

GenRes Carrot Newsletter No. 1

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http://www.hri.ac.uk/gru/gen_res/genres.htm



Project News and Information

At the start up meeting of the project, in Cesena the partners decided that the formal timing of the project from January to December did not equate to the milestones as laid out in the Technical Annex. Following consultation with Fred Steenhoff in the Agriculture Directorate it was decided to reschedule various inputs including characterisation and evaluation into year 1. Various partners took the initiative to grow material for characterisation and preliminary evaluation trials in Summer 2000.



Partners at the first project meeting in Cesena subtitled - what does the Co-ordinator have balanced on his head?

The word Summer carries with it the implication of good growing conditions. However, many partners have been reporting abnormal weather conditions this year. The north-west of Europe has been exceptionally wet this Summer culminating in life threatening floods in many areas. While in contrast, further east in Europe the

Summer and Autumn weather has been extremely dry, broken only rarely by torrential localised storms. However, it seems that the carrot work has continued under all these extremes of climate.

News from Horticulture Research International, Wellesbourne

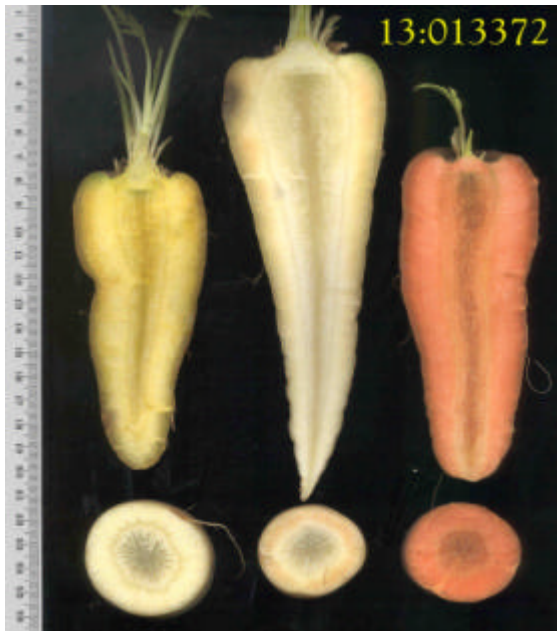
Work has progressed on various fronts, including the development of a project web site, the associated European Inventory for carrot/*Daucus*, characterisation and evaluation.

The GENRES Carrot project web site is located on the HRI Server in association with the HRIGRU pages at the URL above. The pages provide an overview of the technical inputs, the partner roles and the partner contact information. We hope that in due course the GENRES 105 Carrot project will be listed on the EU Europa GENRES web site and a link made to the project pages. The passport data from partner collections has been incorporated into the European Inventory and this will be made available from the above web site shortly.

In the meantime, all the passport data relating to carrot collections received from the project partners have been incorporated into the European Umbellifer Database (EUIDB), which is maintained by the HRIGRU. The URL for the EUIDB is now live <http://www.hri.ac.uk/site2/research/pgb/ecpg/umbellifer/umbellif.htm>

Our characterisation trial was harvested and scored in late November. There were some very interesting populations with mixed root colours, especially white and yellow. This exercise reiterated the recent discussions at our annual project meeting in Angers where we considered the difficulties inherent in scoring very variable populations – see the

scan below of 3 roots from a population originating in Russia.



Our evaluation trials to screen for any resistance to carrot fly and *Pythium* are still in the ground with all the bed channels full of water. The harvest promises to be a very interesting (aquatic) exercise.

Breeding Research on Cultivated Plants (BAfZ-Gene Bank), Braunschweig

The Gene Bank is charged with the provision of News from the Federal Centre for data already contained in our information system and new data generated during the characterisation work. In addition, a total of 25 accessions will be regenerated and another 75 accessions will be characterised in the period 2000 to 2003.

The BAZ-GB passport data set was generated following the ECP/GR standard exchange format and sent to the co-ordinator.

Characterisation: Even though the institute's field plan was already fixed before the first co-ordination meeting, we succeeded to sow 25 accessions and the 3 standard varieties in two replications on 6 June. In late September the leaf characters were scored and 'a typical' leaf was taken and photocopied for documentation purposes. About 4 month later the roots were lifted and characterised according to the minimal descriptor list. About 60 plants

per plot were used for scoring characters in the field. BGRC56330 proved to be a yellow rooted accession. Longitudinal sections were made for a sample of 10 roots per plot, and all accessions per replication were placed on a bench and scored for colour attributes. Finally, a sample of each accession was photographed. Photocopies/photographs can perhaps be used by the project group to assess our (BAZGB) scoring of characters in relation to their own characterisation.

