Phenotyping (Objective 2, March 2007)

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

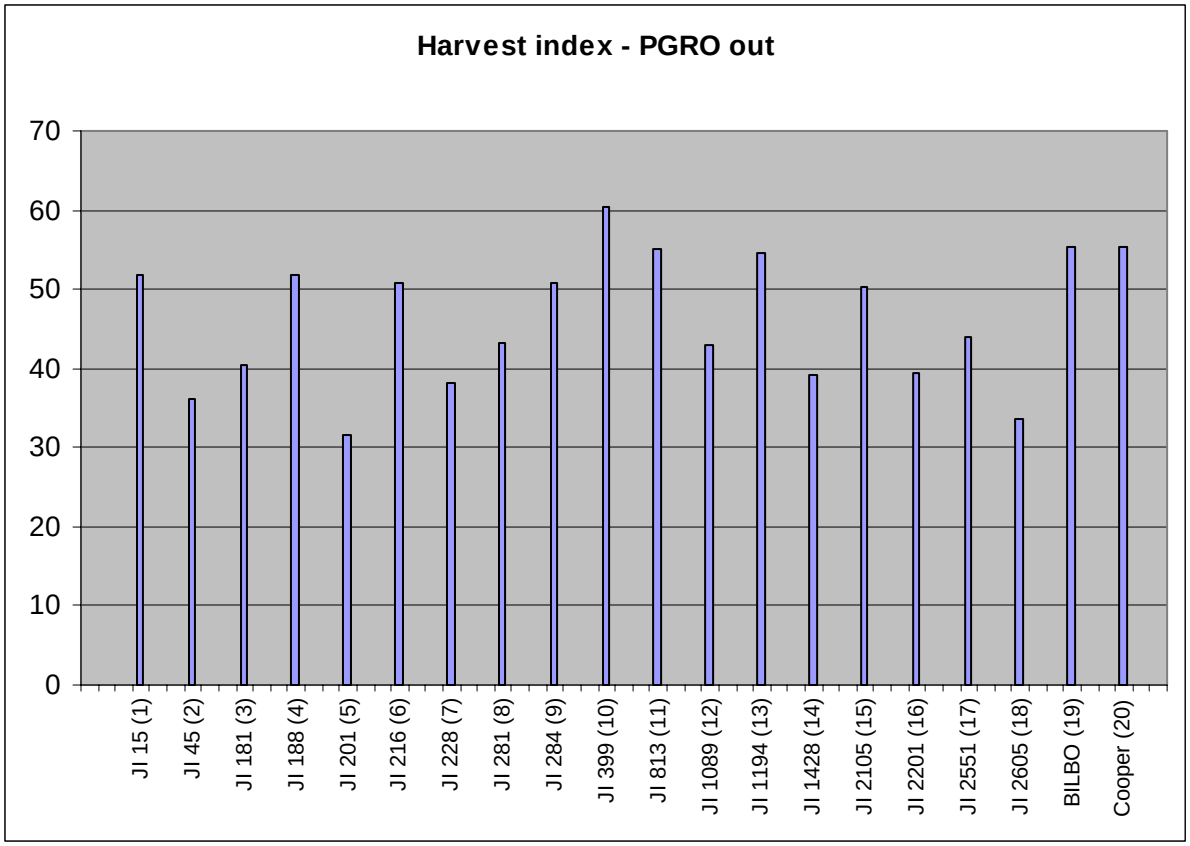
PROGRESS:

