1. Agriculture in the United Kingdom
United Kingdom has the 6th largest economy in the world. UK’s agriculture worth is £5.6 billion pounds to economy. The agriculture occupies 75% of land area and employs approx 484,000 people (1% of workforce). It contributes approx. 1% of national GDP. UK’s population is 62 million, livestock, 5 million pigs, 10 million cattle, 35 million sheep, and 160 million poultry birds. In cultivates 3.2 million hectares of cereals. During 2009, the production of Wheat was 8.0 t/ha (14.7 million tonnes), Barley 5.9 t/ha (5.2 million tonnes), Oats 5.8 t/ha (0.7 million tonnes). About 52% of farms are less than 100 ha. It also has 1.4 million hectares of other arable crops, 0.6 million ha oilseeds, 0.19 million ha beans, 0.17 million ha maize, 0.15 million ha potatoes, 0.12 million ha sugar beet.

2. Plant variety protection
Variety or cultivar - “variety” means a plant grouping within a single botanical taxon of the lowest known rank, which grouping, irrespective of whether the conditions for the grant of a breeder’s right are fully met, can be
- defined by the expression of the characteristics resulting from a given genotype or combination of genotypes,
- distinguished from any other plant grouping by the expression of at least one of the said characteristics and
- considered as a unit with regard to its suitability for being propagated unchanged” - UPOV Conv. 1991 Art 1

Breeder - the person who bred, or discovered and developed, a variety... - UPOV Conv. 1991 Art 1(iv)
Contribution of a breeder through quantification of time spent to develop the variety

Distinct - “The variety shall be deemed to be distinct if it is clearly distinguishable from any other variety whose existence is a matter of common knowledge at the time of the filing of the application...” - UPOV Conv. 1991 Art 7.
One or more important character should be distinct. Expression of ideas cannot be copied

Uniform - “The variety shall be deemed to be uniform if, subject to the variation that may be expected from the particular features of its propagation, it is sufficiently uniform in its relevant characteristics.” - UPOV Conv. 1991 Art 8

Stable - “The variety shall be deemed to be stable if its relevant characteristics remain unchanged after repeated propagation or, in the case of a particular cycle of propagation, at the end of each such cycle.” - UPOV Conv. 1991 Art 9

New variety - The variety shall be deemed to be new if, at the date of filing of the application for a breeder’s right, propagating or harvested material of the variety has not been sold or otherwise disposed of to others, by or with the consent of the breeder, for purposes of exploitation of the variety
- (i) in the territory of the Contracting Party in which the application has been filed earlier than one year before that date and
- (ii) in a territory other than that of the Contracting Party in which the application has been filed earlier than four years or, in the case of trees or of vines, earlier than six years before the said date.” - UPOV Conv 1991 Art 6(1)

Rights over propagating material - “the following acts in respect of the propagating material of the protected variety shall require the authorization of the breeder:
- (i) production or reproduction (multiplication),
- (ii) conditioning for the purpose of propagation,
- (iii) offering for sale,
- (iv) selling or other marketing,
- (v) exporting,
- (vi) importing,
- (vii) stocking for any of the purposes mentioned in (i) to (vi), above.” - UPOV 1991 Art 14(1)

Rights over essentially derived varieties - “(b)... a variety shall be deemed to be essentially derived from another variety (“the initial variety”) when
- (i) it is predominantly derived from the initial variety, or from a variety that is itself predominantly derived from the initial variety, while retaining the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety,
- (ii) it is clearly distinguishable from the initial variety and
- (iii) except for the differences which result from the act of derivation, it conforms to the initial variety in the expression of the essential characteristics that result from the genotype or combination of genotypes of the initial variety - UPOV Conv 1991 Art 14(5)(b)
GM variations are also considered as EDVs. Parental lines are IV for the new variety. Farmers variety/landraces are IVs of new varieties.

**Principal elements of PVP: limitations on rights**

- **Private use** - “the breeder’s right shall not extend to…
  
i) acts done privately and for non-commercial purposes” - UPOV 1991 Art 15
- **Breeding** - “the breeder’s right shall not extend to…
  
iii) acts done for the purpose of breeding other varieties…” - UPOV 1991 Art 15
- **Farmers’ privilege/farm-saved seed** - “each Contracting Party [member country] may, within reasonable limits and subject to the safeguarding of the legitimate interests of the breeder, restrict the breeder’s right in relation to any variety in order to permit farmers to use for propagating purposes, on their own holdings, the product of the harvest which they have obtained by planting, on their own holdings, the protected variety…” - UPOV 1991 Art 15(2)
- **Compulsory licences** - “(1) Except where expressly provided in this Convention, no Contracting Party may restrict the free exercise of a breeder’s right for reasons other than of public interest.
  
(2) When any such restriction has the effect of authorising a third party to perform any act for which the breeder’s authorization is required, the Contracting Party concerned shall take all measures necessary to ensure that the breeder receives equitable remuneration.” - UPOV Convention 1991, Article 17

**Use of PVP:** Unit of commerce, probably necessary to commercial a new variety in an IPR-aware country, Recognition of work of breeder, Enables licensing, in return for royalties

**Future of PVP: Positive** - International, over 80 countries, developing and developed

- Effective, cost efficient, almost no litigation or legal/protection costs
- No claim over genetic material
- No restriction on use for breeding
- No restriction on farm-saved seed

**Future of PVP: Negative** - Does not recognize breeding contribution of farmers

- Does not recognize sources of genetic material
- Plays a role in loss of land races and increased homogeneity of crops

Plant variety right has a continuing and important role in plant breeding in future. The patents will always be attractive, but are unlikely to displace PVP in the medium term. Sui generis systems will develop, to recognize the contribution of farmers and germplasm-rich countries, unless the UPOV system adapts to meet these concerns. Benefit to the developing nations. Increase the number of varieties in commercialization. Due to ecological concerns, other existing varieties are being vanished.

3. **DUS testing procedures for agricultural crops in UK**

**National Listing- agricultural crops:** It is the legal requirement for marketing a variety. However, the variety must be Distinct, Uniform and Stable (DUS) and also provide Value for Cultivation and Use (VCU). The National Listing is aadministered by Fera, PVS

**Plant Breeders rights (PBR)**

- Encourages development of new varieties
- Grants exclusive rights to breeders to authorise and control multiplication and sale of reproductive material
- International Union for the Protection of New Varieties of Plants
- Established: 1961 (67 members)
- International Convention for the Protection of New Varieties of Plants (UPOV Convention)
- Various revisions – most countries signed up to 1991 Act
- Headquarters: Geneva
- Organises: Technical working groups: training

**Technical working group**

- TWA : Agriculture
- TWO : Ornamentals
- TWF : Fruit
- TVW : Vegetables
- TWC : Computers
- BMT : Biomolecular techniques
- TGP/I : General introduction (still in draft)
- TGP/9 : Examining distinctness
- TGP/10 : Examining uniformity
- TGP/11 : Examining stability (still in draft)

**DUS testing system in UK**

- Applies to all species tested:
- Technical Questionnaire (TQ) sent in by the breeder
- AFP number allocated by Fera, PVS
- “ Sowing List” from Fera
- Candidate variety sown in DUS trials (at least two replicates, at least two years)
- New varieties compared with other varieties of "common knowledge"
Reference collection
- UK National List
- Common catalogue varieties in “common knowledge”
- Common knowledge -countries with a similar climate: Germany, France, Austria, Belgium, Netherlands, Denmark.
- Seed stored in long term seed store

• Extra seed authenticated in the field against remaining stock
• Samples of seed sent in by applicant
• Sample annotated with AFP number and breeder’s reference
• Details checked against Fera sowing list
• Fera informed of any discrepancies

APPLICATION FOR A VARIETY TO ENTER TESTS FOR NATIONAL LISTING

BREEDER submits

VCU (value for cultivation & use)

DUS (distinctiveness, uniformity & stability)

1.5Kg of bulk seed + 150 ‘selected seed’