We noticed that accessions exhibited different tastes. Since consumers do not only demand vegetables free of any pesticide residues, but also require good flavour and taste, the Institute of Quality Analysis of the BAZ at Quedlinburg is conducting research on this subject. A flavour assessment panel is available, as one of the methods of assessing the flavour and aromatic qualities in carrot. It is a matter of discussion whether accessions grown at Braunschweig could be evaluated for these qualities in addition to the agreed work plan.

Possible Links with Organic Production

Flavour and taste are strongly determined by the production system. When informed on the forthcoming *Daucus* project the 'Landbauschule Dottenfelder Hof' indicated interest in sharing information with the *Daucus* project partner. Since carrot is an important crop for organic farming we might be able to shift their interest towards active involvement in investigations on quality aspects. A matter for discussion at our next co-ordination meeting ?

Seed Production: In summer, during the pollination and seed maturation phase, the daytime temperature in our small isolation glasshouses can rise to 45 °C. Such high temperatures certainly will have an impact on the survival rate and activity of pollinating insects, and probably affects the seed viability, and subsequent longevity under long-term storage. In consideration of the current project we purchased a foil greenhouse in 1999 and tested its suitability for seed production of carrots starting with sowing a single carrot accession in autumn

1999. The population produced plenty of seeds this year, which are now being processed. A further 7 accessions requiring urgent regeneration were sown as stecklings in early June 2000. Three 3 accessions did not produce enough individuals in the field plot, and so were sown in late October in the greenhouse for young plant production and artificial vernalisation.

News from the Federal Centre for Breeding Research on Cultivated Plants (BAfZ), Quedlinburg

News of changes:

We revised our test strategies in some areas and so will test 10 plants per accession per lab test to give 40 plants/year/accession.

Following discussion with Mathilde Briard, INH Angers we have agreed to use the same test conditions for the field test, perhaps better to call it a **semi-field test**, because the plants will be sown and cultivated under a large plastic tunnel. For each accession we will require approximately 500-800 seeds depending upon the germination quality.

Inocula - we had planned to compare the inocula of both institutes (BafZ-ZG & INH) in a field test last summer. However, a field test was not possible because we had problems with the maintenance and production of the inocula obtained from Mathilde. Therefore we tested a mixture of the inocula from Angers and our own in different lab tests.

Progress in 2000

A laboratory test and a field test were prepared and co-ordinated with the working group in Angers as the basis for the comparability of the evaluation of the *Alternaria dauci* resistance of carrots. Different *Alternaria dauci* isolates were tested in an cotyledon test and an leaf-segment test (laboratory test) for their aggressiveness.

The isolate I 89001 (Quedlinburg) and a mixture of seven isolates from Angers shown more or less the same expression

patterns in both tests. A mixture of the isolate I 89001 and one isolate from Angers will be used for the evaluation of *Alternaria dauci* resistance in the GenRes105 project.

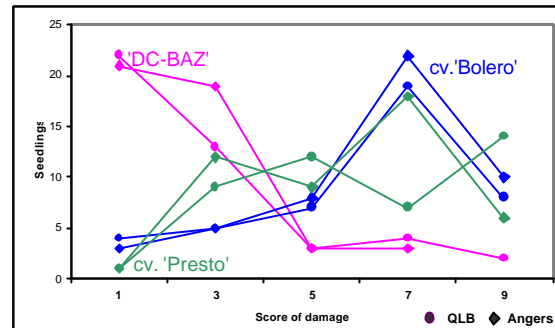


Fig.1: Expression of resistance of three carrot genotypes in the cotyledon test and comparison of the *Alternaria dauci* inocula of Angers and Quedlinburg (1-resistant, 9-dead)

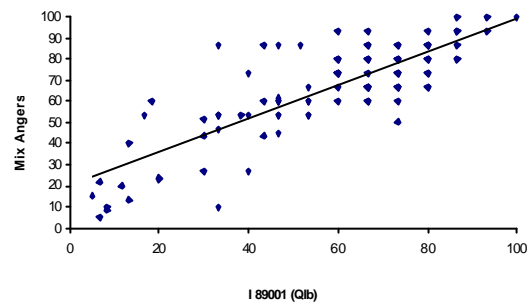


Fig.2: Comparison between the *Alternaria dauci* inocula of Angers and Quedlinburg in a leaf segment test (laboratory test) (n=98 plants, average of three tests in percent of damaged leaf area, evaluation 9dpi)

News from the Scottish Agricultural Science Agency, Scotland

As this season's fieldwork draws to a close, root harvests are well underway. Weather conditions delayed the sowing until mid June, but these same conditions ensured a good, even establishment and certainly reduced our irrigation requirements. The late start has been balanced by our long, cool growing season and an unusually mild, wet autumn. So, cold temperatures or early frosts have not yet checked root growth. During some seasons, we have experienced short leaf growth but this year we have had long, lush, fully extended foliage (Figure 1). Even now at the end of October there is little

indication of leaf senescence. Root size has been similar to past growing seasons. The early and mid-season maturing groups have been lifted. A final lift of the late groups will take place in the next two weeks.