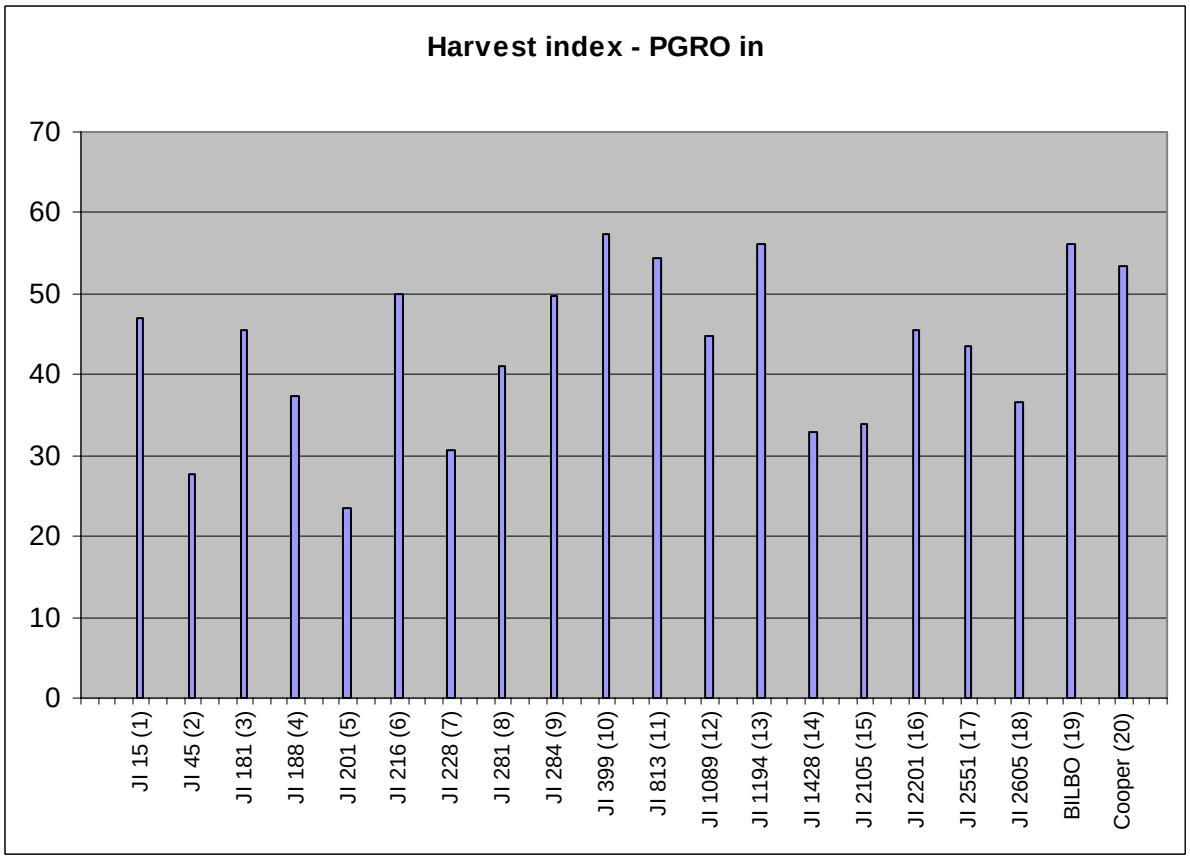
Activities in 2006 (Pea)

A. Plot trials
Molecular marker studies on exotic cultivated germplasm from the John Innes *Pisum* collection were used to select accessions from a wide geographic and taxonomic range, which had been used for a pre-trial in 2005. A proforma for phenotypic data recording was produced, and common protocols for plot husbandry and data recording for priority traits developed for 2006. Based on the pre-trial, a subset of lines was selected to be sown in replicated plots at three locations. In March 2006, triplicate micro-plots of 20 lines were sown at the three sites: 18 lines were selected from the 47 grown at JIC in the pre-trial. The selection was based on including the maximum diversity between lines for plot height, flowering time and seed availability but excluded lines that had yielded poorly or were recorded as badly lodged in the pre-trial. As suggested and agreed with breeders, two commercial lines were included at all sites; the cultivars Bilbo and Cooper, were chosen, based on availability of sufficient seed.

The results accrued from the three sites in 2006, based on measurements of a range of agronomic characters, have been analysed. The characters recorded for all lines included emergence and flowering times, canopy height at full flower, lodging scores, maturity and harvest dates, together with information on vegetative and flowering nodes, and harvest data. The last was based on measurements of 5 outside and 5 inside plants, with the comparison providing a measure of competitiveness. A full report of the analysis of all the character scores for 20 lines will be available via the web-site (www.pcgin.org) before the end of July 2007.

A basic and preliminary analysis of the harvest data was used to inform decisions on the lines to be re-analysed in 2007. This analysis compared the harvest indices for inside and outside plants grown at the three sites. Figure 2.1 shows a comparison of the harvest index calculated for the 20 lines grown in microplots at PGRO, based on analysis of the five plants on the outer edge or inside every microplot.


