



CIRC • CROP IMPROVEMENT RESEARCH CLUB

CIRC: FIRST CALL FOR GRANT APPLICATIONS

INTRODUCTION

Food security for the UK, and internationally, is becoming an increasingly important issue and is a major strategic priority for the BBSRC. An increasing global population combined with global climate change, the potential spread of newly emerging diseases of livestock and crops, and economic issues such as the volatility of oil prices threaten global food security and an urgent response is required. The BBSRC is leading the development of a food security programme together with other funders, to coordinate research efforts in this area.

As a result of discussion with industry and direction from the BBSRC's Bioscience for Industry Panel, crop improvement has been identified as an area where increased investment in research activity would underpin the needs of the crop production and processing industry to address the challenges of climate change and food security.

In order to bring together industry and the research community to support research in the area of crop improvement BBSRC, the Scottish Government and industry have launched a Crop Improvement Research Club (CIRC). The Club will focus on barley, oilseed rape and wheat and their use in food production for humans and animals.

13 companies have agreed to join CIRC to date. CIRC will support research projects from a joint fund totalling £5.95M (£545k of which comes from industrial membership subscriptions, £500k from the Scottish Government and £4.905M from the BBSRC).

CLUB AIMS

The aims of CIRC are:

- To support high quality, innovative, basic research within UK universities and institutes. This research will underpin the development of improved crop production systems that deliver increased productivity and consistent, high quality end products.
- To help strengthen and develop the research community in the areas of crop breeding, production and processing through interdisciplinary research and the provision of training;
- To ensure the transfer of knowledge between the science base and industry through the support of effective networking between academic groups and companies involved in CIRC.

FIRST CALL FOR PROPOSALS

Submissions are invited to the first call for proposals of CIRC. There is a two stage application procedure. Initially, proposals must be submitted on the outline proposal form, which is available on the Research Councils' Joint Electronic Submission system (Je-S; <https://je-s.rcuk.ac.uk>). The closing date for outline proposals is 28 April 2010. Subsequently, full proposals will be invited from applicants successful at the outline stage. Approximately £3M is available for grant awards in this round. The funding is from a common pot with contributions from the BBSRC, The Scottish Government and Industry. Further details on specific guidelines for the call are in **ANNEX 1**.

Proposals may address any aspect of the CIRC research challenges as described below.

The focus of CIRC research will be on understanding the underlying molecular and biochemical mechanisms behind important crop traits in barley, oilseed rape and wheat. Projects supported through CIRC will address key challenges to industry through pre-competitive, innovative and excellent science.

Alongside the research challenges identified below, a number of current and emerging technologies exist that could make important contributions to fulfilling the research aims of the Club. CIRC would welcome proposals that improve or develop the use of these technologies, whilst addressing the research challenges described. Examples of important technology areas include:

- Genetic modification, which should be considered as a tool in tackling the research challenges.
- Next generation sequencing technologies that may allow step changes in the way research challenges are addressed, within the life span of the Club.
- New remote sensing screening tools that enable high-throughput phenotyping for traits in breeders' trials.

Where appropriate, projects supported by the Club should make use of systems approaches to research challenges incorporating mathematical and computational modelling to understand the behaviour of whole systems.

CIRC will work closely with other funding initiatives such as the Technology Strategy Board's Sustainable Agriculture and Food Innovation Platform and the relevant Defra Genetic Improvement Networks to ensure that activities are complementary and capitalise on opportunities to work collaboratively.

It is crucial that research funded through CIRC is strategically relevant to the crop breeding, production and processing industry sectors. Applicants will need to demonstrate this strategic relevance and to identify the likely impacts and routes to impact of their proposed research.

RESEARCH CHALLENGES

There is an urgent need to develop crop varieties with greater yield potential and the ability to deliver this sustainably with reduced inputs and without detrimental effects on the local ecosystem. Equally, new crop varieties are required that reliably and consistently produce high quality products that are safe, nutritious and meet end-user requirements.

The challenge for industry will be to achieve high yielding, high quality varieties that perform well in a commercial context against a background of greater environmental instability; particularly as a result of climate change. Within this context the focus of CIRC will be to develop a greater understanding of quality and yield traits and of the complex genetic and environmental factors affecting them.

Some important research challenges highlighted by industry are listed below. This list is not exhaustive and other traits that demonstrate commercial potential may be identified, especially in liaison with industry.

Clearly there is overlap between some of the research challenges identified below. Proposals that cut across more than one research challenge are encouraged.

