waldock	Mack Multiples
I. Watson	Stemgold Peas
A. Whiting	Birds Eye Ltd

PULSE PANEL

Steve Marx (Chairman)	Consultant
Roger Vickers	PGRO
Becky Ward	PGRO
David Cooper	DEFRA
Keith Costello	Princes Limited
Stuart Cree	Ebbage Seeds
Rodney Fletcher	Grower - Belmont Farms
Martin Stuffins	Grower – Park Farm, Thorney
James Wallace	IAR-Agri
Mark Wells	Grower - Leicestershire
David Whyte	United Oilseeds Marketing Limited
Stephen Francis (Vice-Chairman)	Fen Peas Ltd
Andrew Lensen	Grower - Velcourt Farms Ltd.
David Robinson	Frontier Agriculture Ltd
Peter Smith	BSPB – Wherry and Sons Ltd
Mike Welby	Syngenta Crop Protection
Paul Drinkwater	Grower – Abbots Ripton Estate

Appendix 3

Pulse Panel - Research and Development Strategy for Field Beans, Combining Peas and Lupins (2013 - 2016)

The working strategy document of the PULSE PANEL.

The Pulse Panel is made up of Growers, trade and industry representatives. Meeting twice each year its' purpose is to give guidance and priority to the PGRO for the expenditure of Pulse Levy in the pursuit of grower led objectives concerning the production of combinable pulse crops.

By partnering with growers, other science and research organisations, and by collaborating with commercial industry, PGRO works to leverage additional resources and access EU and UK funds to compliment the levy contributions to deliver maximum effect.

The 5 key priorities identified by the Pulse Panel are as follows.

- 1: Deliver **YIELD STABILITY** by understanding and quantifying the influencing factors and providing recommendations to ensure its realisation.
- 2: **SOIL HEALTH** and plant and soil biological interactions greatly influence pulse crops. Provide recommendations for remedial actions and the delivery of soil health improvement.
- 3: Deliver **CROP NUTRITION** plans for modern production techniques providing recommendations for optimum performance.
- 4: **ENVIRONMENTAL CHANGE** will influence future cropping techniques. Deliver recommendations for growing in a changing environment.
- 5: **LEGISLATION UPDATES**: To provide relevant information which can be used to impact and promote production and consumption.

Objective 1: Deliver YIELD STABILITY by understanding and quantifying the influencing factors and providing recommendations to ensure its realisation, including the development of IPM systems and new crop protection products

Target	Initiative examples	Previous, pipeline, or current work	Priority 1-5 1 highest	Status Planned Current Emerging Gap Previous
General	Identifying traits for peas and beans for yield stability, disease tolerance and quality that can be used for breeding new varieties	Defra: PCGIN – Pulse Crop Genetic Improvement Network	1	Current
Pea weevil/thrips	Peas: Development of seed treatments Peas and beans: Investigate novel systems for control and monitor resistance issues	Evaluation testing in collaboration with chemical company (not currently being tested) IUK 101910: A novel 'lure and kill' system for the control of <i>Sitona lineatus</i> and <i>Bruchus rufimanus</i> . Project started in October 2014 to investigate the use of <i>Beauveria bassiana</i> , an entomopathogen, compared to a standard insecticide, used in a 'lure and kill' system to control pea and bean weevil, with a secondary target for bruchid beetle.	2 2	On-Hold Current
Aphids in beans	Field beans: Improved control and optimisation of product use	IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	2	Current
Bruchid beetle	Field Beans: UK crops at risk with severe losses in 2006/7 Control strategy required	Defra Link LK09102: Field beans: monitoring and control of bean seed beetle (<i>Bruchus rufimanus</i>) (ended) IUK 100871: A novel Monitoring and Forecasting System for the Integrated Management of Bean Seed Beetle <i>Bruchus rufimanus</i>	1	Previous Previous
Pea bruchid risk assessment	Peas: Risk assessment and mitigation strategy. Options for prevention. Communication needed following completion of RA	HDC fact sheet 01/12	1	Previous
Downy mildew	Peas: Improved control of secondary disease required as currently reliant on seed treatments. Further varietal tolerance studies and screening for foliar fungicides required	Peas: downy mildew varietal resistance (PGRO levy) Vining peas: Foliar control of downy mildew (PGRO levy/ Industry partners) HDC FV 436: Pea Downy Mildew diversity in the UK	1	Current Current Current