Year 1 DUS testing

Year 2 DUS testing

75g vernalisation test plot

2 x 75g plots

YEAR 1 PROVISIONAL DESCRIPTION

DUS DECISION, FINAL REPORT IF PASSES

DEFRA Technical questionnaire TQ

35Kg seed sample sown at 6 different trial sites, trialling managed by BSPB

DUS testing Cereal Methods

- 2-year test based upon field sown plots
- 2 independent growing cycles
- Runs in parallel to the 2-year VCU trials
- Separate material submissions for DUS and VCU
- Characteristics recorded according to species and Technical Protocol (CPVO TP)
- After two years data are analysed using class widths (states of expression)
- Candidate variety must be distinct
- Uniformity must meet CPVO TP
- Official description produced after NLSC approval
- Reference samples
- Central database holds descriptions for varieties in “common knowledge” Includes
  - All varieties on UK National List
  - All varieties marketed in the UK
  - All varieties marketed in Denmark and Germany (France)

Based on (CPVO TP /3/3, TP/19/2, TP 20/1)
  - Dataloggers used to record characters
  - Characters recorded as scores (most 1-9)
  - ‘A’ characters recorded April to July
  - ‘B’ characters July

Standards in DUS testing
Year 1 Selected seed: Two plots 9m X 3 rows,
  - Total population approx.2000 plants
  - Acceptance probability =95%

Equivalent to a maximum: not more than 10/2000 variant plants

Data analysis
- Year 1 score + Year 2 score divided by 2 = ‘average score’
- Varieties separated using the “Class width” (minimum distance)
- All variety profiles held in database compared to each other to establish ‘D’
• Forms a permanent record in the variety file
• Description produced
• Awarding of National Listing (PBR)

For non ‘D’ varieties:
• comparison of archive dried material with non D candidate
• if minor differences noted then further test by electrophoresis - SDS Page

4. DUS testing in winter oilseed rapeseed

Uniformity standard
• 2% off-types allowed for open pollinated lines (95% probability)
• 10% off-types allowed for hybrids (95% probability)

Impurity: A plant of the same species where one or more of its morphological characters are clearly different from those of the variety and are considered outside the range of expression for the variety.

Scoring of characters
• Plots drilled beginning September
• Leaf characters (plot score) - November
• Flower characters (plot score & IA) - Start March
• Mature plant characters (plot score, measurement, IA) June, July
• Growing replicated plots or side-by-side comparisons in the field
• Observation, measuring and recording of a series of characteristics
• Use of Image Analysis
• Production of variety descriptions
• Comparison with other varieties “of common knowledge”
• Total number of plots 2009/10= 2300
• Three replicates
• Two randomised
• Third replicate:
• AFP number order
• VCU authentications
• Seed stock authentications
• Side by side comparisons
• Candidate variety must be distinct (COYD @2% combined over years D)
• Uniformity must meet CPVO TP (2% for open pollinated varieties,10% hybrids)
• After two years data are analysed statistically by COYD
• Official description produced after NLSC approval

EC Directives
• 66/400/EEC: Beet Seed
• 66/401/EEC: Fodder Plants
• 66/402/EEC: Cereal Seed
• 69/208/EEC: Oil and Fibre Plants
• 70/438/EEC: Vegetable Seed
• 70/457/EEC: Common Catalogue of Varieties of Agricultural Plant Species

5. Molecular markers in DUS testing

UK research; past and present

UPOV application models for the use of molecular markers in DUS
• Use of molecular markers which are directly linked to traditional characteristics (gene specific markers)
• Calibration of threshold levels for molecular characteristics against the minimum distance in traditional characteristics
• Development of a new system

Application of molecular markers in Plant Variety Registration
• Varietal identity
• Management of reference collections
• Determining Essential Derivation (EDV) status
• Enforcement of Plant Breeders’ Rights (PBR)

Research using molecular markers for DUS in UK
• Variety identification in wheat, barley and oilseed rape
• Management of oilseed rape reference collections using SSRs
• Identification of vernalization genes in barley using SSRs and SNPs
• Development of trait-associated marker assays using SNPs in barley

The Problem….
• Increasing size of reference collections in EU countries
• All varieties of “common knowledge” should be included
• A pragmatic approach is needed
• Reference collections could be managed by the use of molecular markers

Objectives and approach
• Evaluate the use of markers to manage the WOSR reference collection
• Assess the UPOV approach “Calibration of threshold levels for molecular characteristics against the minimum distance in traditional characteristics”
• Maintain the value of variety protection
• Provide an assured method of pre-selection of varieties to grow via a European database to manage the size of the WOSR reference collection
Method used
- 410 varieties (OP lines) analysed between 3 labs using 23 SSRs
- Phenotypic data from 21 CPVO characteristics used: UPOV notes and year means (2003, 2004 and 2005)
- Data from all partners collated for the same 410 varieties genotyped using the selected SSRs

Phenotypic and molecular distances
- Genetic and phenotypic distances calculated and compared
- There was no correlation between any of the morphological and molecular estimates of similarity (<0.1)
- Variety pair similarity showed the morphological and molecular similarities only agreed on 3 of a possible 55,000 pairs

SNPs for barley DUS assessment:
Advances in understanding the molecular basis for variation in barley characteristics
- BBSRC LINK project – Association Genetics of UK Elite Barley (AGOUEB)
- ~600 barley varieties genotyped
- 1536 SNP loci
- Association mapping used to detect associations between SNPs and eight DUS characteristics

Eight DUS barley characteristics (UPOV Test Guidelines: TG/19/10)
- Grain: rachilla hair type (Char. 22)
- Grain: hairiness of ventral furrow hairs (Char. 26)
- Grain: spiculation of inner lateral nerves of dorsal side of lemma (Char. 25)
- Lowest leaves: hairiness of leaf sheath (Char. 2)
- Flag leaf: anthocyanin coloration of auricles (Char. 3 and 4)
- Awns: anthocyanin coloration of tips (Char. 8 and 9)
- Kernel: colour of aleurone layer (Char. 28)
- Sterile spikelet: attitude (Char. 20)

Progress made in the AGOUEB project
- The eight DUS characteristics were mapped at approx. 3cM resolution
- High degree of correlation between allelic state of SNP locus and characteristic state
- Candidate genes are currently being assessed in the immediate location of the eight trait association peaks
- Causative polymorphisms sought
- Convincing candidate gene and polymorphism found diagnostic for presence/absence of anthocyanin coloration.

Relevance to DUS testing
- Produce a rapid marker test for the eight DUS characteristics
- Assess linked and putatively causative SNPs for their ability to predict DUS characteristic states
- Include Seasonal Growth Habit (SGH) and ear row number in the marker test
- Include some VCU quality traits in the study to maximize the potential of the assay

Testing of high throughput genotyping system
- KASPar is a high throughput and relatively cheap genotyping platform
- Provided as a service by KBiosciences (http://www.kbioscience.co.uk/)
- Based on recently developed singleplex technology
- Dispenses with the need for individually labelled fluorescent probes used in the Taqman system
- System tested at NIAB using field bean
- 75 of the 80 SNPs tested produced robust assays

Visualization of SNP data using KASPar
- SNP data from a single assay in field bean
- G/T SNP genotypes are clearly distinguishable
- G = blue
- T = red
- Heterozygotes = green
Design of assays for barley
- For each gene, one or more polymorphic DNA features were assayed
- DNA sequence with SNP positions shown
- GenBank accession number for the DNA sequence of the reference allele
- Reference number linking to the relevant scientific publication describing allelic variants
- Genetic map position of gene
- Information describing SNPs and their phenotypes

6. Statistical analysis used in Winter Oilseed Rape (WOSR) DUS testing

Trial design
- All reference varieties and candidates grown in the field for direct comparison
- 3 replicates, reps 1 and 2 randomized
- Rep 3 in AFP number order, includes side by side comparisons, VCU authentications and seed stock replacement
- Plots 4m x 6m, 4 rows wide
- Parental components (female line, male line and maintainer line) must be grown if they are new to the system
- If a parental line from one breeder is used by another, a letter of permission must be presented
- Each replicate includes a block of OP lines, hybrids and parental components

- Hybrids are not compared with OP lines for D
- Semi dwarf varieties are blocked together with a semi dwarf guard row
- Plot size for A, B, R & H are same

