Minutes of the PCGIN meeting held on
Monday June 20th 2005 at
PGRO Thornhaugh, Peterborough

Present:

PGRO	Geoffrey Gent	(Chair)
	Anthony Biddle	
	Stephen Belcher	(Agenda item 6.)
JIC	Noel Ellis	
	Claire Domoney	
	Mike Ambrose	
	Catherine Chinoy	
	Lynda Turner	
NIAB	Jane Thomas	
	Simon Kightley	
	Haidee Philpott	
	Donal O'Sullivan	
DEFRA	Bruno Viegas	
CSL York	Adrian Charlton	
Unilever	Frances Bligh	
Advanta	Keith Fox	
EUGLIP TTP	Frédéric Muel	
	Catherine Golstein	

1. Apologies

These were received from Chris Goodsall.

2. Welcome and Introduction **Geoffrey Gent**

The Chairman welcomed the participants and emphasised the need to keep to the schedule because of a further meeting at PGRO in mid afternoon.

3. Objectives

i) PCGIN Communication and Delivery **Noel Ellis**

Summary notes**:**
The meeting aimed to review progress and identify work needed to reach target objectives, as follows;

a) establish and promote good communication between UK breeders in the pulse crops and the research base, both basic and applied, and ensure all have the opportunity to provide feedback throughout the project
b) establish a close liaison with SASA to ensure coordination and integration of our activities
c) establish a database of ongoing research in the area of pulse crops especially in the UK, but also at an international level
d) establish a web site, updated every 4 months and linked to the other Defra crop improvement networks
e) enable interaction days for management and stakeholders groups, providing opportunities to view and discuss genetic material
f) develop associated projects linking participants

Comments:
a) The Stakeholder's Forum meeting should take place in Sept 2005. A contact list for Stakeholders is currently at JIC, NIAB and PGRO and will be consolidated.
b) Links with the GLIP and TTP are established, but links to SASA need to be made formally and it was agreed to ask Niall Green or Alex Reid to join the independent assessment group together with UNIP, the TTP and associated projects such as the current CSL project.
c) The database related to pulse crop research to be maintained at JIC has yet to be built.
d) The establishment of the web site was under way and a temporary web site is in place.
f) Links to field bean genetics projects (eg EUFABA) need to be initiated, but cannot be consolidated until the objectives of the PCGIN for faba bean are established.

ii) Phenotyping **Mike Ambrose**

Phenotypic characterisation of novel legume germplasm
This will involve
a) evaluating priority traits for different species by members of the PCGIN, taking account of the assessment of priorities already indicated by the breeders' survey
b) making informed choices on the species, germplasm, traits and specific biotic stresses to be studied, to include the use of exotic germplasm
c) developing a series of protocols for assessment of the traits required, with rapid and reproducible scoring techniques and reliable methodology for G x E interactions established at three sites (NIAB, JIC, PGRO)
d) correlating genetic marker data, where available, with phenotypic characters

Comments:
Some advance work has taken place involving the selection of 47 ‘exotic’ germplasm lines from the available molecular diversity analysis at JIC. Initial plantings of 6 of these lines at NIAB and PGRO have been made a year in advance in part to iron out husbandry issues associated with the growing of exotic germplasm. An extended report was tabled (Appendix 1).
The 47 diverse ‘exotic’ lines are growing in JIC plots and the other participants (PGRO and NIAB, together with Unilever representative) will view these on July 1st. A discussion on what characters to score and how to score them in subsequent years

will also take place at this meeting; this discussion will be reported in a separate document.

iii) Performance **Jane Thomas**

Extant varietal performance data will be associated with genotype data
This will be based on

a) selection of maximally informative databases for UK pulse crop characters, site characteristics, history and yearly records
b) selecting a set of 50 cultivars that are differential for the traits identified in the assessment of breeders' priorities (yield, standing ability, disease resistance), based on maximally informative databases
c) genotyping selected cultivars with genetic markers (200 each)
d) selecting three cultivars that are maximally informative on the basis of phenotypic data and marker analysis for the generation of segregating populations
e) establishing recombinant inbred lines (RILs) to F_6 from crosses between the chosen lines (150 lines per population).