Objective 1: Deliver YIELD STABILITY by understanding and quantifying the influencing factors and providing recommendations to ensure its realisation, including the development of IPM systems and new crop protection products

Target	Initiative examples	Previous, pipeline, or current work	Priority 1-5 1 highest	Status Planned Current Emerging Gap Previous
	Spring beans: Foliar vs Seed treatment	Pulse levy funded investigation comparing seed treatment versus foliar applications		Current
Sclerotinia	Peas: Development of improved control strategy as disease becoming more frequent	SA Defra Link SA563/LK09130 Sustainable Arable Link: Reducing the impact of Sclerotinia disease on arable rotations, vegetable crops and land use (ended)	3	Previous
Pigeon control	Peas and beans: To be raised at AHDB by HDC for industry action	HDC FV426: A review of the woodpigeon costs to Brassicas, salad crops and oilseed rape and the effectiveness of management activities	1	Previous Planned
Chocolate spot	Field beans: Limited approved products and severe infection in 2008 and 2012	IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops HDC FV 355: Broad beans: Fungicide programme for chocolate spot control (ended) EUF7 – Legumes for the Agriculture of Tomorrow (LEGATO) – investigating resistance to chocolate spot	2	Current Previous Current Current
Ascochyta fabae	Field beans: development of improved control strategy	IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops EUF7 – Legumes for the Agriculture of Tomorrow (LEGATO) – investigating resistance to <i>Ascochyta fabae</i>	4	Current Current Current
Pulse Varieties	Peas and field beans: Variety evaluation Lupins: Variety evaluation Field beans: Optimum sowing density for field beans	Recommended List trials – Pulse Levy IUK 101084: An Integrated Program for the Development of Lupins as a Sustainable Protein Source for UK Agriculture and Aquaculture (LUKAA) IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	1	Current Current Current Current

Objective 1: Deliver YIELD STABILITY by understanding and quantifying the influencing factors and providing recommendations to ensure its realisation, including the development of IPM systems and new crop protection products

Target	Initiative examples	Previous, pipeline, or current work	Priority 1-5 1 highest	Status Planned Current Emerging Gap Previous
	Peas: Drought tolerance in peas	EUFP7 – Improving the resistance of legume crops to combined Abiotic and Biotic Stresses (ABSTRESS) – investigating drought tolerance in peas		
Mechanisation	Field Beans: Inter-row weeding using precision spraying equipment Peas: Use of vision guided spot sprayer for control of weeds	IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops HDC FV307b – Control of volunteer potatoes in vining peas	2	Current Current
Harvest guidance	Providing guidance for the most effective way to avoid losses at harvest		2	Gap
Visual quality retention	Providing guidance for the most effective way to retain visual quality of grains		2	Gap
Weed Control	Field beans: Inter row weeding and wide spaced rows with inter row glyphosate	IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops PGRO SRUC collaboration 2013 2014	3	Current
Resource management	Efficient use of energy	<ul style="list-style-type: none"> Alternative energy sources? Cold storage 	4	Gap
	Resource management	Direct drilling/ non-inversion in peas	3	Gap
Population	Peas: Assessing yields to determine optimum target populations Field beans: Assessing optimum plant population and drilling timing for yield	Pulse levy funding has been allocated to investigate plant population/ yield interactions IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	2	Current

Pod Set	Peas and beans: Maximisation and stability of pod set	TSB 10182: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	2	Current Gap for peas
Desiccation	Peas and beans: Most effective timing and comparative effectiveness of Diquat and Glyphosate	Pulse levy funding has been allocated to investigate further	2	Current

Objective 2. SOIL HEALTH and plant and soil biological interactions greatly influence pulse crops. Provide recommendations for remedial actions and the delivery of soil health improvement.

Target	Initiative examples	Previous, pipeline, or current work	Priority 1-5 1 highest	Status Planned Current Emerging Gap Previous
Pea yield decline/ Root diseases	Peas: Understanding the complex that is believed to cause this phenomenon and providing recommendations as to how to manage rotations to best effect Peas: Root rots are becoming an increasing problem with no plant protection products currently available for control. An evaluation of cultural methods of suppression is required and the use of bio fumigant cover crops. Evaluation of identification techniques.	HDC FV429: Towards the development of a laboratory based assay for the detection of Common Root Rot (<i>Aphanomyces euteiches</i>) in vining peas. HDC FV428: Vining peas – The effect of soil phosphate levels on rhizobial population. EUF7 – Improving the resistance of legume crops to combined Abiotic and Biotic Stresses (ABSTRESS) – investigating Fusarium root rots EUF7 – Legumes for the Agriculture of Tomorrow (LEGATO) – investigating resistance to <i>Mycosphaerella pinodes</i>	1	Current Gaps identified Current Current Current Current
Rhizobium and nodulation	Peas: The effect of soil phosphate levels on rhizobia populations	HDC FV428: Vining peas – The effect of soil phosphate levels on rhizobial population.	1	Current