The reference collection
- The size of the growing trial increases each year
- All varieties of “Common knowledge” should be included
- For WOSR this means all varieties granted Community Rights by CPVO, varieties on the UK NL, varieties on the Common Catalogue
- Pragmatic approach is to grow only those varieties in a similar climatic zone

Cyclical planting
- Used for several years in herbage DUS
- Historical data replaces real data on a partial set of reference varieties for one year (using modified regression analysis (MJRA))
- A different set of reference varieties used each year
- A variety MUST have >4 years of data to be excluded from the growing trial
- Allows a reduction of 12-15% of reference varieties each year
- Not a solution to the growing size of the reference collection
**Trial design**
- Bar-coding the labels
- Cream colour flowered brassica variety which is the father of brassica in UK used to demarcate the plot

**Recording of characteristics**
- CPVO-TP/036/1
- 21 characteristics
- Quantitative (measured) and qualitative (scored) characteristics
- Many quantitative characteristics measured by Image Analysis (IA)
- IA cotyledon measurements require a separate glasshouse trial
- Characteristic 21: “Tendency to form inflorescences in year of sowing for late summer sown trials” requires a dedicated field trial
  - For IA petal and cotyledon measurements, 2 reps x 30 plants measured – Accuracy of data
  - For IA pod measurements, 3 reps x 20 plants measured - Quantitative
  - Mean calculated for each of 3 reps and for each year
  - Trials also conducted in other locations and data collected for analysis.
  - DGP4 – Protocol for new species

**Combined Over Years Distinctness Analysis (COYD) is used**
- In cross pollinated crops
- Where quantitative characteristics are predominant
- Where there are some differences between plants or plots
- Where observations are made over two or more years
- In WOSR COYD @ 1% (@95% probability) is used
- Takes into account variation between years
- Over year means are taken from established varieties and candidates from two years of trial
- Least significant difference (LSD) calculated from variety-by-years variation

- If the over-years mean difference between two varieties is greater than or equal to the LSD then the varieties are said to be distinct in respect of that characteristic
- Candidates must be distinct from all others in the test in at least one characteristic
- If the variety score is 1 in the first year and 5 in the second year, then there may be dissimilarity in the variety over the variety.
- If the average score is 5.41 over the years the score will be considered as 5.0. Similarly if it is 5.56 then 6.0.

**Examples of Statistical Data**

**Variety Means Data**

<table>
<thead>
<tr>
<th>CHARACTER</th>
<th>STRINGENCY</th>
<th>MJRA ANALYSIS</th>
<th>F3</th>
<th>SIGNIFICANCE</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 ALT</td>
<td>1.46</td>
<td>0.34</td>
<td>73.59</td>
<td>NS</td>
<td>1</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>D</td>
</tr>
<tr>
<td>15 PLEN</td>
<td>0.99</td>
<td>1.09</td>
<td>27.86</td>
<td>NS</td>
<td>1.5</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>+</td>
</tr>
<tr>
<td>14 HTFLOW</td>
<td>1.12</td>
<td>0.46</td>
<td>64.72</td>
<td>NS</td>
<td>0</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>+</td>
</tr>
<tr>
<td>8 SERRA</td>
<td>0.89</td>
<td>-1.51</td>
<td>13.11</td>
<td>NS</td>
<td>3.6</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
</tr>
<tr>
<td>7 LOBING</td>
<td>1.16</td>
<td>-2.69</td>
<td>0.754</td>
<td>**</td>
<td>3.8</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>1</td>
</tr>
<tr>
<td>4 COLOUR</td>
<td>1.02</td>
<td>-2.95</td>
<td>0.347</td>
<td>**</td>
<td>3.4</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
</tr>
<tr>
<td>11 PETLEN</td>
<td>0.96</td>
<td>-4.46</td>
<td>0.001</td>
<td>***</td>
<td>2.2</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>1 (not good)</td>
</tr>
<tr>
<td>12 PETWID</td>
<td>0.95</td>
<td>-1.54</td>
<td>12.368</td>
<td>NS</td>
<td>1</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
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<td>-</td>
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<td>NC</td>
<td>-</td>
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<tr>
<td>19 FEDEL</td>
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<td>0.077</td>
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<td>1.4</td>
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<tr>
<td>91 PodWToL</td>
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<td>0</td>
<td>NS (non significance)</td>
<td>NC (not compared)</td>
<td>NC</td>
<td>1 (good)</td>
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**Table summarizing Distinctness**

<table>
<thead>
<tr>
<th>YRS</th>
<th>CANDIDATE VARIETIES</th>
<th>2115</th>
<th>2116</th>
<th>2126</th>
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<td>537</td>
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<tr>
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<td>-3</td>
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<td>D</td>
</tr>
<tr>
<td>997</td>
<td>997</td>
<td>-3</td>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

**Final reports**
- A computer program abstracts the variety mean data from selected statistical files.
- The mean data is converted into scores according to the CPVO guideline.
- The computer program uses the calculated scores in combination with the summary report to produce Final Reports.

**Table showing analysis of one Candidate compared with a Control**

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<td>12.368</td>
<td>NS</td>
<td>1</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
</tr>
<tr>
<td>54 PETWTOL</td>
<td>0.99</td>
<td>2.92</td>
<td>0.374</td>
<td>**</td>
<td>0</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>1</td>
</tr>
<tr>
<td>17 PODW</td>
<td>0.95</td>
<td>4.41</td>
<td>0.002</td>
<td>***</td>
<td>0</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>1</td>
</tr>
<tr>
<td>16 PODLEN</td>
<td>0.99</td>
<td>-5.79</td>
<td>0</td>
<td>**</td>
<td>3.2</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
</tr>
<tr>
<td>18 BEAKLEN</td>
<td>1.08</td>
<td>-1.52</td>
<td>13.051</td>
<td>NS</td>
<td>0</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
</tr>
<tr>
<td>19 FEDEL</td>
<td>0.96</td>
<td>-3.4</td>
<td>0.077</td>
<td>**</td>
<td>1.4</td>
<td>NS</td>
<td>NC</td>
<td>NC</td>
<td>-</td>
</tr>
<tr>
<td>91 PodWToL</td>
<td>3.47 (class width)</td>
<td>3.83</td>
<td>0.016</td>
<td>***</td>
<td>0</td>
<td>NS (non significance)</td>
<td>NC (not compared)</td>
<td>NC</td>
<td>1 (good)</td>
</tr>
</tbody>
</table>
### Summary table report (Once all results are collated a Summary table report is produced)

<table>
<thead>
<tr>
<th>AFP No.</th>
<th>BREEDER’S REF</th>
<th>VARIETY TYPE</th>
<th>NLPB R</th>
<th>TEST STATUS</th>
<th>APPLICANT</th>
<th>UNIFORMITY AND DISTINCTNESS</th>
<th>VCU AUTHENTICATION</th>
<th>RESULT</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>35/2069</td>
<td>WRH 313</td>
<td>HY-RCMS</td>
<td>NL</td>
<td>DUS3</td>
<td>DSV</td>
<td>Uniformity satisfactory. Non distinct from 35/1978 Emerson. No differences observed in side by side plots in third year of testing. See Appendix 1</td>
<td>DUS: FAIL</td>
<td>N/A</td>
<td>Non-distinct in DUS year 2: third year of DUS testing</td>
</tr>
<tr>
<td>35/2083</td>
<td>X06W202C</td>
<td>HY-RCMS</td>
<td>NL</td>
<td>DUS2</td>
<td>Pioneer Hi-Bred Northern Europe Service Division GmbH</td>
<td>Uniformity satisfactory. Distinct on additional cotyledon characteristics only.</td>
<td>DUS: PASS</td>
<td>OK</td>
<td>DUS: PASS</td>
</tr>
<tr>
<td>NW4304FC</td>
<td></td>
<td></td>
<td></td>
<td>Complete</td>
<td></td>
<td></td>
<td></td>
<td>see p-line 35/1904 (pass)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Afp Number</th>
<th>ALT21</th>
<th>ALT21 note</th>
<th>PLLEN15</th>
<th>PLLEN15 note</th>
</tr>
</thead>
<tbody>
<tr>
<td>537</td>
<td>2.23</td>
<td>Very Weak to Weak</td>
<td>154.33</td>
<td>Short to Medium</td>
</tr>
<tr>
<td>625</td>
<td>2.91</td>
<td>Weak</td>
<td>176.16</td>
<td>Long to Very Long</td>
</tr>
<tr>
<td>982</td>
<td>5.18</td>
<td>Medium</td>
<td>161.3</td>
<td>Medium</td>
</tr>
<tr>
<td>997</td>
<td>4.35</td>
<td>Weak to Medium</td>
<td>158.35</td>
<td>Medium</td>
</tr>
</tbody>
</table>
CPVO REPORT ON TECHNICAL EXAMINATION