Comments:
Good progress has been made with initial PCO analysis of NIAB trial data (performance data for spring sown combining pea, spring sown field bean, and winter sown field bean) but the 50 cultivars for genotyping have not yet been selected. Further database work was discussed, including the use of distinctness, uniformity and stability (DUS) data and vining pea performance data. DUS data for faba beans is recorded by NIAB, while that for peas (both vining and combining) is recorded and held at SASA. Performance data for vining pea (and broad bean) is recorded and held at PGRO. Approaches will be made to both SASA and PGRO for access to these databases. Plant characteristics will be different to those recorded for combining variety performance, and further views on appropriate characters for inclusion in PCO analysis will be sought from all project partners. The marker work will need to wait for the appointment of a band 7 RA at JIC.

iv) Reverse Genetics **Noel Ellis**

TILLING *for genes that regulate the development of the aerial part of the legume plant*

This will involve

a) access to ca. 5000 pea cDNA sequences (ESTs).
b) annotating sequences and identifying targets for TILLING, based on database mining and identity of orthologous genes involved in plant shoot architecture
c) designing primers based on candidate genes, derived from a) and b) and from databases developed within the EU project (Grain Legumes)
d) TILLING for mutants in these genes, using the platform developed within the EU project (Grain Legumes) and assessing phenotypes of mutants.

Comments:
Some sequencing had to be done before the project proposal was agreed to ensure that relevant sequences were included within the *Pisum* array developed at Bielefeld as

part of the GLIP project. Thus we have gained a little time but consultation with the stakeholder group is needed to identify additional sequencing targets and consider potential TILLING targets.

v) Genetic Mapping in Crop Legumes **Noel Ellis**

Objective Va (Novel germplasm for trait analysis) will be achieved by:

a) selecting a set of 12 independent M_3 individuals from a novel legume genetic resource [fast neutron (FN) deletion pea population]
b) performing cDNA-AFLP analysis of gene transcripts from total plants of these individuals and determining the number of genes deleted per FN line
c) sequencing the cDNA-AFLP fragments corresponding to the missing transcripts and identifying the corresponding genes
d) performing marker analysis of the deleted fragments by mapping identified genes in extant mapping RI populations

Comments:
Initial studies with the pea fast Neutron population are underway, but additional lines will be selected for the cDNA-AFLP approach.

Objective Vb (Integrated Genetic Maps) will involve**:**

e) identifying the most effective strategy for relating the genetic maps of pea, field bean and lupin for UK use
f) establishing genetic mapping populations for bean and lupin within UK through coordination with the EU Grain Legumes project
g) designing a comprehensive set of gene-based markers (at least 100) to enable integration of gene maps across crop species
h) defining a set of molecular markers for priority traits that can be exploited by breeders

Comments:
To date no work in this area has been undertaken within the PCGIN, but ample data have been generated by the GLIP project. When the band 7 appointment is made markers will be scored in extended *Pisum* mapping populations.

With respect to f), Frédéric Muel has suggested that it would be efficient for the PCGIN to consider parent lines of RIL populations that already exist in Europe, in particular those from other national programmes (for example INRA and Genoplante), and for the PCGIN's activities to bridge and interact with other research programmes for mutual benefit. Frédéric has said that the GL-TTP can help with this.

vi) Genetics of seed quality traits **Claire Domoney**

This will involve
a) expansion of Objective 1 to include industrial end users within the range of interested parties
b) wide consultation with a wide range of industries to define priority seed quality traits

c) development of tools and definition of protocols for analysis of these traits
d) establishment and analysis of recombinant inbred populations that segregate for key traits in relation to seed and protein quality, as defined by these end-users
e) *de novo* satellite projects with industry to exploit this variation

Comments:

This objective links closely with Objective 1 and depends on establishing links with the wider stakeholder group that includes end-users. Definition and prioritisation of target traits will be based on wide consultation and will aim to provide tools and resources for industry.