Harvest index - PGRO out
70
60
50
40
30
20
10
0
JI 15 (1)
JI 45 (2)
JI 181 (3)
JI 188 (4)
JI 201 (5)
JI 216 (6)
JI 228 (7)
JI 281 (8)
JI 284 (9)
JI 399 (10)
JI 813 (11)
JI 1089 (12)
JI 1194 (13)
JI 1428 (14)
JI 2105 (15)
JI 2201 (16)
JI 2551 (17)
JI 2605 (18)
BILBO (19)
Cooper (20)


Harvest index - PGRO in
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JI 2551 (17)
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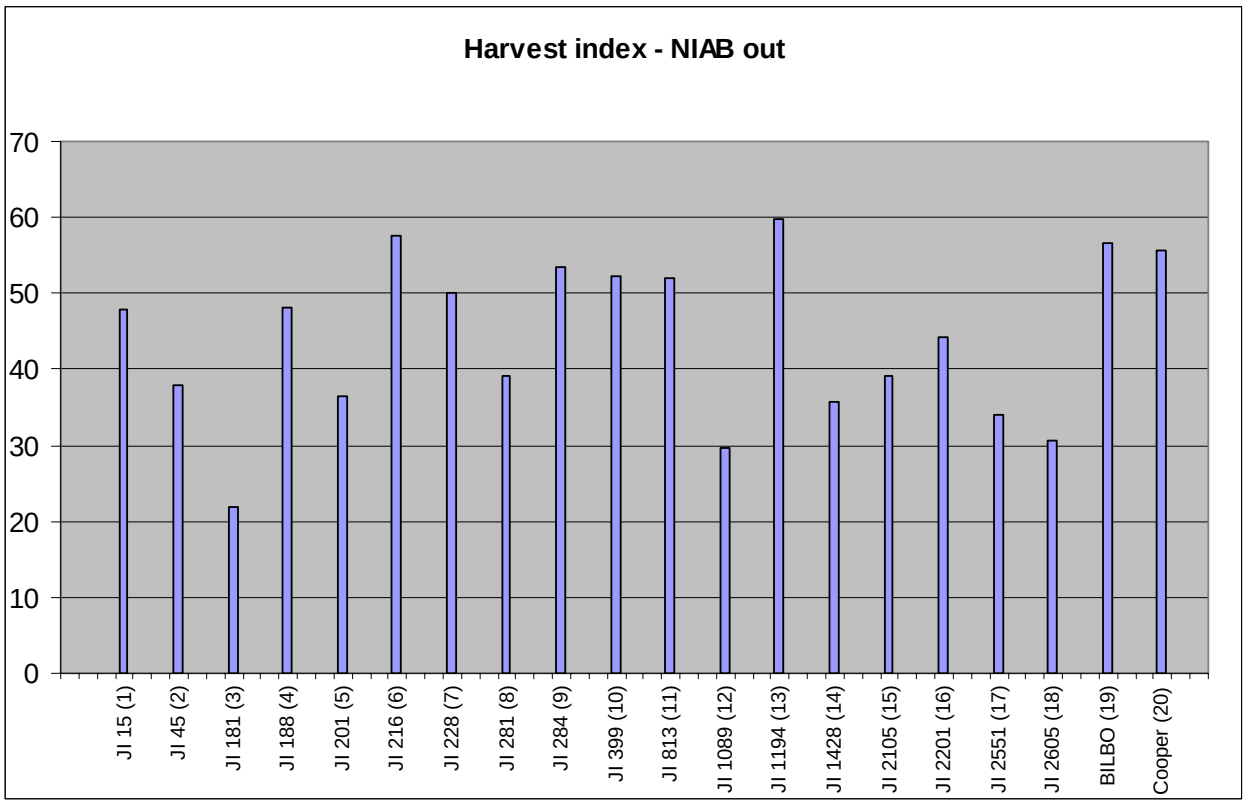
BILBO (19)
Cooper (20)

Figure 2.1: Harvest index (HI) calculated for pea lines. HI = seed weight as a percentage of the total plant harvest (seeds plus oven-dried haulm and pods) for 5 plants on the outer edge (out) or inside (in) every microplot at PGRO in 2006.

The Figure shows that there is some consistency in the data acquired for particular lines, regardless of their location in the plot. It is also apparent that some of the exotic material has a harvest potential comparable to the commercial cultivars of >50%. In contrast, the line JI 201 for example showed poor yield regardless of location.