1. Reference number of reporting authority 35/7007
2. Requesting authority
3. Reference number of requesting authority
4. Breeder’s reference OSR 06/142
5. Date of application in requesting state
6. Applicant’s name and address OILSEED RAPE BREEDER CAMBRIDGE UNITED KINGDOM
7. Agent’s name and address As above
8. Botanical name of taxon Brassica napus L. oleifera
9. Common name of taxon Oilseed Rape
10. Variety denomination JOLIE
11. Breeder’s name and address OILSEED RAPE BREEDER CAMBRIDGE UNITED KINGDOM
12. Testing authority Department for Environment, Food and Rural Affairs, UK
13. Testing station(s) and place(s) NIAB, Cambridge
15. Date and place of issue of document 17 November 2008, NIAB, Cambridge

16. RESULTS OF THE TECHNICAL EXAMINATION AND CONCLUSION

(a) Report on Distinctness:
The variety - is clearly distinguishable from any other variety [x]
- is not clearly distinguishable from all varieties whose existence is known to us. [ ]

(b) Report on Homogeneity:
The variety - is sufficiently homogeneous [x]
- is not sufficiently homogeneous having regard to the particular features of its sexual reproduction or vegetative propagation. [ ]

(c) Report on Stability:
The variety - is stable [x]
- is not stable in its essential characteristics. [ ]

In the case of a positive conclusion, a description of the variety is given as annex to this report

17. Remarks:

18. Signature: C. Novis
UPOV VARIETY DESCRIPTION

1. Reference number of reporting authority 35/7007
2. Reference number of requesting authority (bilateral agreements only) OSR 06/142
3. Breeder’s reference OILSEED RAPE BREEDER
4. Applicant’s name and address CAMBRIDGE UNITED KINGDOM
5. Botanical name of taxon Brassica napus L. oleifera
6. Common name of taxon Oilseed Rape
7. Variety denomination JOLIE
8. Date and/or document number of CPVO Test Guidelines CPVO-TP/036/1
9. Date and/or document number of National Test Guidelines 25th Mar 2004
10. Testing authority Department for Environment, Food and Rural Affairs, UK
11. Testing station(s) and place(s) NIAB, Cambridge

14. GROUP: (Grouping characters are marked G in Section 15)

<table>
<thead>
<tr>
<th>CPVO No.</th>
<th>UPOV No.</th>
<th>National Characteristic</th>
<th>State of Expression</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>*1</td>
<td>01 Seed: erucic acid</td>
<td>Absent</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>*5</td>
<td>25 Leaf: lobes present or absent</td>
<td>Present</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>*11</td>
<td>56 Time of flowering</td>
<td>Late</td>
<td>7</td>
</tr>
</tbody>
</table>
15. CHARACTERISTICS included in the CPVO Test Guidelines or National Test Guidelines:

<table>
<thead>
<tr>
<th>CPVO No.</th>
<th>UPOV No.</th>
<th>National Characteristic</th>
<th>State of Expression</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 G</td>
<td>*1 G</td>
<td>Seed: erucic acid</td>
<td>Absent</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Cotyledon: length</td>
<td>Short to Medium</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Cotyledon: width</td>
<td>Narrow to Medium</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cotyledon: width/length ratio</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>*4</td>
<td>Saddle Depth</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Leaf: green colour</td>
<td>Medium to Dark</td>
<td>6</td>
</tr>
<tr>
<td>6 G</td>
<td>*5 G</td>
<td>Leaf: glaucosity</td>
<td>Present</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>*6</td>
<td>Leaf: number of lobes</td>
<td>Medium to Many</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(fully developed leaf)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>*7</td>
<td>Leaf: dentation of margin</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>9 G*</td>
<td><em>11 G</em></td>
<td>Time of flowering</td>
<td>Late</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>*12</td>
<td>Flower: colour of petals</td>
<td>Yellow</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>13</td>
<td>Flower: length of petals</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>14</td>
<td>Flower: width of petals</td>
<td>Narrow to Medium</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>15</td>
<td>Production of pollen</td>
<td>Present</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
<td>16</td>
<td>Plant: height (at full flowering)</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>15</td>
<td>*17</td>
<td>Plant: total length</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>18</td>
<td>Silica: length (between peduncle and beak)</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>19</td>
<td>Silica: width</td>
<td>Medium</td>
<td>5</td>
</tr>
<tr>
<td>18</td>
<td>20</td>
<td>Silica: length of beak</td>
<td>Short to Medium</td>
<td>4</td>
</tr>
<tr>
<td>19</td>
<td>21</td>
<td>Silica: length of peduncle</td>
<td>Short to Medium</td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Tendency to form inflorescences in year of sowing for spring sown trials</td>
<td>Very Weak to Weak</td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>22</td>
<td>-- Tendency to form inflorescences in year of sowing for late summer sown trials</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

16. Similar varieties and differences in relation to those varieties

<table>
<thead>
<tr>
<th>Denomination of similar variety</th>
<th>Characteristics in which the similar variety is different</th>
<th>State of expression of similar variety</th>
<th>State of expression of candidate variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>35/1580 MISSOURI</td>
<td>(UK) 74 COTWP/W COYD @ 2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

17. Additional information:

a) Additional data

b) Remarks
7. Food and environment research agency (FERA), Cambridge

Fera brought together
- Central Science Laboratory (CSL)
- UK Government Decontamination Service (GDS)
- Plant Health and Seeds Inspectorate (PHSI)
- Plant Varieties and Seeds Division (PVS)
- Plant Health Division (PHD)

Purpose
- Developing a sustainable food chain
- Developing a healthy natural environment
- Protecting the global community

Role
- **Regulation**: Policy and inspectorate functions for plant health, bee health and plant varieties and seeds
- **Research**: Robust scientific research, analysis and evidence for government and commercial customers worldwide
- **Response**: Advice, guidance and support as part of the UK’s capability to respond and recover in emergency situations

Key Facts
- Projected turnover 2009/10 - £72million
- Staff - 850
- Location

Cambridge PVS run three separate but related schemes
- National Listing
- Plant Breeder’s Rights
- Seed Certification and Enforcement

The first and last are based on European Union legislation and middle one on UK Law

National Listing and Seed Certification lay down minimum standards and are seen as consumer protection

Plant Breeders’ Rights is a voluntary form of intellectual property protection which allows plant breeders to collect royalties

National Listing is a requirement for most agricultural and vegetable species in order that seed may be marketed

All crops must be Distinct, Uniform and Stable (DUS), meaning that they are new and remain true to type over generations.
- Agricultural crops must also have Value for Cultivation and Use (VCU)

**How do we test new varieties?**
- Application is made to Fera PVS
- Entered into DUS tests and VCU trials
- These normally take about 2 years
- If the variety passes VCU and DUS testing, it is added to the UK’s National List
- The variety will automatically be added to a European Union list, the Common Catalogue

The Cambridge Office has been handling Plant Breeders Rights for the UK since 1966. From 1966 to 1973 there were 899 applications

**Current legislation handling the UK PBR**
- The Plant Varieties Act 1997 (which came into force on 8th May 1998) gives effect to the 1991 UPOV convention in the UK
- Covers the following details:
  - Operation of PVRO, including appeals
  - What can be protected / conditions to be met to qualify for protection
  - Who is entitled to rights
  - Scope of rights / duration
  - Infringement

**What can be protected?**
The Plant Variety Act 1997 states: “Plant breeders’ rights may exist in all genera and species…” CRITERIA:
- For Plant breeders’ Rights. A variety must be: Distinct, Uniform, Stable, Novel (New)

**DUS Tests**
- DUS tests are conducted in accordance with agreed UK protocols. These accord, wherever possible with CPVO protocols or, where these don’t exist, UPOV Guidelines
- These cover administrative procedures, trial design, describe tests, how the procedures are to be applied and specify the characters to be measured.
- Based on UPOV/CPVO principals and TGs, but customised for UK varieties/conditions

**Who is entitled to rights?**
- The person who breeds the variety, or discovers and develops it, or his successor in title.
- If a person breeds, or discovers and develops, a variety in the course of his employment, then unless there is an agreement to the contrary, the employer is entitled to the rights.