We have some history in this area, based on earlier Defra funding, and current industrial and EU GLIP funding. Our definition of seed quality here is based on end-use for animal feed (pig, poultry) and human food, rather than that used to describe germination, seed vigour and/or disease status. One success story has led from a study of the biochemistry and genetics of a family of anti-nutritional proteins in pea seeds to a facile DNA marker screen that is being used currently by two companies. Relevant variant pea lines have been tested in poultry trials by the University of Nottingham, where we have links with nutritional scientists. In an industrially-funded project, where we are examining the effects of stress on plants and seeds, we rely heavily on the expertise at CSL, York (represented by Adrian Charlton at this meeting), for NMR analysis and metabolite profiling. Basically, these analyses facilitate small molecule biochemistry, where large numbers of samples can be processed and their metabolites profiled and quantified; we anticipate that these methodologies will facilitate studies of seed quality, even where quality has not been defined biochemically as yet. Within the EU GLIP project, a module on seed composition is focused on linking transcriptomics and genomics of a model (*Medicago truncatula*) with protein variants in pea. Overall, we aim to simplify our genetic screens for 'field' use, which will benefit crop improvement generally, but is of particular value for seed characteristics where these can be screened at a very early plant stage.

Past contacts with industries suggest interests in a variety of seed genetic variants, should these become available; queries have included those related to allergens and health, novel colours and shapes for the vegetable market, as well as opportunities for non-food uses, e.g. bioenergy/biofuel. Within PCGIN, we wish to formalise our contacts with relevant industries and discuss scientific opportunities within the area of end-use to include feed/food uses and the niche markets that utilise pulses in other products.

Some discussion centered on the following points: relationships with nutritionists (Simon Kightley, NIAB), the ability to define quality in, for example, a marrowfat pea (Keith Fox, Advanta) and interaction with the relevant industry, and the relationship with GLIP objectives (Catherine Golstein, EU GLIP-TTP). There then followed some discussion on the best way to achieve an effective dialogue with industry in relation to what scientists can achieve and where gaps in knowledge and resources exist. Geoffrey Gent suggested that a 'Pulse Trade' day to be held at PGRO on July 12th would provide an initial opportunity for scientists to 'illustrate their wares'; Geoffrey also pointed out the valuable experience held by PGRO in how best to achieve effective interaction with industry (and the pitfalls to be avoided).

vii) Outside Links **Noel Ellis**

Links to GLIP/TTP and SASA had been discussed under Objective 1. A further consideration was links to other UK legume projects, in particular the ongoing lupin projects that are Defra-funded. Bruno Viegas agreed to provide some information on this project and the contact for AR0142, and discussions with Mike Abberton at IGER were initiated during the formulation of the PCGIN project.
Details of a LINK project, LISA (LK0950), involving lupins, were provided by Bruno Viegas subsequent to the meeting; these are given in Appendix 2.

4. *Vicia faba:* how to proceed **Geoffrey Gent**

Geoffrey Gent said that *faba* beans are now the most important leguminous crop for UK farmers, with an estimated 200,000 hectares being grown in 2005, compared with the total of 80,000 hectares of peas for both freezing and dry harvesting. He said that innovative new types of faba beans have been produced for the broad bean market and he was pleased that these had been obtained by Mike Ambrose when he extended his plant collection to cover faba beans. Geoffrey reported that some of the recent success with the spring bean crop came through the use of the broad bean variety Minica as one of the parents that gave the variety Alfred in the mid 1980's which was then further developed to the variety Victor which has been the mainstay of the export business since that time. He also drew attention to the traits shown by the broad bean varieties Polar, Beryl and Compacta.

There was a short discussion of tannin free beans and the way they could help farmers who were using their own crops for livestock rations.

A problem with *Vicia* germplasm within the UK was discussed; lines that were developed at the Plant Breeding Station, Cambridge, are now owned by Wherry & Sons and it has become apparent that the PCGIN cannot have access to this material. Frédéric Muel has added the comment that the European programmes (EUFABA and the French research programme with GIE Feverole) could help to define a UK project on fababean.

5. Relations with GLIP **Frederic Muel & Catherine Golstein**

The GL-TTP, Grain Legumes Technology transfer Platform, is an initiative of the GLIP, Grain Legumes Integrated Project. The GLIP is a 25M Euro, 4-year European Project that re-groups 17 countries, 60 partners, in an effort to boost the European production of Grain Legumes. The research programme of the GLIP encompasses economical, environmental, agricultural and nutritional issues of crop legumes, as well as the production of genetics and genomics tools in model legumes. Comparative genomics have identified syntenic relationships between legume species that should facilitate the transfer of genomics knowledge from model to crop legumes.