Figure 2.2 shows the data acquired for plants grown at NIAB, analysed and presented in the same way as Figure 2.1.



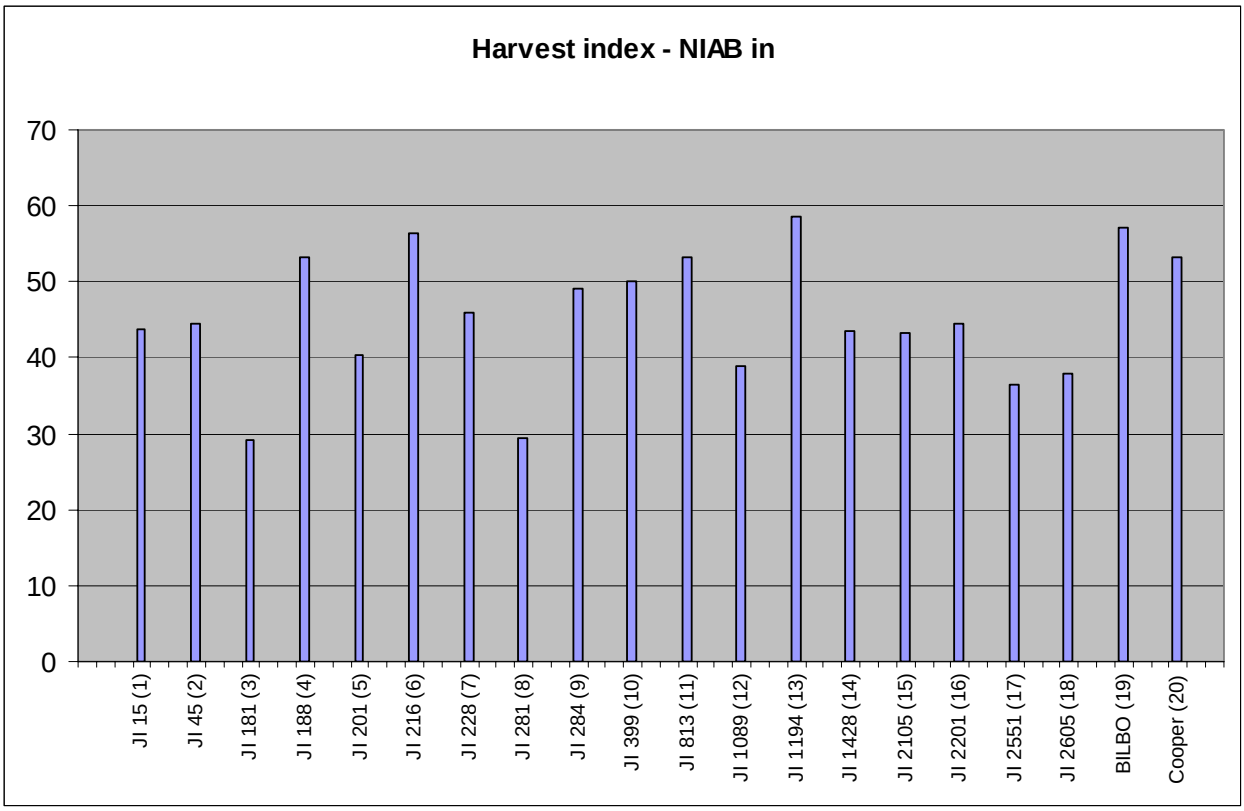
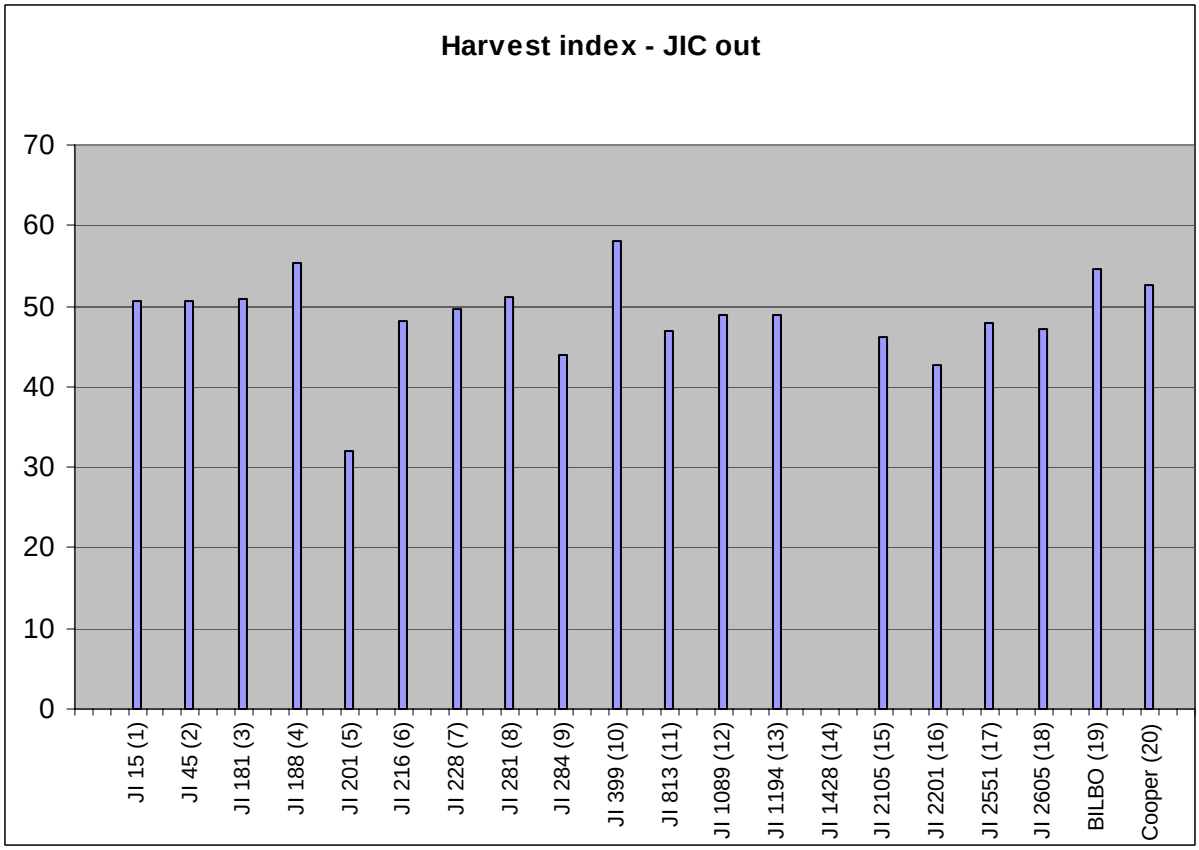