**Scope of rights** - Rights in respect of propagating material include:
- Production or reproduction

- Conditioning for purpose of propagation
- Offering for sale, selling or marketing
- Exporting and importing
- Stocking for any of the above purposes

Rights may extend to harvested material (Farm Saved Seed) obtained through unauthorised use of propagating material provided the breeder did not have the opportunity to exercise rights on the unauthorised use of propagating material, before harvest

**Duration of rights**
- 30 years for trees, vines and potatoes
- 25 years for all other genera and species

**Infringement of rights**
- Plant breeders’ rights are a CIVIL right - the breeder must pursue infringements through the civil courts.
- The PVRO does not enforce rights.
- Some remedies exist as for other intellectual property rights – e.g. seizure of material, destruction of illicitly produced material.

**Applying for UK PBR**
- Submit relevant forms and fee to the PVRO by the closing date.
- Required forms: Application form and Technical Questionnaire.
- Assignment of Rights form if appropriate.
- Authorisation of Agent form if appropriate.
- A colour photo for ornamental applications.

**Naming**
- Before a variety can be granted Plant Breeders’ Rights it must have an approved name.
- Proposed names are advertised in the Gazette for 3 months in order to allow for any objections.
- There are rules on naming. Full details are in our guide on the web at: [http://www.fera.defra.gov.uk/plants/plantVarieties/plantbreedersRights/index.cfm](http://www.fera.defra.gov.uk/plants/plantVarieties/plantbreedersRights/index.cfm)
- Names must not mislead or cause confusion about the characteristics, value or identity of the variety or the breeder.
- It must differ from every other name existing for that species or group of species.
- Names cannot consist solely of figures (unless this is establish practice for a species).
- Prior rights of third persons are not affected. If prior rights to a name exist and the holder objects, then another name must be proposed.

**Fees**
- PVRO and CPVO recover FULL cost of testing and application administration fees
• The UK Government does not subsidise the system. It recovers the direct cost but does not charge for maintaining the system.

Since 1973 to present day the Cambridge office has received the following National List applications:
• 16100 Agricultural species
• 3338 Vegetable species

What is National Listing?
• A consumer protection measure
• Aimed at providing farmers with new, better, (higher yielding) varieties
• Based on European Directives
• Implemented through National Legislation

Aims of EU Directives
• To increase productivity by ensuring seed can only be marketed to farmers and commercial growers if it meets certain conditions

UK Regulations
• The Seeds (National Lists of Varieties) Regulations 2001
• The Seeds (National Lists of Varieties) (Amendment) Regulations 2004
• The Seeds (National Lists of Varieties) (Amendment) Regulations 2007

Criteria For Acceptance Onto A National List - The variety must:
• be of a species specified in Regulations
• be distinct, uniform and stable
• have satisfactory value for cultivation and use (amenity grasses and vegetables do not need VCU)
• have an approved name
• have a maintainer
• The variety will automatically be added to a European Union list, the Common Catalogue, if accepted onto the UK list

History of an NL Application
• Relevant paperwork (application form and technical questionnaire minimum) received in PVSD by closing date
• Sowing list prepared and sent to trial organiser/test centre with copies of Technical Questionnaires
• Seed received at trial sites/test centre by closing date and sown at appropriate time
• After two to four years of tests and trials (dependent on species being tested) PVS are informed of results via VCU data sheets and DUS test centre minutes/summaries
• NLSC meets to consider data and propose whether candidate variety can be added to the National List

DUS Tests
• For National Listing the DUS test must be conducted in the EU.
• We might buy a report from another European country, if we have a bi-lateral agreement with them.

DUS Test Centres - UK DUS Test Centres
• NIAB (Cereals, Oilseeds, Beans)
• SASA (Vegetables, Potatoes, Pulses)
• AFBI (Grasses/Herbage)
• Some crops not tested in UK, ie SOSR & Maize (bilateral agreements with Germany & France respectively.)

VCU Trials Co-ordinated by BSPB
• The UK breeders’ organisation The British Society of Plant Breeders (BSPB) is responsible for the co-ordination of all VCU trials.
• They ensure that the correct number of trials are undertaken, and carried out to the standards laid down in the official protocols and procedures.
• BSPB use the NL data in the Recommended List matrix.

National List and Seeds Committee – NLSC Membership
- Representatives from the National Authorities, Fera (for Defra) Chair and Secretary
  • Scottish Agricultural Science Agency
  • Agri Food & Bio-science Institute
  • National Assembly for Wales
  • Plus experts are invited to attend as necessary
- This Committee makes National List ‘proposed’ decisions based on available information (VCU and DUS test results)
- Recommendations are published as proposed decisions in the PVS Gazette, and interested parties are given 18 days to make a representation, either in writing or in person.
- Representations, if received, are considered by technical experts aligned to the National Authorities, and a common view passed to the NLSC.
- The NLSC consider the representation and makes a recommendation to the Plant Varieties and Seeds Committee (PVSC) for a final decision.
- The NLSC also considers technical matters which refer to National Listing, Plant Breeders’ Rights and Seed Certification.
- They have the power to make recommendations or seek the views of experts, such as the DUS test centres, statisticians or VCU trial organisers/ operators.
Plant Varieties and Seeds Gazette
- Everything to do with National Listing is published in the monthly Plant Varieties and Seeds Gazette.
- We advertise proposed names, grants and awards to give interested parties the opportunity to object.
- The Gazette provides: instructions to applicants; varieties information on: withdrawals, naming, grants, awards and terminations.
The published Gazettes can be found at: http://www.fera.defra.gov.uk/plants/publications/index.cfm

Duration on NL
- Varieties are accepted onto the National List until the end of the tenth calendar year following acceptance.
- Acceptance may be renewed for a further ten years if we are satisfied a variety is still DUS and cultivated on such a scale to justify renewed acceptance.

Deletion from National List - If the maintainer wants to
- We advertise it in the gazette to ask if anyone else wants to maintain it. If no one does, it is deleted.
- We notify the Commission so if the UK is the only country with the variety on the CC, it will come off that as well.

PVS can delete a variety if
- It is no longer distinct, uniform or stable
- Facts are discovered which if known before the variety was added to the NL would have resulted in refusal of the application
- There is no maintainer

In 2009, the Cambridge Office received the following applications:
Total Agricultural species: 414
Total Vegetable species: 11
The main Agricultural species are:
- Winter and Spring Oilseed rape: 104
- Winter and Spring wheat: 64
- Winter and Spring barley: 70
- Sugar Beet: 50
- Maize: 41
- Perennial ryegrass: 41

8. Plant IP and royalty collection in the UK
The association and royalty collecting agency for the commercial plant breeding industry in the UK
- Limited company, not for profit, funded by retention and membership fees
- Board and Chairman elected by the membership
- Small executive team based in Ely
- Active internationally in Europe (European Seeds Association - ESA) and globally (International Seeds Association - ISF)

Functions
- Licensing and royalty collection, certified and farm saved seed, optimising returns on members’ IP
- Technical & regulatory issues, working for an enabling regulatory framework that allows innovation and an orderly market at minimum cost
- Commercial plant breeding profile in global food security and climate change debate, public investment in relevant R & D

Licensing & Certified Royalty Collection - Royalty collection - certified seed
- A PBR based system – EU or UK
- Head licences with breeders (combinable crops, fodder, potato – where breeders cannot or do not wish to supply all the seed)
- Sub-licences for production and sales (royalty payers)
- Sub-licences for royalty paid sales
- Breeders set royalties independently
- Cost effective, final retention rate < 2%
BSPB as Head Licensee