The GL-TTP is an independent, not-for-profit, association, that aims at forming a durable partnership between science and industry in the legume community by (1) providing its members with information, advice and expertise necessary for the exploitation of the results of the GLIP and other research programmes relevant to

Grain Legumes, (2) proposing and commissioning research and development activities for its members, (3) contributing to the design of tools, methodology and know-how for commercial application of the results of research. The priority of the GL-TTP is to provide plant breeders with molecular markers to facilitate and expedite the introgression of essential agronomic traits, such as disease resistances or stress tolerances, from exotic to cultivated legume species.

The PCGIN and its members are invited to join the GL-TTP to ensure easy access to the genomics tools generated in the GLIP and to enable the transfer of their research to the industrial members of the platform, plant breeders, producers and end-users.

For questions, comments or suggestions, please contact the GL-TTP manager, Frederic Muel (f.muel@prolea.com), or its scientific manager, Catherine Golstein (c.golstein@prolea.com).

6. PGRO Plot Inspection **Stephen Belcher**

Stephen Belcher demonstrated variety trials for both winter and spring beans and spring peas. Additionally Barrie Smith demonstrated crops of peas from diverse world areas (see Appendix 1; Table 1); in some cases, the establishment had been poorer than anticipated.

7. Plans for stakeholder meetings **Keith Fox**

Keith Fox outlined plans for the participation of trade personnel from both the vining pea and pulse sectors. These were based on contacts with the British Edible Pulse Assn, the Vegetable Agronomists Assn and the British Society of Plant Breeders. He agreed to pursue representatives in consultation with Geoffrey Gent and during discussion it was agreed that further contacts with LEAF (Linking Environment with Agriculture and Food), Premium Crops and the Campden and Chorleywood RA could be useful.

8. General administration items **Claire Domoney & Noel Ellis**

The following arrangements were agreed.

1. 1st July 2005: plot inspection at John Innes. (This and follow-up visits to JIC plot trials by PGRO and Cebeco are recorded in a separate report).

2. 12th July 2005: participation in the BEPA Open Day at PGRO through the provision of samples from distinctive pulse types.

3. 20th September 2005: next meeting of the PCGIN Steering Group.

APPENDICES

PCGIN meeting on 20th June 2005: APPENDIX 1.

Tabled report on Objective 2: Phenotyping Mike Ambrose

***Pisum* Phenotyping**

Selection of 'Exotic' pea germplasm (February/March 05)
47 germplasm accessions were selected on the basis of pre-existing data. The selection was undertaken to identify a diverse set of 'exotic' germplasm across the taxonomic and geographical range for which there was sufficient seed for the project. All material was known to be cultivated (including JI 2202, *P. abyssinicum)*.

- 5 lines included on the basis of their being parents of mapping populations (JI 15, 399, 281, 813, 1194).
- One line selected on the basis of its additional uses in the project (JI 2822) - initial line for the Fast Neutron mutagenesis programme.

Passport data for the 47 lines are presented in Table 2.

Seeds of the 47 lines were prepared in March for sowing at JIC experimental plots in early April. There was sufficient seed of 6 lines from the 47 to send to NIAB and PGRO for growing as small plots as a trial run in both locations. Details of the 6 lines are presented in Table 1.

Table 1. Details of the 6 lines sent to PGRO and NIAB on 30th March 05

LINE	NAME	Country of Origin
181	KEERAU PEA	Nepal
228	P.SATIVUM	Bolivia
281	P.SATIVUM	Ethiopia
284	P.SATIVUM	Afghanistan
804	P.TIBETANICUM	Egypt
2424	WBH 1109	Russia

Short Passport Data

LINE	NAME	DONOR	DONOR NUMBER	DONOR COUNTRY	SYNONYM	STATUS
181	KEERAU PEA	HERKLOTS,G		NPL	WBH 2033	Primitive cultivar
228	P. SATIVUM-BOLIVIA			BOL		Primitive popul.
281	P. SATIVUM-ETHIOPIA	THOMAS,C.E.H	ETHIOPIA 11	GBR		Primitive cultivar
284	P. SATIVUM-AFGHANISTAN		023	DEU	WBH 1586	Wild type
804	P. TIBETANICUM	BLIXT,S	WBH 806	SWE		Selection
2424	WBH 1109	BLIXT,S	WBH 1109	SWE	700/48	Selection

Progress update.