Objective 3: Deliver <u>CROP NUTRITION</u> plans for modern production techniques providing recommendations for optimum performance				
Target	Initiative examples	Previous, pipeline, or current work	Priority 1-5 1 highest	Status Planned Current Emerging Gap Previous
Nutrition	<p>Peas and Field Beans: More information needed on P and K requirements and N residues</p> <p>Sulphur: Revisiting the potential need for sulphur (as a major nutrient) applications as a result of environmental change.</p>	<p>HGCA 3425/ HDC FV 345: Establishing Best Practice for determining soil nitrogen supply - addition of field Veg sites to HGCA project 3425</p> <p>HDC FV380: Identification of critical soil P levels in peas</p> <p>IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – investigating the residual benefit of N from field beans to the following crop – Sustainable Protein Crops</p> <p>HDC FV428: Vining peas – The effect of soil phosphate levels on rhizobial population</p>	1	<p>Previous</p> <p>Current</p> <p>Current</p> <p>Current</p> <p>Gap</p>
Production continuity	<p>The balance of supply and demand is crucial to determining market price:</p> <ul style="list-style-type: none"> • Forecasting supply and demand. • Techniques to alter crop maturity i.e. delay or bring forward harvest. • Improved storage techniques. 	<p>IUK 131422: Novel computer vision techniques for food quality analysis - identification of <i>Bruchus rufimanus</i> (bean seed beetle) damage in field beans (<i>Vicia faba</i>) for export for human consumption. Further development of the system is proposed</p>	4	<p>Previous</p>
Root development	<p>Ensuring stronger more vigorous root development and greater nodulation for improved nitrogen fixation and plant growth</p>	<p>HDC FV428: Vining peas – The effect of soil phosphate levels on rhizobial population</p>	1	<p>Current</p>
Micro nutrient studies	<p>Understanding the impact of Micronutrient benefits in crop health and providing recommendations</p>		4	<p>Gap</p>

Protein production	<p>Influence of foliar N applied at and shortly after pod set and its effect on yield and protein content</p> <p>To investigate links between protein content and yield and introduce new genetic material into breeding programmes</p>	<p>Studies show that N fixation declines abruptly after flowering. Just 10-16% of the total plant N requirement is fixed after flowering, just at the point when seed is being set.</p> <p>IUK 101079: Protein content vs yield in legumes: releasing the constraint</p>	2	<p>Gap</p> <p>Current</p>
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Objective 4: <u>ENVIRONMENTAL CHANGE</u> will influence future cropping techniques. Deliver recommendations for growing in a changing environment.				
Target areas	Initiative	Current or previous work	Priority 1-5 1 highest	Status Planned Current Emerging Gap Previous
Minimise risks of diffuse pollution (nitrate, phosphate, pesticides, silt)	<ul style="list-style-type: none"> • Is agriculture making a substantial contribution to diffuse pollution? • Fertigation techniques to minimise N and P pollution. • Improved drainage management • Efficient use of N,P & K • Precision farming, variable rate application 	<p>HGCA 3425/ HDC FV 345: Establishing Best Practice for determining soil nitrogen supply - addition of field Veg sites to HGCA project 3425</p> <p>HDC FV380: Identification of critical soil P levels in peas</p> <p>IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – investigating the residual benefit of N from field beans to the following crop – Sustainable Protein Crops</p>	1	<p>Previous</p> <p>Current</p> <p>Current</p>

Minimise climate change impact	Minimisation of nitrous oxide emissions in a range of crop types including vining peas and field beans – in addition, to establish the impact of returning crop residues	DEFRA Link LK09128– Minimising nitrous oxide intensities of arable crop products (MIN-NO) IUK 101082: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – investigating the residual benefit of N from field beans to the following crop – Sustainable Protein Crops (LCA)	2	Current Current	
Irrigation	Effect of irrigation post flowering on pod set and yield		3	Gap	

Objective 5: LEGISLATION UPDATES: To provide relevant information which can be used to impact and promote production and consumption