Figure 2.2: Harvest index (HI) calculated for pea lines. HI = seed weight as a percentage of the total plant harvest (seeds plus oven-dried haulm and pods) for 5 plants on the outer edge (out) or inside (in) every microplot at NIAB in 2006.

Again, here there is a consistency among lines, regardless of their position within the microplot. In addition, some lines show results comparable to the commercial lines. These include JI 188, JI 216, JI 284, JI 399, JI 813 and JI 1194, which apart from JI 188 all showed good HI values in the PGRO plots (Figure 2.1).



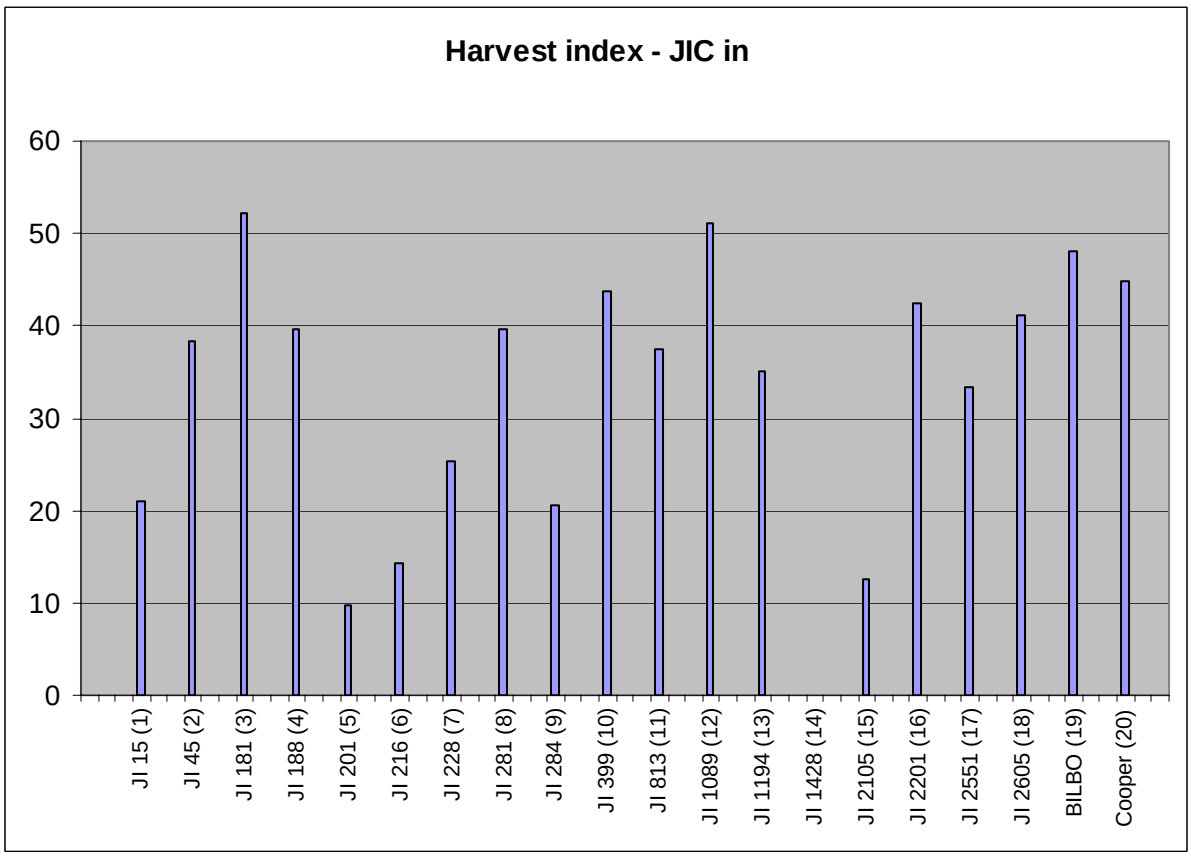


Figure 2.3: Harvest index (HI) calculated for pea lines. HI = seed weight as a percentage of the total plant harvest (seeds plus oven-dried haulm and pods) for 5 plants on the outer edge (out) or inside (in) every microplot at JIC in 2006.

Figure 2.3 shows the data acquired in a similar way for the plants grown at JIC. Here there was less consistency among plants harvested from the outside relative to those inside, and data for one line (JI 1428) are missing. The lack of agreement here between the two positions within the microplot may reflect the different soil type and/or method of planting. Based on the performance of the outside plants alone, a greater number of lines showed HI values that were comparable to those of the commercial lines. These included JI 188, JI 216, JI 399, JI 813 and JI 1194, noted above as the best lines at NIAB, on the basis of harvest index (Figure 2.2).

B. Disease trials

The 20 pea lines have been further assessed for disease resistance; two of the most important diseases that were highlighted by the breeders' survey were downy mildew and *Mycosphaerella*. The first has been assessed by infection under controlled conditions, whereas the second has been monitored and scored in the field and the data are currently being tabulated.