BSPB has right to grant sub-license and collect royalties for varieties listed in Schedule 1

**Intellectual Property/Plant Variety Rights**

**RIGHTS** of the Sub-licensee

**OBLIGATIONS** of the Sub-licensee

- Production, Reproduction and Propagation (Clause 2.1)
- Sale and Marketing (Clause 2.2)
- Export and Import of Seed (Clause 2.3)
- Royalties (Clause 4)
- Farm Saved Seed (Clause 5)
- Records and Information (Clause 7)
Special collections
• One off or repeat collections for specific breeders from specified merchants
• New variety, PBR not granted in time for inclusion on the BSPB licence
• Special premium, new variety, seed supply short
• Old variety, PBR expired, levy charged to keep variety in production for niche market

Audit and enforcement
• Audit once or twice a year royalty payers
• Under and overpayments charged as field officers findings
• Positive balance to BSPB with more than cost recovery
• Targeted
• Certification information from national authorities is available when things are going wrong
• Credit risk and monitoring is always an issue

Farm Saved Seed - The agricultural exemption
• An exemption from PBR – not a right
• Optional under UPOV 1991
• Adopted by the EU in Article 14 of Council Regulation 2100/94
• The use by a farmer of the produce of his own harvest on his own holding
• In exchange for equitable remuneration
• Strives for balance between the rights holder and the user
• Biggest problem in UK
• It is not the farmers right but exemption from the right
• No royalty upto 92 tonnes seed production. If it more than 92 tonnes royalty will be collected from the farmers.

The legal framework
• Definition of FSS, farmer and own holding
• List of species covered
• Small farmer exemption
• Information rights – to holder and to user
• Level of ‘sensibly lower’ remuneration determined:
  – By contract (Breeder Vs Farmer)
  – By agreement (Breeder Association Vs Farmers Association)
  – By default – in which case 50%
• ECJ – Schulin et al

Is it working?
• 27 Member States, 13 have a collection system, the others have nothing yet
• CPVO has taken a lead in reviewing how to achieve a fair and equitable system across Europe
• Discussion points are provision of information, ‘own holding’, small farmer
• The UK has the most effective system in Europe

The UK system - combinable crops
• Based on relationships, agreements, cooperation, and pragmatism
• Combination of education, intelligence and targeted enforcement
• BSPB-NFUs Agreement signed June 2007
• Flat rate per crop, 46 to 60% of certified rate, calculated annually as % of weighted average certified rate
• 80% of collection through mobile processors at tonnage rate – agreements with processors through NAAC
• 20% direct from farmers at a hectare rate

Information
• Ask everyone, BSPB pilot
• 19,000+ farmer contacts, more than 90% complete but still building
• Help from the seed trade; no help from the Government
• All names linked with use or purchase of protected varieties; no data protection issues

100% return is achievable
• Make it easy, paper, ‘phone, e-mail, online
• Structured series of reminders
• Reduce to manageable numbers
• Become Schulin compliant, using certified seed sub-licence, contact Trade for certified seed purchase details
• Solicitors letter and follow up
• Ultimately possibility of private prosecution

Education is as important as enforcement FAIR PLAY concept
• Strong campaign identity
• Simple look - simple theme
• Universal message
  – level playing-field for all
• Supported by the farming unions

Plant Breeding Matters
• Highlighting plant breeding benefits & progress
• Reinforcing the link between royalties and new varieties
• Practical advice on FSS collection system
• Putting a face to BSPB

Previously zero rated varieties
• Misdeclaration of zero rated varieties (prior use) believed to be a major source of evasion
• Independent statistical analysis of BSPB data provided evidence

Verification
• Certified seed invoice
• Grain invoice
• Agronomy records
• Seed sample
• Crop inspection
• Many farmer errors in declaration
• More farmer contact brings other issues to light – illegal trading

Issue
• Agreement model generally works well – UK best system in Europe BUT:
• Evasion reducing but still a problem for some crops
• ECJ rulings have meant onerous demands on merchant trade; breeders don’t know who buys their varieties
• Not all farmers are known to BSPB; no official help
• Breeders have no right of verification other than for PZRVs or by using contracts
• The ‘sensibly lower’ and 50% default rules restrict breeders’ income potential income

Potatoes – no agreement
• Royalty rates set independently by breeders at 50% or below licensed rate
• Agreement with merchants to supply details of all certified seed transactions of protected varieties
• Breeders’ terms and conditions of sale allow right of audit
• Collection has increased from £89k in 05/06 to £600K in 08/09
• Farmers gives information on the variety grown and production of seed

Vining peas – a licensed system
• FSS (Farmers Saved Seed) not allowed under EU legislation
• Illegal by-passing of seed was a major issue for breeders
• Agreement to legitimise through licensing
• BSPB vining pea and bean licence allows holder to by pass or intentionally produce seed of protected varieties on payment of a royalty
• Royalty is calculated from weighted average of certified royalty, using rolling 3 year average
• BSPB licences, collects and audits

Contractual approaches
• Standard models are not right for all breeders and all varieties
• Some varieties are marketed on 'no FSS' contracts
• 6 varieties of oats, peas and beans are currently marketed on 'Royalty Area Collection' contracts
• More breeders may try this route
• Future collection by BIPO (Breeders Intellectual Property Organisation)

Principles of Royalty Area Collection
• Royalty is detached from the seed
• Use of contract law to over-ride PBR legislation – most importantly the 50% rule for FSS
• Unified royalty paid per hectare on sowing regardless of source of the seed
• Contract gives right of verification and audit
• Breeders must set the royalty independently
• Farmer must understand what he is doing
• Intention is greater control of IP, more income, less evasion

Leafy salads conditioning licence
• The problems are different in the vegetable seeds sector
• Plagiarism key issue rather than royalties
• BSPB licences “conditioning”
• Makes use of conditioners as bottlenecks
• Head licences with breeders
• Sub-licences with conditioners
• Auditing and sampling right are key to success

Leafy salads audit
• Print out of all seed lots conditioned
• Common catalogue/orange label check
• PBR check – is it in or has it been in a DUS test somewhere?
• Quantity – is it in commercial quantities?
• If no answers ask the supplier to explain
• Sample and test if required
• Source check for licensed varieties
• Possible new service to audit at seed purchasers

Co-existence of patents and PBR
• More patenting in plant varieties; no breeders’ exemption for patented material
• Hotly debated at all levels; divides the breeding industry globally
• Technology providers promote strong IP, no access or licensed only access to patented germplasm
• Breeders using PBR want free access to breed but accept licensed commercialisation
• Plantum (veg) position of free access and commercialisation
• Which option is best for breeding progress?
• You can protect the trait available in the germplasm but not as a variety

9. Introduction to seed certification
UK Seed Certification was originally a voluntary scheme established by members of the seed industry. In order to export seed produced, the UK made wide use of the OECD seed schemes to trade seed with other countries, including the EC before the UK joined. Certification became a statutory requirement with membership of the EC to allow equal free trade.

EC directives
• 2002/54/EC: Beet Seed
• 66/401/EEC: Fodder Plants
• 66/402/EEC: Cereal Seed
• 2002/57/EC: Oil and Fibre Plants
• 2002/55/EC: Vegetable Seed
• 2002/53/EC: Common Catalogue of Varieties of Agricultural Plant Species

**OECD Schemes**
- Grasses and legumes
- Crucifers and other oil or fibre species
- Cereals
- Fodder beet and sugar beet
- Subterranean clover and similar species
- Maize and sorghum
- Vegetables

**England seed schemes**
- 2001 No. 3510 (National Lists of Varieties)
- 2002 No. 3171 The Beet Seed Regulations
- 2002 No. 3172 The Fodder Plant Seed Regulations
- 2002 No. 3173 The Cereal Seed Regulations
- 2002 No. 3174 The Oil and Fibre Plant Seed Regulations
- 2002 No. 3175 The Vegetable Seed Regulations
- 2002 No. 3176 Registration, Licensing and Enforcement

**Generation control:** Certification uses a system of generation tracking to control production and quality of seed

**Maximum seed lot weights**
- Cereals 30 tonnes
- Pulses 30 tonnes
- Oilseeds 10 tonnes
- Herbage 10 tonnes
- There is a 5% tolerance – should not be used routinely.

