

Minutes of PCGIN Stakeholders Meeting

Genetic improvement of pulse seed quality (a focussed Stakeholders' meeting)

Birds Eye, Colworth, Sharnbrook, Bedfordshire
October 4th 2007

Present:

JIC	Noel Ellis
	Claire Domoney
	Mike Ambrose
	Catherine Chinoy
	Carol Moreau
	Mary Wade
PGRO	Salvador Potter
	Anthony Biddle
NIAB	Jane Thomas
	Simon Kightley
	Donal O'Sullivan
CSL York	Adrian Charlton
Advanta Seeds	Keith Fox
Unilever	Frances Bligh
Birds Eye	Milika Buurman
Pulse Breeding consultant	Mervyn Pope
Rothamsted Researchers	Lesley Smart
Rothamsted Researchers	Toby Bruce
Velcourt Ltd	Keith Norman
SASA	Tom Christie

Apologies: Chris Goodsall, Haidee Philpott, Barrie Smith, Julian Wiseman

Session 1: Chair: Anthony Biddle (PGRO, Peterborough)

Milika Buurman welcomed participants to Birds Eye

Anthony Biddle thanked MB for hosting the PCGIN meeting. Julian Wiseman was supposed to be giving a presentation - 'Limitations to UK pulse crops for animal feed use' on behalf of Mick Hazzledine (Premier Nutrition), but unfortunately was unable to attend the meeting at very short notice. AB pointed out that pulse and seed quality was very important. Production this year had been very low which meant that prices had

rocketed. The increased dependence on vegetable protein in animal feed meant that producing the correct quality was important. For human consumption the visual aspects were increasingly important – colour, size and flavour as well as the nutritional value.

Limitations to UK pulse crops for animal feed use

Noel Ellis reported on behalf of Julian Wiseman from a document prepared by Mick Hazzledine, Premier Nutrition. (This document will be circulated with these minutes).

A recent article in a Saturday paper gave legumes a good positive image. The main uses are for human consumption and animal feed, mainly for monogastrics - pigs and poultry - and for ruminants. For monogastrics, the digestible amino acid content is a primary determinant of value, whereas in ruminants it is crude protein or, in dairy rumen, degradable protein. The anti-nutritive factors in peas and beans (particularly trypsin inhibitor and to a lesser extent vicine and convicine) are important to monogastrics, but are not to ruminants. A formulation for feeds in the UK is produced which supplies the required nutrients at the least possible cost within the constraints applied by the nutritionist. Therefore the value of a commodity, such as peas, depends upon the price and analysis of all other commodities, the age, the productive purpose and class of stock being fed. Other constraints are availability of wheat distillers grains plus solubles. Because of biofuel production supply of these may increase. A substitution for peas using these solubles is possible and so may seriously erode the potential value of pulses.

There has been a scarcity of peas and beans for feed this year and last year was poor. They are popular in organic feeds and this may divert some of the supply. Continuous supplies are more attractive to the processors than small parcels of peas and beans. Home grown pulses are also a useful hedge against the vagaries of the soya market.

Discussion: SK pointed out that breeders are aware of trypsin inhibitors and they are screened out. KF reported that screens for trypsin inhibitors are not relevant for the UK market. Levels are now low in general, but for marrowfats are relatively high and these are considered adequate for feed use in the UK. MP reported that France still screens for trypsin inhibitors. He also said that beans are used as an energy source not for a protein source. There are new distinct varieties for export and feed with the former markets being more important. There is a lot of cheap protein around and therefore peas and beans will only be considered if the price is low. NE asked if the protein level is higher will the yield drop and if so whether it would make sense to be trialling peas with a lower protein level. KF said there are exceptions to the inverse correlation between yield and protein. CD asked if there would be an advantage to low protein marrowfats (higher yield?) and low trypsin inhibitor marrowfats, since poor quality marrowfats are used ultimately for animal feed. MP reported that work had been done at increasing protein in field beans so that a lower yield could be accepted but feed companies were not interested. AB said that it was important to produce the yield necessary for compound feed but for human consumption there was a need to produce all the other factors. KF pointed out that if selection is based on low protein, high starch in legumes would not be a good idea since they would be competing with wheat.