- All lines germinated and established at JIC. Plots are being regularly monitored.
- Problems experienced at PGRO and NIAB with respect to poor germination of some lines.
- Recording started based on the JIC Phenotypic descriptor list.
- Photographic records are being made of overall plot appearance and specific details of interest.

- Discussion required to extend recording into additional areas of interest e.g. yield, yield components and lodging.

Issues arising:

- Sowing density
- Microplot support
- Pigeon deterrents

Table 2. Passport data for Pisum germplasm selected for PCGIN phenotyping

JOHN INNES PISUM COLLECTION

LINE	NAME	DONOR	DONOR NUMBER	DONOR COUNTRY	SYNONYM	STATUS
15	WBH 1458	BLIXT,S	WBH 1458	SWE		Selection
45	P.TRANSCAUCASICUM	LAMPRECHT,H	WBH 1060	SWE	PIS 132	Selection
52	P. ASIATICUM	LAMPRECHT,H	WBH 1478	SWE	L5059	Selection
85	P. SATIVUM-AFGHANISTAN	BLIXT,S	WBH 1402	SWE	WP 526	Primitive
86	P. SATIVUM-AFGHANISTAN	BLIXT,S	WBH 1403	SWE	WP 527	Primitive
156	P. SATIVUM-SUDAN	THOMAS,C.E.H	ETHIOPIA 11	GBR		Primitive
166	P. SATIVUM-ETHIOPIA	THOMAS,C.E.H	ETHIOPIA 117	GBR		Primitive
181	KEERAU PEA	HERKLOTS,G		NPL	WBH 2033	Primitive
185	WIRAIG	NOUR,M.A		SDN	WBH 2058	Primitive
188	WIRAIG	NOUR,M.A		SDN		Primitive
201	P. THEBAICUM			ITA		Wild type
216	KANAWARI		IC 7912	IND		Cultivar
228	P. SATIVUM-BOLIVIA			BOL		Primitive
241	P. HUMILE	ZOHARY,D		ISR		Primitive
250	P. JOMARDII			GBR	WBH 2055	Wild type
267	P. SATIVUM-GREECE		06	DEU	WBH 1603	Wild type
281	P. SATIVUM-ETHIOPIA	THOMAS,C.E.H	ETHIOPIA 11	GBR		Primitive
284	P. SATIVUM-AFGHANISTAN		023	DEU	WBH 1586	Wild type
399	CENNIA			NLD		Cultivar
711	AUSTRIAN WINTER			GBR		Cultivar
799	GOLDKONIG	BLIXT,S	WBH 2	SWE		Cultivar
800	P. ELATIUS	BLIXT,S	WBH 226	SWE		Selection
804	P. TIBETANICUM	BLIXT,S	WBH 806	SWE		Selection
813	YELLOW POLLEN-yp	MURFET,I.C	51y	AUS		Isoline
960	P. SATIVUM-TURKEY		PI 343958	USA		Primitive
975	P. SATIVUM-COSTA RICA		PI 262189	USA		Cultivar
1089	P. ELATIUS		PI 343998	USA	22670	Primitive
1194	MISOG-1:CONVENTIONAL	MARX,G.A		USA		Genetic S
1267	P. SATIVUM-INDIA	DOLAN,D.D	PI 356984	USA		Primitive
1428	P. TIBETANICUM	BLIXT,S	WBH 611	SWE	Thibet 6095/-	Wild type
1543	P. SATIVUM-MONGOLIA	BLIXT,S	WBH 1933	SWE	PIS 1164	Primitive
1544	P. SATIVUM-CHINA	BLIXT,S	WBH 1934	SWE	PIS 984	Primitive
1871	P. SATIVUM-ALBANIA	BLIXT,S	WBH 1909	SWE	PIS 981	Primitive
2078	P. ELATIUS	PERRINO,PROF	ITPDB 100956	ITA		Primitive
2105	P.ELATIUS	PERRINO,PROF	ITPDB 104333	ITA	PI 227258	Primitive
2200	P. SATIVUM-USSR	VITKOVSKIJ,V	VIR 3671	SUN		Primitive
2201	P. ELATIUS	VITKOVSKIJ,V	VIR 1947	SUN		Wild type
2202	P. ABYSSINICUM	VITKOVSKIJ,V	VIR 3567	SUN		Primitive
2225	RAMONSKII 77	BLIXT,S	WBH 2100	SWE		
2348	BAI WAN DOU	MEHRA,M		CHL		Cultivar
2424	WBH 1109	BLIXT,S	WBH 1109	SWE	700/48	Selection
2551	P. SATIVUM SIBERIACUM	LEHMANN,C	M 1258	DEU	PIS 2326	Primitive
2571	P. SATIVUM-GEORGIA	LEHMANN,C	PIS 2123	DEU	M 1368	Wild type
2605	P. SPECIOSUM-LIBYA	LEHMANN,C	PIS 2129	DEU	M 1376	Primitive
2640	P. SATIVUM-MALAWI	KISYOMBE C.	PMC 6	GBR		Cultivar
2713	P. CINEREUM	BLIXT,S	WBH 1490	SWE	VIR 16037	Genetic S
2822	RIL 15x399_39	ELLIS,N		GBR		Mapping