Target	Initiative	Previous or current work	Priority 1-5 1 highest	Status Planned Current Emerging Previous Gap
Encouraging Use and Consumption of pulses	Review of health benefits of pulses to be used to promote use and consumption. High Collaborative approaches to pulse promotion.	Pulse and Legume Research Network – new Defra: PCGIN – Pulse Crop Genetic Improvement Network Defra Link: QDiPS – Quality Determinants in Pea Seed	5	Current Previous
CAP reform	Interpret and provide guidance upon the impact of CAP reform for Pulse cropping		1	Gap
Changes in agro-	Identifying and anticipating changes in agro-chemical	IUK 101910: Lure-and-kill technology to manage	1	Current

chemical registrations	registration legislation and where possible proposing solutions to gaps created.	beetle pests (<i>Sitona lineatus</i> and <i>Bruchus rufimanus</i>) of field beans and peas – Innovate UK (TSB) with industry partners BASF, Oecos, Exosect and PGRO. Rothamsted Research as academic partner		
Pollinator strategy and review of benefits to pulses	Investigate the benefits of pollinators to UK pulses and the impacts that farming practices have on pollinators		2	Gap

Appendix 4

Processing Legume Industry Panel - Research and Development Strategy for Vining Peas, Green Beans and Broad Beans (2012 - 2015)

Objective 1: Ensuring adequate and sustainable crop protection measures are available for the key pests, diseases and weeds of each crop/category				
Target	Initiative examples	Previous, pipeline, or current work	Priority	PLiP Co-ordinator
Pea weevil/ thrips/ bean seed fly	Vining Peas: Development of seed treatment delayed	FV 58: Evaluation testing in collaboration with chemical company IUK 101910: A novel 'lure and kill' system for the control of <i>Sitona lineatus</i> and <i>Bruchus rufimanus</i> . Project started in October 2014 to investigate the use of <i>Beauveria bassiana</i> , an entomopathogen, compared to a standard insecticide, used in a 'lure and kill' system to control pea and bean weevil, with a secondary target for bruchid beetle.	HIGH	
Aphids in beans	Vicia faba: Improved control and optimisation of product use	TSB 10182: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops		
Bruchid beetle	Broad Beans: UK crops at risk with severe losses in 2006/7 Control strategy required	FV 184: Broad beans: monitoring and control of bean seed beetle (<i>Bruchus rufimanus</i>) FV 322: Broad beans: Management and control of Bruchid bean seed beetle TSB 100871: A novel Monitoring and Forecasting System for the Integrated Management of Bean Seed Beetle <i>Bruchus rufimanus</i> IUK 101910: A novel 'lure and kill' system for the control of <i>Sitona lineatus</i> and <i>Bruchus rufimanus</i> . Project started in October 2014 to investigate the use of <i>Beauveria bassiana</i> , an entomopathogen, compared to a standard insecticide, used in a 'lure and kill' system to control pea and bean weevil, with a secondary target for bruchid beetle.	HIGH	
Pea bruchid risk assessment	Risk assessment and mitigation strategy. Options for prevention. Communication needed following completion of RA	HDC fact sheet	Medium	
Slugs	Vining Peas: Improved control Industry initiative (AHDB) needed	FV 230: Vining peas: reducing risk of slug contamination FV 379: Leafy salads and Brassicas: Slugs - A review	Medium	
Downy mildew	Vining Peas: Improved control of secondary disease required as currently reliant on seed treatments. Further varietal tolerance studies and screening	FV 215: Peas: downy mildew control FV 436: Pea downy mildew diversity in the UK	HIGH	