Genetic improvement of colour stability in pea seeds

Claire Domoney reported on progress with identifying genetic loci involved in colour stability in peas. Genetic variants for two loci implicated in seed colour retention are being studied and markers have been developed to follow the variant genes in crosses. Crosses with marrowfat lines have been set up and are being developed to study the effect of introgressing variant *sgf* and *LOX* gene genes on bleaching.

Discussion: CD reported that the greenness of peas is variable in the harvested seed of some crosses and some of the variation is likely to be heritable. Light direction was taken into account when the plants were grown. The leaf and seed behave differently from light exclusion: leaves naturally lose colour during senescence, regardless of final seed colour. KF asked a question about bleached seeds being harvested at immature stages – this is not easy to study as bleaching is detected after harvest. AB commented that loss of colour is important commercially. TB said that he was aware of the importance of *lox* genes in connection with tobacco susceptibility to insects. Does this pose a problem? CD said that the *lox* in peas implicated in seed bleaching was one of several isozymes, and is not in fact a major form in leaves.

Metabolite profiling in relation to pea seed quality

Adrian Charlton presented an update on the characterisation of metabolites that vary in pea seeds both in response to environmental factors, as well as genetic ones. The amount of raffinose oligosaccharides in the progeny of a cross between round- and wrinkled-seeded peas was correlated with seed shape. This is probably an epistatic effect of the *rb* locus segregating in this population. Within the two groups of progeny, there was additional evidence of quantitative variation.

Discussion: KF asked if any other work is being done to correlate plant (leaf) metabolites with those in seed. AC said he doesn't know of any but this has the potential to provide useful seed quality markers. DO'S asked what lessons for breeders to create a drought resistant legume. NE said a proposal had been submitted to BBSRC to investigate the genetics of the variation of drought-resistant compounds (but this was rejected). KF – asked about varieties more susceptible to water logging. DO'S asked if wrinkledness is always increased when sugars decreased. NE described the relationship between starch content, free sugar and the wrinkled-seeded phenotype in the *rugosus* mutants. TB said it would be interesting to see if genotypes with quantitative variation in metabolites showed variation in drought-stress responses. MA said that drought tolerance/resistance is not defined or measured at present. Perhaps some of Adrian's results could be used to explore how variation was expressed but there was a need to refine measurements and clarify how data is recorded. KF said the timing of drought stress is very important.

AB referred back to earlier discussion on the uses of beans and peas to ask how to view the future of growing commodity legumes as opposed to premium ones. KN said anything that can be done for stability and consistency in performance is important. There are huge swings of yield from year to year that make it impossible to plan as a business. What persuades growers: they like to grow premium types but these have the biggest yield abnormalities and difficulties with crop performance, due to collapse,

variation and weather. Therefore there is a high risk with the premium market. AB stressed there was an equal place for premium and commodity crops. KN would like to make them agronomically more friendly.

Session 2: Chair: Jane Thomas (NIAB)

Genetic markers for seed quality determinants

Noel Ellis reported on the state of play with genetic markers generally and their availability. He also presented an update on the markers that are available for seed quality, based on CD's work. Some of these are in use by companies.

Previous work on genetic markers for seed quality was based on various mapping populations from JIC. PCGIN is developing 3 x related crosses specifically to look at breeders' agronomic traits. These are currently on F₃. The selection of parents decided at the last meeting led to the vining pea crosses that CM is currently working on. Background mapping information can be accessed via the PCGIN website. Also information on another linkage map is available on the closed site. The linkage groups have links to further information on the genetic markers. Also available are genetic map data files (pre- publication material), pea primers, information on primer names, images, and markers used as the basis of primers for comparative maps. Some examples of linkage mean that, following an architectural factor, breeders may lose out on other factors. Other examples discussed were trypsin inhibitors that do affect availability of amino acids to chickens (work with Julian Wiseman, Nottingham), and poorly digested albumins that are linked to availability of nitrogen.