- **Increasing Nutrient Use Efficiency**

Improving the efficiency with which crops use nitrogen and other nutrients is an important research challenge for a variety of reasons, e.g. reducing chemical inputs, reducing the emissions of green house gases (GHGs) from the agricultural sector, reducing the pollution of water courses and the wider environment, and reducing farm costs. In addition, increased nutrient use efficiency is likely to improve the productivity of crops, their range and in some cases may help to improve crop quality, e.g. through effects on the composition of protein in wheat.

There is a pressing need for better knowledge of root function, especially root interaction with the nitrogen cycle and with other key nutrients such as phosphate, potassium and sulphur. Greater understanding of nutrient metabolism and of the remobilisation of nutrients to seed tissues during grain fill and senescence will also be vital.

- **Combating Pests and Diseases**

Pests and diseases cause major losses to crop production world-wide. The use of agrochemicals requires industrial processes, transport and machinery that contribute to GHG emissions, farm costs and soil compaction. Furthermore, their application can lead to toxic effects for the environment and humans. The use of pesticides will need to be reduced in the future in line with new regulations and the reliance on alternative approaches, in particular genetic resistance, will become vital.

Responding to this research challenge will require the identification of genetic resistance to pest and disease organisms, through specific or general defence mechanisms including tolerance mechanisms. These traits will then need to be incorporated into new varieties in ways which optimise their efficacy (e.g. through pyramiding of several genes) without detrimentally affecting overall crop performance. New genetic strategies will also have to take into account the different and sometimes contradictory approaches needed to target specialist and generalist organisms. Greater understanding of plant defence strategies is required; this includes the study of plant semiochemicals and methods for eliciting natural defence responses.

The drivers for this research challenge are similar to those for the Technology Strategy Board's Sustainable Agriculture and Food Innovation Platform competition "New Approaches to Crop Protection"; however, this is an entirely separate funding initiative. The types of project funded will be different from the Sustainable Agriculture and Food Innovation Platform initiative due to CIRC's focus on underpinning scientific knowledge rather than the

development of innovative products, methods or systems favoured by the Technology Strategy Board.

- **Increasing Yield Potential**

Research is required into how to increase the yield potential of crops and to help ensure this yield potential is realised in the field as marketable products.

Research in this area will need to consider a broad range of traits that influence the potential and actual yield of crop varieties. This will involve work in a number of areas including, but not exclusively, crop architecture, photosynthetic efficiency, crop phenology, resource partitioning and their interactions with hybrid vigour. Seedling establishment is a particularly important challenge in the context of oilseed rape and research in this area is urgently required.

Most of the developments in the area of yield potential are likely to be delivered through improved crop varieties combined with optimised agronomic practice.

- **Seed Structure and Composition**

Research is required to improve the understanding of factors that affect the structure and composition of seeds. As the seed is the commercially valuable component of all three crops covered by CIRC, understanding these factors is vital for optimising quality. The structure and composition of the seed affect quality from a process and consumer perspective.

The following aspects of seed structure and composition have been highlighted by industry as being particularly important; however this list is not exhaustive and other areas may be identified, especially in liaison with industry:

- **Protein quality and functionality in wheat**
New wheat varieties are needed that will consistently deliver the quality requirements of the milling and baking industries.
- **Non-starch polysaccharide functionality in wheat and barley**
Non-starch polysaccharides (NSPs) are an important constituent of wheat and barley grains and have significant effects on quality. Greater understanding is needed of the metabolism and deposition of NSPs in the grain tissues as well as their behaviour and effect on grain quality during the processing of flour and malt and in the subsequent end products.
- **Starch functionality in wheat and barley**
Starch is a major component of wheat and barley grains and has fundamental quality implications for both. There is an important need to improve our understanding of starch properties and to develop varieties that meet industry quality requirements.
- **White wheat varieties**
White wheat varieties produce whole grain flours that combine the palatability of refined flours from red wheat varieties with the nutritional value of whole grain flour. All of the major hard and soft wheat varieties currently grown in the UK are red and there is a strong need to develop white varieties that are suitable for cultivation in this country.
- **High malt yield in barley**
The most important single quality characteristic for brewing and distilling end users of malting barley is high malt extract. There is a need for greater understanding of the factors influencing malt extract which include seed composition and structure aspects

such as grain filling, starch/nitrogen interaction, enzyme development and starch properties.

- **Germination Properties**

The germination properties of seeds have important implications for quality as well as for crop establishment. Climate change will increase the importance of improving our understanding of dormancy and germination.

- **Barley**

Improved understanding of grain germination is one important component of delivering consistent, high quality malted barley, as it could lead to varieties with reduced occurrence of pre-harvest sprouting, better control of dormancy and grain with improved uniformity during the malting process leading to higher malt yields. The complex biochemical changes in the grain during malting include not only factors influencing starch, protein and NSPs (see above) but also relatively minor components which might have important end user implications.