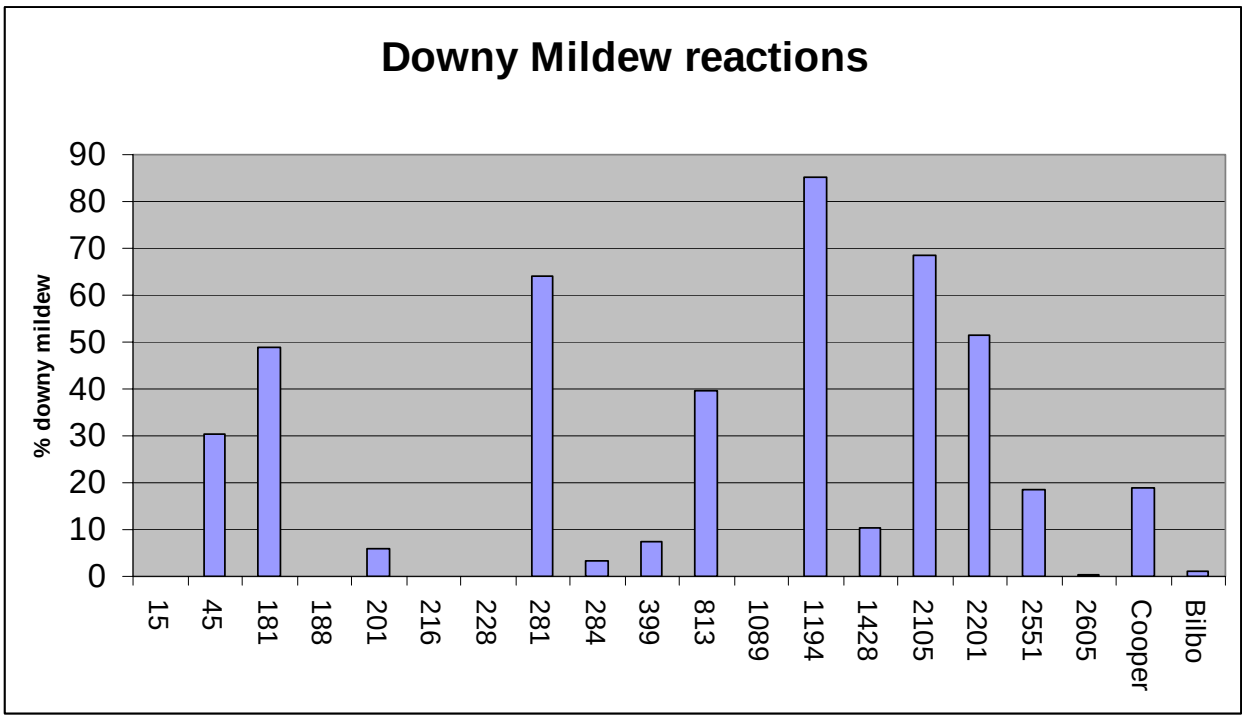


Figure 2.4: Mean % infection of pea lines inoculated with downy mildew under controlled conditions at NIAB.

Figure 2.4 shows the data acquired by the NIAB laboratory for downy mildew infection of 20 pea lines. There was a large spread of susceptibility/resistance to this disease with some of the exotic lines showing high tolerance or apparent complete resistance.

On the basis of these data, together with the scores for lodging (basal sagging, leaning, creeping habit) and the disease trial data (see below), the selections below

were made for the 2007 plot trials. The complete data set for 2006 will be available via the web-site (www.pcgin.org) before the end of July 2007.

Activities in 2006 (Faba bean)

- 26 germplasm accessions from the JIC collection were grown under glasshouse conditions and a set of exotic lines sourced by JIC for observation at the three sites in 2007.
- A single field plot of a Portuguese landrace was grown over Winter 2005 at JIC from seed obtained by PGRO for seed multiplication and for a preliminary characterisation of the line.
- Different methods for encouraging seed set were evaluated. A basic characterisation of these lines was undertaken and added to the web-searchable database.
- A further 35 faba bean accessions from the JIC collection were selected for regeneration and characterisation of a range of morphological characters in consultation with breeders.

Phenotyping to be undertaken in 2007

Based on the results outlined above, 12 pea lines were selected for the plots at three sites, together with 7 faba bean lines (listed below). Of the pea lines, 9 of these were chosen from those grown in 2006 (8 and one commercial line, Cooper), together with 3 lines from a recombinant inbred population (JI 15 x JI 1194) that had been scored as having good scores for lodging resistance in JIC microplots over the previous two years. The faba bean lines comprise 2 UK and 5 Australian lines; since *Vicia narbonensis* has some desirable characteristics that are not seen in *Vicia faba* (for example, tendrils), a genotype that has been released commercially in Australia was included.

Pea lines:
KEERAU PEA (JI 181)
WIRAIG (JI 188)
P.SATIVUM-ETHIOPIA (JI 281)
CENNIA (JI 399)
YELLOW POLLEN-yp (JI 813)
MISOG-1:CONVENTIONAL (JI 1194)
P.ELATIUS (JI 2201)
P. SATIVUM SIBERIACUM (JI 2551)
Cooper
JI 15 X JI 1194 RIL 2947
JI 15 X JI 1194 RIL 2959
JI 15 X JI 1194 RIL 3142

Faba bean lines:
Fuego (UK)
Maris Bead (UK)
Cairo (Aus)
Farah (Aus)

Fiesta (Aus)
Icarus (Aus)
Nura (Aus) and

Tanami (*Vicia narbonensis*).