Objective 1: Ensuring adequate and sustainable crop protection measures are available for the key pests, diseases and weeds of each crop/category				
Target	Initiative examples	Previous, pipeline, or current work	Priority	PLIP Co-ordinator
	for foliar fungicides required			
Sclerotinia	Vining Peas: Development of improved control strategy as disease becoming more frequent	FV 361 (SA Link SA563/LK09130) Sustainable Arable Link: Reducing the impact of Sclerotinia disease on arable rotations, vegetable crops and land use	HIGH	
	Green Beans: Development of improved control strategy as disease becoming more frequent	FV 361 as above	HIGH	
Pigeon control	To be raised at AHDB by HDC for industry action. Potential for investigation of bitterness genes		HIGH	
Chocolate spot	Broad Beans: Limited approved products and severe infection in 2008	FV 355: Broad beans: Fungicide programme for chocolate spot control TSB 10182: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	HIGH	
Ascochyta fabae	Vicia faba: development of improved control strategy	TSB 10182: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	Medium	
Root diseases	Vining Peas: An increasing problem with no chemicals available. An evaluation of cultural methods of suppression is required and the use of mustard bio fumigant cover crops. Build BBSRC proposal with WCC on bio-fumigants.	Proposal submitted to Agri-Tech Catalyst rejected for funding	HIGH	
Weed Control	Vining Peas: Volunteer potatoes - No herbicides available for peas. Post emergent product being evaluated. FV307a extension including pea row width to adapt spot weeder	FV 307b: Vining and podded peas: control of potatoes by vision guided spot spraying FV 243: Vining peas: the use of mechanical weeding techniques	HIGH	
	Vining Peas: Post emergence broad leaved weed control - Limited products available. Evaluation of potential products and management of existing products is required	FV 181: Volunteer oilseed rape control in vining peas and broad beans	HIGH	
	Vining Peas: Loss of pre and post emergence herbicides with limited number of products available. Screening of potential products for both pre and post and management of applications and product use required	FV 256c Continuation - solutions to the loss of active ingredients for weed control in vegetable crops	HIGH	
	Green Beans: Loss of pre emergence and limited post emergence products available		HIGH	

Objective 2. Increase returns on investment through efficient use of resources				
Target	Initiative examples	Previous, pipeline, or current work	Priority	PLiP Co-ordinator
Nutrition	Vining Peas: More information needed on P and K requirements	FV 345: Establishing Best Practice for determining soil nitrogen supply - addition of field Veg sites to HGCA project 3425 FV 354 Dwarf green beans: Evaluation of Rhizobium inoculant for nitrogen fixation FV380: Identification of critical soil P levels TSB 10182: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	HIGH	
Potato apples in vining peas		Investigate options for processing control	HIGH	
Pea maturity		Investigate possible options for current cross check standards and validation of products	HIGH	
Mechanisation	Vicia faba: Inter-row weeding using precision spraying equipment Harvesting technology for Mange Tout peas	TSB 10182: Improving the availability of UK sourced protein feed through new faba varieties, production and utilisation systems – Sustainable Protein Crops	HIGH	
Crop storage				
Efficient use of water resources	Drought tolerance in vining peas.	FV 363 HortLink: developing precision irrigation for field scale vegetable production, linking in-field moisture sensing, wireless network CP 54 Rhizobacteria to reduce water use and enhance crop quality (HDC Studentship)	HIGH	
Efficient use of energy	<ul style="list-style-type: none"> • Alternative energy sources? • Cold storage 			
Waste management	<ul style="list-style-type: none"> • Recycling of crop covers • Composting and use of pack house waste 			
Staff management	Labour efficiency	FV 298 - Production of increased labour efficiency models in field veg		
Resource management	Direct drilling/ non-inversion in vining peas			

Objective 3: To supply consistent quality product and continuity and to achieve customer satisfaction				
Target	Initiative examples	Previous, pipeline, or current work	Priority	PLiP Co-ordinator
Vining Pea Varieties	<ul style="list-style-type: none"> Variety evaluation - Limited sites for trials Site on a silt soil type now running at Holbeach Variety performance at optimum sowing times, Optimum sowing density for varieties - Only limited indications that this may be necessary Drought tolerance Pre-germinated seed 	<ul style="list-style-type: none"> FV 154, 154a, b & c: Vining Peas: Evaluation of new and established varieties sown at appropriate commercial timings FV 340 Vining Peas: Extension of variety evaluation trials 	HIGH LOW	
Broad Bean Varieties	No variety trials undertaken since 1999 Broad bean variety evaluation trial for fresh market	<ul style="list-style-type: none"> FV 182: Evaluation of new and established broad bean varieties for processing FV 369 Broad bean: evaluation of varieties 	HIGH	
Sugar snap varieties	Variety evaluation for stringiness. Screening trial for 2013.			
Production continuity	The balance of supply and demand is crucial to determining market price: <ul style="list-style-type: none"> Forecasting supply and demand. Techniques to alter crop maturity i.e. delay or bring forward harvest. Improved storage techniques. 			
Improving product quality	<ul style="list-style-type: none"> Influencing agronomic and pre-harvest factors. 	<ul style="list-style-type: none"> FV 295: Carbon dioxide as muscle relaxant for removal of invertebrates in salad crops FV 351: Understanding Quality Determinants in Pea Seeds 		
Improving the quality of flavour/nutritional aspects	<ul style="list-style-type: none"> Flavour and colour 	FV 196: Vining peas: commercial assessment of near infrared (NIR) spectroscopy for measuring pea maturity		
Shelf life and storability				