- **Wheat**

Grain germination properties are also of great importance to the quality of wheat. As with barley, pre-harvest sprouting of wheat grains in the ear causes major losses of yield during poor growing seasons. Germination leads to the hydrolysing of starch reserves which ruins the processing quality of wheat. Improved knowledge of the processes of dormancy and germination is required so that varieties can be produced which are less prone to pre-harvest sprouting, but which germinate uniformly when planted.

- **Spoilage Factors**

A number of important spoilage factors can affect the quality of crop products from oilseed rape, barley and wheat. These factors are of great significance to industry as they can lead to considerable reductions in quality and yield. It is important to improve understanding of the processes involved in spoilage and to develop varieties that are less prone to damage. The following areas have been highlighted as important by industry:

- **Reducing the occurrence of mycotoxins**

The infection of cereal grains with fungal pathogens can lead to the accumulation of elevated levels of mycotoxins, which are harmful to human health. EU regulations limit the permissible levels of some of these toxins in both wheat and wheat products for human consumption. New varieties are required that are resistant to fungal infection during growth and post-harvest storage; however the emphasis should be placed on resistance to infections in the field. Better understanding of the host - pathogen relationship and of the development of these fungal diseases will help to deliver improved varieties and fungicides and will inform management practices that reduce their incidence.

- **Climate related spoilage**

Climate change is likely to produce more fluctuations during the growing season that will increase the occurrence of grain damage factors. For example in barley, skinning, splitting and sprouting, can lead to reduced malt extract and/or processability. It is important that we develop varieties that produce high quality seeds, even when grown under conditions of greater climate variation.

GUIDELINES FOR CALL

- The objectives of the research proposed must fit within the CIRC research challenges and must fall within the remit of BBSRC.
- Research proposals are sought for funding for up to five years.
- Outline proposals must be submitted in the first instance.
- It is likely that the aims of CIRC can best be achieved by an interdisciplinary approach. Collaborative applications which bring together groups with relevant expertise are therefore particularly encouraged.
- Total funding of around £3 M is available for this first call to support a portfolio of projects at FEC.

CRITERIA FOR ASSESSMENT

The primary criteria for assessment are the quality of science proposed and the strategic relevance to CIRC. It is expected that any proposal that goes on to be funded through CIRC will be competitive against comparable international work and will demonstrate alignment with the Club's aims. Proposals will be assessed against the following criteria:

- **Scientific Excellence**
The extent to which the proposal meets the highest international standards of current research in its field. High performance against this factor will indicate a project of the highest standard, competitive with the best activity anywhere in the world, demonstrating originality and innovative potential.
- **Strategic Relevance to CIRC**
Demonstrated alignment with CIRC research challenges, relevance to the crop breeding, production and processing industry sectors and balance of overall CIRC research portfolio.
- **Economic and Social Impact**
The extent to which the output of the research will contribute knowledge that shows direct potential for economic return or societal benefits to the UK.
- **Timeliness and Promise**
The extent to which the proposal is particularly appropriate at the present time, or offers longer-term benefits over and above the direct value of the research.
- **Cost Effectiveness**
The extent to which the resources requested, relative to the anticipated scientific gains, represent an attractive investment of BBSRC funds.
- **Staff Training Potential of the Project**
Where resources are requested for postdoctoral or other research staff please comment on the extent to which the proposed project will provide research training and development opportunities of benefit both to the individual(s) employed, and to the wider science base beyond the completion of the specific project.

SPECIAL CONDITIONS

Recognising the financial support for the programme from industrial members of the Club, it should be noted that special conditions will be attached to any research grants from CIRC. A letter from the institution's technology transfer office or equivalent, acknowledging that the institution is able to accept those conditions relating to IP, will be requested at the full proposal stage. The conditions are as follows:

- Grant holders will be expected to liaise with the external coordinator of the club, making available progress reports as requested and participating in meetings with both industrial members and other participants

- To respond to requests from BBSRC regarding project outcomes as required, following the end of the award

- **Early Access**

Commercial parties are entitled to early access to results from research funded by the Club. To ensure this grant holders must:

- Give a minimum of 28 days notice of an intention to publish, outside of the Club, results from research funded by a Club grant. The material for proposed publication should be submitted to the Club coordinator along with the notice of intent to publish. The coordinator will distribute a copy of the same to each of the industrial members within seven days of receipt; who shall then have 21 days to inform the coordinator if in their view the proposed publication may:
 - (i) dilute or prejudice the value of proprietary information of an industrial member or
 - (ii) jeopardise the application for resulting IPR protection or
 - (iii) otherwise inhibit future exploitation of the results where an industrial member has an interest in exploiting those results.