Final report of the 2006 plot trials

Mike Ambrose reported that this analysis was not complete yet, but a final document would be circulated in the next few weeks. The overall objective here is to explore the agronomic performance of exotics, looking for material that could be exploited. After screening in 2005, 20 lines comprising 18 exotics were used. For 2006, the weather patterns from March to July were summarised. Vigour (germination, emergence, vegetative growth) was variable, with flowering from 50 – 100%. Some went from flowering heavily to nothing. Assessment of vigour was on a scale of 1-5. Plotting seed weight to total vigour score showed variation within a seed category. Standing ability was scored as yes or no. Lodging was divided into a series of categories: basal sag, leaning, creeping and scored 1-5. There were differences over the 3 sites but fewer at NIAB, a lot of leaning and creeping at PGRO and a variety at JIC. Height was measured at full flower and at maturity. Exotics varied a lot. Harvest indices were presented previously with notable consistencies and differences.

Discussion: SK asked about the origin of Cooper seed, as this year's trials underperformed. AB had supplied these and his were fine. KF asked about lodging scores. MB asked if the outer edges of the plots always perform better than the inner, i.e non-competitive. SK suggested that growth at all the different sites was very varied. MP asked about the origin of the seed of each line, if they were grown in the same place and, if not, were the age and different storage factors considered? JT asked if the relationship of vigour with weevil damage was looked at. MA said the weevil damage had varied with the different sites. MA said there were differences in basal branching, and that this was another factor to take into the data analysis.

General discussion:

Anthony Biddle gave an update on the *Aphanomyces* and *Fusarium* trials and where resistance had been detected. Some clear-cut differences had been measured but these need to be repeated.

Discussion: KN asked if there was a relationship between pea and rape disease phenomena. JT said no. AB said the diseases can cross from year to year. JT asked how common *Aphanomyces* is. AB said in wet conditions it is difficult to differentiate between wetter lodging and *Aphanomyces* damage. KF asked how diseases get into the roots. Do they have to be damaged first? AB said yes. MA said JI181 had particularly good characteristics. It originated from high up in the mountains of Nepal and grows in very wet cold soils there. NE commented that JI 2201 was also good in AB's chart, especially for standing ability, and suggested a cross between 2201 and another line should be done. It was suggested that this might produce undesirable black peas (though backcrossing and segregation may eliminate undesirable characteristics). Most commercial lines are susceptible to root diseases.

Vicia faba : LINK timetable; new LINK

An original objective of the PCGIN was to promote related LINK projects. There are now two such projects: one on bruchids and a new LINK on nutritional value for pigs. AB reported that work for the bruchid LINK on *Vicia faba* is underway but the official start date is 1st August 2007. There are 10 co-operative members of the consortium. It is planned to look at exotic lines and the degree of tolerance in these lines. Work will be done on chemical application timing. Frederic Muel had reported (PCGIN meeting 09/06) how bruchids are controlled in France. Velcourt has trialled some of these tests. PGRO was now promoting advice based on the scheme that the French had developed and this seems encouraging. There will be a meeting of the LINK consortium soon when others will be invited to look at plots. Bruchid damage will be scored and anything else needed.

A new LINK involving NIAB, PGRO, Nottingham University and Premium Nutrition is 'Nutritional value of home grown pulses'. SK reported that pea genetic variants for lots of seed characters will be studied. The project is due to start in March 2008 when there will be a clearer agenda.

The minutes of the management meeting, held on July 20th 2007, were discussed:

- A report of the 2006 plots will go onto the website shortly.
- The next stakeholders meeting will be in October 2008.
- SK suggested that exotic lines should be particularly analysed for nodulation. NE said there has been a survey at JIC with a wide range of peas looking for nodulation.
- MA will gather information for nodulation

The next management meeting will be on 18th January 2008 at Nickerson-Advanta, Docking, Norfolk.