Objective 4: Develop technologies and practices that will keep the sector ahead of changing EU and government legislation that affect agriculture and horticulture

Target areas	Initiative	Current or previous work	Priority	PLiP Co-ordinator
Minimise risks of diffuse pollution (nitrate, phosphate, pesticides, silt)	<ul style="list-style-type: none"> • Is horticulture making a substantial contribution to diffuse pollution? • Fertigation techniques to minimise N and P pollution. • Improved drainage management • Efficient use of N,P & K • Precision farming, variable rate application 	FV 345		
Waste management				
Securing water supplies	How to define the footprint – understanding required	Factsheet 07/05 'Securing your water supply for the future' (Abstraction and Supply issues)		
Minimise climate change impact	Minimisation of nitrous oxide emissions in a range of crop types including vining peas and Vicia faba – in addition to establish the impact of returning crop residues	DEFRA Link LK09128– <i>Minimising nitrous oxide intensities of arable crop products (MIN-NO)</i>		

Objective 5: To provide information which can be used to promote the consumption vegetables

Target	Initiative	Previous or current work	Priority	PLP Co-ordinator
Encouraging Consumption	<ul style="list-style-type: none"> • Review of health benefits of legume vegetables to be used to promote consumption. • High Collaborative approaches to Legume/vegetable promotion. 	HDC Board-funded promotion to encourage consumption of seasonal British produce		

Appendix 5

Chairman's Report PGRO 2014

The 2014 PGRO year can possibly be best described as the year of growing confidence. The UK area sown with pulses, although marginally below the previous year, was still above the historic lows of the 2012 crop. Although the crop was planted late in wet conditions, during the growing season near ideal conditions were experienced by the growing crop, resulting in generally speaking excellent yields coupled with good prices. Hence for a significant number of pulse levy payers their 2014 pulse crop became one of their top performers in terms of financial returns. During the first half of 2014 pulse trading was very slow, with the result that levy income to PGRO was both low and well below budget. It was not until the latter part of the year that trade volumes increased and consequently PGRO levy income improved markedly.

During the middle of the year the EU commission published its CAP reforms. These proposals, when implemented through a number of new rules and regulations, appear to be favourable to a potential expansion of the pulse area in the UK. Both the environmental aspects of the new rules and the restriction on the use of a number of widely used active ingredients should lead to a return to a slightly wider rotation in arable cropping. The lesser use of pesticides in a number of non-cereal crops widely grown during for the last twenty years, is likely to result in a reduction in crops with a heavy insecticide use, thus leading to a clear opening for alternative non-cereal cropping such as peas and beans. The first tentative signs of an increased interest in winter sown beans were evident during autumn 2014. There is thus a big opportunity for PGRO to provide guidance to the industry.

For a large number of years the organisation has tried to come up with the right answer to the criticism levelled at PGRO that insufficient trials were located on typical pulse growing soils. It is thus very pleasing to note that during the year PGRO has been able to conclude an arrangement with Beeswax Farming to extend the trial locations which can be serviced from our administration base at Thornhaugh. Consequently PGRO now has 6 sites in the area Bourne, Wisbech, Boston, Lincoln, Newark with varying soil types, suitable and typical of pulse growing, to provide multi trial sites for both herbicide and varietal work for both dried pulses and vining peas.

Forecasting PGRO's income is and remains a difficult task. The UK agricultural statistics for pulses are poor. As a consequence of the change of the DEFRA June census being carried out on a sample basis in 9 out of 10 years, the accuracy of the data gathered for minor crops such as pulses has suffered significantly. Couple this poor area sown information with the annual variability in yield potential plus variations in marketing patterns of the crop between years, then it should be self-evident that PGRO's management is faced with a near impossible task to accurately forecast the pulse levy income. The pulse levy which is made up for about 80 % from levy on the trading in dried pulses and for 20% on fresh pulse trading, accounts for about half PGRO's income, the other half being from contract work.