The coordinator will feedback comments to the grant holders who will be expected to consider the advice with their technology transfer officer. If an industry member wishes to enter into negotiations with a grant holder regarding exploitation of IP, these negotiations may be pursued as outlined "Access to Resulting IPR".

- Produce annual progress reports. A form will be available on the website for grant holder to complete and grant holder will be notified in advance when the final report will be due.
- Attend and present the results and progress of Club funded research at 6-monthly Club dissemination events. Grant holder will be notified of the dates and format of their presentation.
- Give advance notification of any opportunities to exploit intellectual property arising from their grant to the industrial members.

- **Access to Resulting IPR**

Industrial members are entitled, if they wish, to engage in good faith negotiations with the grant holders for terms of access to the resulting IPR to allow further development or commercial exploitation of results, such access rights preferably to include the right to sublicense. This must be offered before access to resulting IPR can be offered to third parties outside the Club. An interested Industrial member can exercise its option right by giving notice to the grant holder within two months of the date of receipt of notice of results or resulting IPR.

- **Good Faith Negotiations**

Good faith negotiations imply a willingness to reach agreement with industry members on the terms and conditions of a commercial licence, to desist from publishing results or making offers to third parties while negotiation with industrial members are ongoing and, if such agreement is not reached within a reasonable period (for example four months from the exercise of the option) the grant holder will not seek to enter into negotiations with third parties on terms substantially more favourable to such third parties.

APPLICATIONS PROCEDURE

There is a 2-stage application process:

- Outline proposals must be submitted in an electronic form using the Je-S system. CVs of all applicants (maximum 2 pages per applicant) and a completed Case for Support document (please see the Downloads section of the website at www.bbsrc.ac.uk/circ) should be uploaded to Je-S. Please read the CIRC outline proposal Je-S guidance notes (also in the Downloads section of the website).
- The closing date for outline proposals is **28 April 2010, 4pm**. A workshop will be held on 24 March at the Royal Society to facilitate the development of research proposals by enabling applicants to discuss their ideas with CIRC industry members.
- Successful applicants will be invited to write a full proposal in May 2010 for submission by August 2010 (dates are for guidance only and may be subject to change).
- Impact statements will be required at the full proposal stage and these should be formulated to meet the needs of the crop breeding, production and processing industry sector.

ASSESSMENT

Outline proposals will be assessed by the CIRC Steering Group and will not be externally reviewed. Full proposals will be externally peer reviewed prior to final assessment by the CIRC Steering Group. The decision to fund proposals will be announced in January 2011 (dates are for guidance only and may be subject to change). Further details on assessment are as follows:

- In order to be considered fundable proposals must demonstrate both scientific excellence and strategic relevance to CIRC.
- The Steering Group consists of a chair, 7 academic members (nominated by BBSRC) and 7 industrial representatives (chosen by the CIRC Industry Members). Steering Group membership is shown on the website (www.bbsrc.ac.uk/circ)
- For assessments conducted by the Steering Group, each full proposal has two Introducing Members (IMs). One IM is from academia and the other is from industry.
- The procedure for dealing with conflicts of interest (e.g. where a Steering Group member has pre-existing links to an applicant) is the same as for other BBSRC Research Committees. Conflicted individuals leave the room while the proposal is being discussed.
- Outline and full proposals may be circulated to company members of CIRC that are not represented on the Steering Group to seek their views. Any comments provided by company members will be taken into account by the Steering Group when the proposal is assessed.

STUDENTSHIPS

Due to the need to foster development of research skills in this sector **5, 4-year Targeted Priority Studentships** in the area of crop improvement are available as part of this call.

These studentships will be awarded formally as part of CIRC. Funding for awarded studentships will start in 2011/12.

The competition for these studentships will be held later in the application process when further details will be provided on how to apply. No information on potential studentship projects is required at the outline stage.

Studentships will only be awarded to applicants receiving a research grant under this call.

ELIGIBILITY

UK Higher Education Institutions, Independent Research Organisations and BBSRC-sponsored institutes are eligible to apply. In addition, the contribution of £0.5M to CIRC from the Scottish Government's Rural Environment Research and Analysis Directorate (RERAD) means that the Main Research Providers (MRPs) of RERAD are also eligible. This includes the Moredun Research Institute, The Macaulay Land Use Research Institute, the Scottish Crop Research Institute (SCRI) and Biomathematics and Statistics Scotland (BioSS).

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