**Statutory Tetrazolium testing (STZ)**
- The STZ test is based on 100, 200 or 400 seeds
- For 100 seeds the STZ% must be: 93% or above
- For 200 seeds it must be: 90% or above
- For 400 seeds it must be: 85% or above

Germination takes precedence over the STZ

**10. Crop inspections: The principles and procedures**

*Crop Inspectors*:
- All crop inspectors are licensed by FERA. Two types of cereal crop inspectors
  - “Official” - PHSI and NIAB
  - “Licensed” - employed in seeds industry
- “Official” inspectors inspect Pre-Basic and Basic seed crops
- “Licensed” inspectors inspect other categories

**Field Problems**
- Inspection may reveal “field problems” which are not related to the seed sown or the sample sent to NIAB
  - Wrong seed lot(s)sown
  - Incorrect crop details
  - Drilling errors
  - Volunteers from previous crops
  - Wild oat plants
  - Lodging
  - Isolation
Weeds, pests or diseases
Establishment

11. Seed production statistics as a marketing tool

- In the European Union (almost) all seed sold to growers must be certified. Certification is a quality assurance system that ensures that growers buying a variety get the right variety that it meets standards of varietal purity that it meets standards of ‘analytical purity’ and that it meets standards of germination.
- NIAB manages the Seed Certification Scheme for England and Wales on behalf of Fera.
- It is important to note that seed is often multiplied and marketed by companies other than the breeder.
- The breeder therefore loses some degree of control over seed production but benefits by having third parties involved. The breeder earns income through royalties payable on seed sold. It is therefore of great interest for the breeder to know how much seed has been certified of their varieties.
- There is a lot of bureaucracy in the certification process relating to seed testing and seed pedigree.
- NIAB collates this information and stores it on our ‘Cosacs’ database. The database is therefore a fantastic information resource. NIAB makes use of the data held by making it available to subscribers.
- ‘NIAB Specialist Membership’ - £205 per year (includes quarterly updates of seed certification data + other benefits)
- ‘NIAB Seedstats Membership’ - £584 per year (includes weekly updates to certification data, five issues of a journal per year, annual comparisons of data, market share analysis and details of seed imported for further multiplication. Seedstats is used by a relatively small but varied group of subscribers. It allows breeders to track quantities of seed being produced, whether they are on track or whether more is being produced than they expect or even desire. Data is presented in two main ways viz., As areas registered (entered) as seed producing crops and As weights certified from those crops
- The data is grouped by crop type, for example winter wheat. Within that crop type it is presented by variety and by certification category (generation). The data is presented as hard data, for example the number of tonnes certified to date, and as the overall proportion that a variety has of the total. A glance at data will show whether a variety is increasing, steady or in decline depending on the relative proportion of generations.
- New varieties will have relatively high numbers at the pre-basic/basic end and low numbers at the final generation end. Old varieties will show the opposite trend.
- Seedstats subscribers receive weekly updates as data changes. Areas change as new ‘crop entries’ are received. Weights change as certification procedures of seed lots are completed. Seedstats subscribers receive weekly email updates as data changes and can access historic data online.
- Areas change as new ‘crop entries’ are received.
- Weights change as certification procedures of seed lots are completed.
- Data is also available to show market share by variety type (e.g. bread-making wheat compared to feed wheat. Data also available to show quantities of seed imported for further multiplication.
- NIAB produces the data for England and Wales but is dependent on information being sent to us from Scotland and Northern Ireland. England and Wales produce by far the largest quantities of seed. Breeders use the data to monitor the progress and market share of their varieties as well as those of their competitors.
- Knowledge of market share helps them plan future production levels - do they need to increase or decrease production? Seed merchants use the data to track overall market share of varieties. Are they growing enough of a variety to meet likely demand? Are they growing too much?
- Data also helps to track the development and likely availability of new varieties.
- If a breeder is producing large quantities of a new variety there is a high expectation of success which a seed merchant may wish to tap into.
- Similarly if a breeder is cutting back on production perhaps it is time to move on to different varieties.
- Data also reveals how varieties are adopted differently in different areas, for example in Scotland variety choice is more conservative.
- Data have been used to detect fraudulent claims of variety identity.
- Grass varieties are often sold in mixtures. In the past the quantities of certain varieties being advertised for sale has exceeded the amount that has been certified. It is unlikely that most customers would know if they were receiving the wrong grass varieties.
• It is important to note that Seed Certification data does not and can not take account of quantities of Farm Saved Seed or of final generation seed imported into the UK from other EU countries
• Fera also produce their own sets of seed certification statistics under freedom of information legislation but the information is only released to summarize certification for a year and is not timely.
• Rape seed (8kg/ha) – Seeds are produced from France because of the growing conditions and earlier harvest to supply the seed material for sowing in UK. The certified seed is sold at the rate of 30GBR/tons

12. Disease resistance in VCU testing
• Resistance to key diseases is assessed as part of statutory programmes for “Value for Cultivation and Use”
• For some crops and diseases, minimum standards must be reached
• For others, disease resistance is given a weighting which is used, with other characters, to decide whether a variety is placed on the National List
• Nearly all disease resistances are rated on a 1 to 9 scale, where 9 is highly resistant

Methods in disease resistance testing
• Inoculated tests
  ❖ Controlled inoculation, uniform disease pressure, conditions managed to promote good epidemic development. Frequent assessments to rate disease
• Disease observation plots
  ❖ Situated in areas of high disease risk. Will not always generate high quality data
• Untreated plots in yield trials
  ❖ Becoming less useful as most yield trials are treated to allow maximum genetic potential to be measured

13. Farm and plot agronomy
Area – 300ha (741 acres)
• 70 ha (173 acres) are rented
• 60 ha (148 acres), 4 miles West of Cambridge – Farmed commercially.
• Rest is split in half by a major road network
• 90 ha (222 acres), to south
• 150 ha (370 acres), to North
  ❖ 200 ha uniform enough to conduct trials
  ❖ Additional 40ha (100 acres) ‘BORROWED’ for off centre trials
We have four rotations
• 2 year cereal break for pre-breeding program (45 ha allocated to provide 15 ha in trialing year)
• Single year break for our yield trials
• Commercial cropping to provide the entry to trials and cropping land not suitable for trials
• DUS and Certification (45 ha for 7 year cycle)

Basic principles for all trials
• AIM – Uniform crop development so accurate assessments can be made.
  ❖ Magnetic soil scanning
• June/July: Testing for: Soil Acidity (pH), Phosphate (P), Potassium (K) and trace elements
• August: Rectify Soil acidity (pH 7) and maintain Phosphate (P) and Potassium (K) levels.
  ❖ Test digs to ensure good sub soil structure
  ❖ Sub soil fields to cure compaction if needed
• August, September, October: Plough and Furrow press OR non inversion cultivations
  ❖ All done at 90 degrees to Drilling direction
• After drilling
  ❖ All crops rolled, if soil conditions allow. Seed to soil contact and moisture retention

DUS and Certification Rotation
• Establishment year for Herbage trials
• Herbage trials
• Oilseed Rape trials
• Winter Cereal trials
• Pulse trials
• Oil crop trials – excluding Oilseed Rape
• Spring Cereal trials

_DUS and Certification trials operation sequence - Oilseed Rape trials_
• Ploughed late July
• 6m long plot ends/tramlines established by gps
• Drilled early September
• Irrigated
• Pre-emergence herbicide (fertilizer 30kg/ha nitrogen)
• ½ rate fungicide
• Thinned
• Caged for winter
• Cage removed as plants start to elongation
• ½ rate fungicide
• Pollen beetle sprays
• Fungicide sprays
• Combined late once records verified.