Contract work for both the private sector and Government sponsored work are, and remain, an essential part of PGRO's activities. Private sector work can be either field or laboratory based. For many years PGRO has enjoyed GEP status and it is pleasing to report that during the year PGRO also achieved GLP accreditation, enabling chemical residue studies to be undertaken. This will provide potential additional revenue opportunities in the future. Private funded work for both herbicide and varietal work has contributed its traditional share to the organisation and the first signs are that due to the better trials facilities now on offer, there is increasing interest from these sectors in cooperating with PGRO. The Government sponsored work is undergoing significant changes. A number of longer term projects are coming to fruition and the funds available for replacement work appear to be less with additional administration requirement, which is putting a significant amount of strain on the team. We also have to look more towards fundamental work funded by pan European institutions. It is equally evident that PGRO will need to be working more closely with universities in order to attract UK Government funded projects. In order to help to understand this process better, it is encouraging to note that Professor Mike Gooding, Director for the Institute of Biological, Environmental and Rural Sciences (IBERS) at Aberystwyth University has joined the PGRO Board and we look forward to his input in helping PGRO.

During 2014 the Board adopted a new strategic plan covering the period 2014-2018. This should provide the CEO and his team with clear aims which the Charity wishes to achieve.

The Board is indebted to both the organisations staff and to the levy collectors. Without the expertise and dedication to duty of our staff, PGRO would not be seen as a credible provider of agronomy and

related advice and thus neither our levy payers nor our contract customers would be inclined to use and pay for the organisations services. Our levy collectors are responsible for collecting the voluntary PGRO levy, which raises close on half the organisations income. From my position I wish to express sincere thanks to both groups.

The usual Trustee's Report and Financial Statements show that over the 2014 trading year PGRO reserves have increased by £191,057 whilst at the same time the PGRO continued to fulfil its charitable aims. This would not have been achieved without clear management guidance and diligent cost control exercised by both our CEO and his management team and for this they deserve our thanks. The cooperation and constructive and wide ranging discussions with both the Board and the Management and Finance Committee I hope have contributed to these results.

Bram van der Have, June 2015

Appendix 6

LEVY COLLECTORS

1. *PULSE CROPS*

2 Agriculture Ltd.
Acorn Arable Ltd.
Adams & Howling Ltd.
ADM Direct
Agrii – A divn of Masstock Arable Ltd
S.C. Andrews & Son
Robin Appel Ltd.
Argrain Ltd.
Armstrong, Richardson & Co. Ltd.
Askew & Barrett (Pulses) Ltd.
H. Banham Ltd.
Bartholomews (Chichester) Ltd.
Henry Bell & Co. (Grantham) Ltd.
Andrew Bird (Seeds & Services)
Bodle Bros. Ltd.
Campbell & Penty Ltd.
Cherwell Valley Silos Ltd.
Chilton Grain Ltd.
W.A. Church (Bures) Ltd.
Cotswold Agricultural Merchants
A.L. Cox & Sons Ltd.
Criddle & Co. Ltd.
Crop Marketing (Groups) Ltd.
Dalmark Grain Ltd.
J.E. & V.M. Dalton Ltd.
G. O. Davies (Westbury) Ltd.
Dengie Crops Ltd.
Dodson & Horrell Ltd.
Dunns (Long Sutton) Ltd.
John Ebbage Seeds Ltd.
Ellingham Grain Ltd.
Elsoms Seeds Ltd.
Fengrain Ltd.
Fengrain (Services) Ltd.
John Foad & Co.
FramFarmers Ltd.
Frontier Agriculture Ltd.
Glasson Grain Ltd.
Gleadall Agriculture Ltd.
Glencore Grain UK Ltd.
Peter Glossop Seeds
GrainCo Ltd
Grainlink Ltd.
Harlow Agricultural Merchants
Henson & Jackson Retail Ltd.
Hubbards Seeds
J.S. Hubbuck Ltd.
l'Anson Bros. Ltd.
A. Inglis & Son

Charles Jackson & Co. Ltd.
Robert Kerr Agriculture Ltd.
Limagrain UK Ltd.
W.N. Lindsay Ltd.
Maviga Europe Ltd.
James Mortimer Ltd.
Nidera UK Ltd.
Openfield Agriculture Ltd.
Organic Arable Marketing Co. Ltd.
Peters Commodities Ltd.
Premium Crops Ltd.
Saxon Agriculture Ltd.
Scotgrain Agriculture Ltd.
Senova Ltd.
Simpson Malt Ltd.
Soya UK Ltd.
David Trethewey Seeds
United Oilseeds Marketing Ltd.
R.W. Warnock Ltd.
Wellgrain Ltd.
Wessex Grain Ltd.
Westland Horticulture Ltd.
Weston Mill Farming Co.
Wherry & Sons Ltd.
G. Williams & Co. (Grain) Ltd.
G. Williams & Co. (Seeds)
Witney Grain Ltd.
Charles Wright & Sons Ltd.