NB. JI 15, 813, 281, 399 and 1194 are parental lines used in mapping populations
JI 2822 is the initial line for the Fast Neutron mutagenesis programme.

PCGIN meeting on 20th June 2005: APPENDIX 2 (Outside links)

Summary details for LISA (LK0950):
List of participants: IGER, University of Newcastle, ABN, Arable Research Group, PGRO, Germinal Holdings, MDC, MLC and Kelvin Cave Ltd.

Summary: Diffuse pollution from farming enterprises is a particular cause for concern. In the livestock sector, this includes volatilisation of ammonia and emissions of greenhouse gases, particularly methane and nitrous oxide. In both arable and livestock sectors, the leaching and run off of nitrogen (N) and phosphorus (P) into water courses is a major environmental issue reflected in the implementation of nitrate vulnerable zones (NVZs) and the forthcoming EU Water Framework Directive. However, alongside more environmentally sustainable farming there remains a requirement for economic sustainability. In this respect there is a continuing need in the livestock sector for high levels of quality protein of known provenance alongside sources of oil and energy. Considerations of resource use efficiency are clearly also an integral part of the rationale for organic farming and the need for traceable, non-genetically modified sources of protein is perhaps even more pressing here. The use of a high protein, nitrogen fixing grain legume has the potential to aid progress towards meeting these aims. It allows reduced applications of nitrogen fertiliser; this is likely to be particularly important with respect to NVZs in conventional farming and in particular the organic sector. Grain legumes are well placed to supply the protein requirements referred to above and act as important sources of oil and energy. These benefits can be realised in two distinct systems:
(i) an arable break crop for incorporation into feed for ruminants, pigs and poultry.
(ii) on-farm feed in beef and dairy systems.
In (i), legumes have the additional advantage of supplying N to the subsequent cereal as well as reducing weed build up and improving soil structure. In (ii), the incorporation of a grain crop may have a significantly beneficial impact in terms of biodiversity and reduced environmental impact from livestock wastes.

Aim of the project:
The purpose of the proposed work is to develop economically viable systems, germplasm and approaches to the incorporation of lupin grain in feed that will facilitate significant progress towards realising the potential of this species in promoting more environmentally sustainable production both as an arable break crop and for on-farm feed in livestock enterprises.
A strong focus of the work will be the role of lupins as part of organic rotations and the identification of factors important for the greater utility and uptake of this species in the organic sector. The proposed project is unique in that it offers agronomy, husbandry, environmental and nutritive evaluation of existing lupin varieties as well as developing approaches underpinning the improvement of traits that currently restrict uptake by the industry. The industrial partners have been assembled on the basis of their track record in relevant areas of strategic, applied science and their knowledge transfer capabilities. The degree of innovation of this work is described and no partners are currently involved in similar studies.