_DUS and Certification trials operation sequence - Winter Cereal trials / Pulse trials / Oil crop trials – excluding Oilseed Rape / Spring Cereal trials_
• Ploughed,
• Plot ends/tramlines driven in with GPS
• Spray weeds pre drilling if present,
• Drilled
• Pre or post-emergence herbicide,
• Spring- fertilizers where required,
• Herbicides as required.
• Fungicides as required
• (only to t2 on winter cereals – t1, 1st node. T2, flag wheat/ boot-awns barley)
• Combined

14. Machinery to deliver DUS and certification trials
• GPS steered tractor for marking plots ends and drilling.
• A drill that has two distribution heads
• Tine coulter arrangement catering for varied requirements
  ▶ 1x6 rows, 1x4 rows, 2x2 rows, 2x3 rows
• Molluscicide applicator for accurate placement of pesticide
  ▶ Front cultivators for seed bed preparation
• Other equipment shared through the centre to deliver this work
  ▶ 24m Boom fertilizer spreader
  ▶ 24m Self propelled sprayer – Agrochemical application
  ▶ Rolls for consolidating seed beds, pre or post drilling
  ▶ Commercial combine for harvesting plots once recorded

15. Management and financial considerations of PVP & DUS testing
• Based on practical experience gained since 1964
• Mainly from perspective of a testing station rather than government authority
• Please feel free to draw out any “lessons learnt” so that you can avoid some of the problems that we experienced in the UK
• This is an interactive session – please ask questions and discuss!

Background to Plant Variety Rights
• Paris (later UPOV) Convention signed in 1961
• Parliament approved Plant Varieties and Seeds Act in 1964
• Plant Variety Rights Office (PVRO) established with a Controller
• Controller has responsibility of assessing the information submitted by the breeder and the results of official tests
• Controller decides to grant or refuse rights for a particular variety
• If awarded a breeder can then issue a licence for other people/ organisations to multiply his variety and collect a royalty from them

Plant Variety and Seeds Act 1964
• Primary legislation in the UK
• Implemented through series of Regulations thereafter
• Part 1 – provided the statutory power to establish PBR in the UK
• Part 2 – established the official index of varieties and required statutory performance trials before the seed was marketed for certain crops
• Introduced for wheat, barley, oats and potatoes in 1965-1966
• Fees charged but they did not cover the full cost of granting PBR ie government were subsidising the breeding companies

Arrangements with NIAB in the 1970’s
• 1973 service contract signed between NIAB and MAFF
• Section A provided for statutory commitments of MAFF arising from UK obligations as an EEC member
• Section B dealt with continuing responsibilities under Trust Deed, especially for Recommended Lists
• Contract included providing technical and other information as needed, training and advice.
• Once a programme of work had been agreed at start of year NIAB would give it priority for the allocation of staff, land and equipment.
• MAFF could extend and improve facilities for section A work.

Developments in the 1970’s and 1980’s
• 1975 – 1980, the numbers of candidates entered for NL and RL trials exceeded resources (land, building, equipment and staff) available.
• Government started a process of looking for economies (savings), setting new priorities and cutting back on trial design/ complexity.
• 1980, public expenditure was capped by Government. In turn this then limited NIAB’s funding.
• 1981, DUS testing of ornamentals started at NIAB, mainly chrysanthemum crops and roses
• 1982, the existing MAFF Agreement from 1973 updated slightly
• 1983, Plant Varieties Act introduced, updating the 1964 Act
• 1983, fees introduced for VCU tests for the first time
• 1985, cost recovery for PBR and NL testing was proposed to rise from 23% to nearly 50% PLUS further simplification
   DUS testing of herbage stopped at NIAB
   Numbers of VCU trials reduced and measurements made reduced
   Bilateral arrangements encouraged for DUS tests
• 1986, new Agriculture Bill entered Parliament for discussion
• 1987, new set of fees introduced for DUS testing
• 1989, recommendations of an earlier review implemented
   DUS testing concentrated at one station per crop
   Bilateral arrangements encouraged for DUS tests, as well as discussion on a system of Community PVR
   Vegetable DUS testing cut significantly (and stopped in 1991)
   Government to withdraw from Recommended List trials

Arrangements with NIAB in the 1990’s
• 1991, began drafting a new Agreement to cover changed responsibilities of MAFF and NIAB
• Two years later in April 1993 Agreement still not signed
• 21 March 1996, new Agreement drafted and signed!
• NIAB was privatised as NIAB Trust and Company
• New MAFF-NIAB Agreement comprised four parts
• Part 1 covered the provision of services to the statutory programmes
• Other parts covered Indemnity, Pension and Redundancy agreements
• Contract duration 1996 - 2006
• Prices updated based on estimated changes in work load

Current arrangements for DUS testing
• Plant Variety Rights Office (PVRO) is part of Fera (Food and Environment Research Agency)
• Fera, based in York, is an executive agency of Defra (a Government Department)
• Plant Varieties Act 1997 implements revisions to the 1991 UPOV Convention
• Fera carry out administrative functions before and after DUS tests
• Three subcontractors carry out the actual DUS tests
• Fera charge industry fees for PBR service

Fees charged to industry
Aim is to achieve full cost recovery (which they do apart from on minor crops such as field beans)
• Fees updated periodically through introduction of new Regulations following a period of consultation with industry
• Please see attachment for Fee Structure currently in force
• Taking wheat as an example
   £365 administration fee
   DUS testing fees £600 year 1 + £600 year 2 fee
   Reference variety charge fee £55 year 1 and £55 year 2
TOTAL £1,675 over two years for every candidate entered

Subcontractors doing tests
Three separate organisations carry out the DUS tests
   NIAB (England) – cereals, oilseeds, sugar beet, field beans
   AFBI (N. Ireland) – grasses
   SASA (Scotland) – potatoes, peas, onions, some vegetables
• NIAB has a modern contract based on a reduced specification
• Bid process started July 2004, contract signed September 2005
• AFBI and SASA have separate agreements

Current arrangements with NIAB
• Long term contract of 10 years duration, 2006 - 2016
• Partnership approach rather than subcontractor – means we work together on trying to achieve the desired outcome
• Contract based on series of unit prices for services delivered
• Work on principle of invoicing as the actual work is completed
• Value For Money (VFM) is a key component of the contract
• Performance management is also a key component

Unit prices
• Total contract value approx £2.1 million per annum
• Series of 9 sub-components (Lots) for each work area
• Lot 1 is DUS testing of cereals
• Value of Lot 1 in FY2009/10 comprises (c. £150,000):
   Testing candidates £120,000
   Reference variety costs £18,000
   Advice & Representation £12,000
• Payment is made when the actual work is completed
   40% sowing (October 2009 and April 2010)
   40% recording (spread over April to July 2009)
   10% data analysis (August 2009) and 10% reporting (November 2009)

Balancing the costs?
• Fee income from industry (c. £172,985):
   Admin fees 124 @ 365 = £45,260
   Year 1 fees, 124 @ 600 = £74,400
   Year 2 fees, 71 @ 600 = £42,600
   Reference variety costs, 195 @ 55 = £10,725
• Costs of DUS testing of cereals in FY2009/10 (c. £150,000):
   Testing candidates £120,000
   Reference variety costs £18,000
   Advice & Representation £12,000
• Other costs include Fera staff time and overheads

**Value for Money process**
• Designed to reduce the cost of the contract and ensure that the industry (fee payers) get improved service over time
• Target of 4% saving in costs per annum. Achieved through:
   Innovation projects
   Introducing efficiency savings
   Decommissioning areas of work
• Protecting NIAB’s increasing costs is a formula that allows price increases in line with UK inflation figures

**Performance management**
• Cash refund when savings through VFM are introduced
• Key Performance Indicators (KPI’s) rather than a long list of specific targets to achieve Joint risk register that is reviewed regularly

16. Conclusions and Recommendations
1. Establishment of National Institute for DUS Testing (NIDUST) may be needed with all the lab & field facilities for conducting DUS test for all the Agricultural Crops under the PPV&FRA.
2. The systematic DUS testing with focus on DUS traits other than yield parameters for registration of varieties must be informed to the breeders
3. Licensing of registered varieties must be facilitated through PPV&FRA under the public-private partnership consortium mode with all public and private sector breeders as members.
4. DUS testing with two replication and two locations will reduce the cost of testing
5. Using new equipments like data-loggers, image analyzers and new molecular analysis techniques during the DUS testing will reduce the cost of evaluation
6. Molecular characterization of the reference collections must be done in priority
7. Parental lines of all the notified crops for registration under the PPV&FRA must be done first to avoid the exploitation of similar lines by the private companies.