2. *VEGETABLE CROPS*

Anglian Pea Growers Ltd.
Aylsham Growers Ltd.
Beeswax Farming (Rainbow) Ltd.
Bishop Farm Partners
W.P. Bruce Ltd.
R. Caudwell (Produce) Ltd.
Fen Peas Ltd.
J.W. Grant & Co.
The Green Pea Co. Ltd.
A & E G Heading Ltd.
Holbeach Marsh Co-Operative
Mack Multiples
Scottish Borders Produce Ltd.
Stemgold Peas Ltd.
Swaythorpe Growers
K.H. Taylor Ltd
Birds Eye Ltd and their growers
Wootton Marsh Farms

Appendix 7

ASSOCIATE MEMBERS

The following were Associate Members of the Organisation at 31st December 2014

UNITED KINGDOM

Acorn Seeds
Agrichem (International) Ltd.
Agrii – Trading div of Masstock Arable UK Ltd.
Agrii – Trading div of United Agri Products Ltd.
Agrivice Ltd.
Agrovista UK Ltd.
Allen Agriculture Ltd.
A.P. (East Anglia) Ltd.
Bartholomews Agri Food Ltd.
BASF Plc
Bayer CropScience Ltd.
BCS Agriculture Ltd.
Belchim Crop Protection Ltd.
Birds Eye Ltd.
British Society of Plant Breeders Ltd.
Certis Europe
Chelmsford & W Essex Training Group
Coles, K.S.
Coy, C.R.
Dodman Ltd.
Doug Balderson Agriculture Ltd.
Du Pont (UK) Ltd.
Elsoms Seeds Ltd.
Eurofins Agrosociences Ltd.
Field Technique Ltd.
Finlays Fresh Produce UK Ltd.
Freemantle, M.J.
Frontier Agriculture Ltd.
Harper Adams University College
Hartpury College
Headland Agrochemicals Ltd.
H.L. Hutchinson Ltd.
l'Anson Bros. Ltd.

James Hutton Institute
J.S. Frozen Foods Ltd.
Limagrain UK Ltd.
Lincoln, University of
L.S. Plant Breeding Ltd.
Mack Multiples
Makhteshim-Agan (UK) Ltd.
Monsanto UK Ltd.
Norman & Spicer (Agrochemicals) Ltd.
Nottingham, University of
NuFarm Ltd.
Pinguin Foods UK Ltd.
PMC Harvesters Ltd.
Prime Agriculture LLP
Princes Ltd.
Procam UK Ltd.
Pro-Veg Seeds Ltd.
REA Agronomy
Royal Agricultural College
Sandfields Farms Ltd.
SAC FBS Office
Scottish Borders Produce Ltd.
Syngenta Crop Protection Ltd.
David Trethewey Seeds
Trevan Cropcare Ltd.
A.L. Tozer Ltd.
United Phosphorus Ltd.
Walford & North Shropshire College
G. Williams & Co. (Seeds)
Woodheads Seeds Ltd.
Writtle College
Zantra Ltd.

OVERSEAS

Agis, Germany
Agro Seed Services bvba, Belgium
Alterra SA, Greece
Barba Stathis SA, Greece
W. Brotherton Seed Co. Inc., USA
Canterbury Seed Co. Ltd., New Zealand
Crites Seed Inc., USA
Dept. of Industry & Investment – Primary
Industry & Investment, Australia
Findus Sveridge, Sweden
Hans-Georg Lembke KG, Germany
Inagro VZW, Belgium
Massey University, New Zealand
Midland Seed Ltd., New Zealand

Novozymes France S.A.S., France
Nunhems Netherlands BV, Holland
PGG Wrightson Seeds Ltd., New Zealand
Plant & Food Research, New Zealand
Ploeger Machines BV, Holland
Pop Vriend Seeds BV, Holland
Seneca Foods Corporation, USA
Strube Espana SA, Spain
Toft Plant Breeding, Denmark
Van Waveren-Saaten GmbH, Germany
Vegras CVBA, Belgium
Vilmorin SA, France
Charles R. Wynne Ltd., Eire
Yaadim Development Corporation, Israel

* Joined during 2014

Processors & Growers Research Organisation

The Research Station, Great North Road, Thornhaugh, Cambridgeshire PE8 6HJ, UK

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