At SASA we maintain a collection of cultivated material. As hybrid cultivars have dominated carrot breeding for more than a decade, we have had little requirement to regularly grow out traditional open-pollinated carrot varieties from our reference collection. Similarly, the adoption of standard maintenances from the EU 'umbrella' vegetable programme has reduced the need to include large numbers of maintenances in our trials. The GENRES programme, therefore, gives us a welcome opportunity to update our descriptions of, and in some cases describe for the first time, selected open-pollinated cultivars and approved maintenances from our collection. This year we will have characterised 77 seed accessions, 60% of which are over 15 years old.

Variety Group	No Accessions
<i>Imperator</i>	1
<i>Nantes</i>	20
<i>Chantenay</i>	18
<i>Danvers</i>	9
<i>Amsterdam</i>	1
<i>Berlicum</i>	7
<i>Flakkeer</i>	21
<i>Reference</i>	3

Growing the trial has enabled us to assess the emergence and viability of the seed in relation to the laboratory germinations.

This will indicate whether accessions may have to be replaced or regenerated.

Over the winter months we shall be adding images from this trial to a photographic library of carrot cultivars which we have been developing for the past five years. This project will allow us to add an extensive range of open-pollinated cultivars to this library.

News - Institut für Pflanzengenetik und Kulturpflanzenforschung, Gatersleben

Andreas Börner is the Deputy Head of the Genebank Department at IPK responsible for the long term storage and reproduction of the genebank collection. The number of accessions has grown and is now up to 100.000 covering a wide range of different species. The main plant groups preserved are cereals and grasses (46.000 accessions), legumes (21.000 accessions), vegetables (14.000 accessions), potatoes (5.500 accessions), oil seeds and fibre plants (5.000 accessions), medicinal herbs (3.500 accessions) and fruits (3.000 accessions). The vegetables group includes about 300 accessions of the genus *Daucus*. Most of the accessions including *Daucus* are maintained as seeds in four cold chambers at temperatures of 0°C or -15°C. Regular germination tests of the seed stocks are performed to control the viability of each accession. On the basis of these test results, specific intervals for viability monitoring of genera or species are suggested. The reproduction of about 8.000 accessions in the field or in greenhouses each year is initiated, when:

- the stored seed quantity has diminished due to delivery to users,
- the viability of the stored seeds decreases,
- evaluations of the accessions are conducted in Gatersleben,
- new accessions enter the collection, which have to be multiplied and characterised

About 15.000 seed samples per year are distributed world-wide making the regeneration programme an essential part of our work.

The passport data of the material, i.e., information concerning the identity, history, geographical origin or botanical determination can be searched via Internet (<http://fox-serv.ipk-gatersleben.de>).

Molecular methods assessing genetic variation at the DNA level are used to prove the purity of genebank accessions after long term maintenance.

News from Institut National d'Horticulture, Angers

Alternaria dauci trial 2000

The trial was performed under two plastic tunnels. There were 2 replications of 3 meters per accession (2 blocks) in each tunnel with 100 seeds/m being sown. Within each block 14 rows of the susceptible cultivar Presto were used as positive controls and homogenizers of the disease. Seven rows of the tolerant cultivar Bolero were used as negative controls. A total of 44 accessions have been evaluated in both tunnels. Tunnel n°1 was inoculated with 'French strains of *Alternaria*', while tunnel n°2 was inoculated with 'German inoculum' (see news from BAZ-ZG, Quedlingburg).

The weather conditions delayed the sowing until 27 July 2000, which was too late because summer temperatures were not favourable to symptom development. Therefore it was very difficult to give any reliable conclusion. The tendencies were that the accessions inoculated with the German inoculum were attacked slightly less than with the French isolate. The mean scores were 1.27 against 2.10 respectively. However the range among accessions from the greatest disease index to the lowest one seemed quite similar in both tunnel.

Jaune du Doubs trial

When accessions are presumed to be duplicates on the basis of passport data and/or phenotypical characteristics, we planned to evaluate if molecular markers could help to decide for elimination or not of accessions. The partners decided to target a first analysis on a variety called 'Jaune du Doubs'. Partners checked their

collection data and sent seeds of any yellow carrot for an initial trial. 25 accessions were sown in mid August. After morphological descriptions 14 accessions were sampled for DNA extraction. For some of these accessions there were 2 or 3 phenotypes. Each of them was separately sampled to compare their genome. Molecular analyses will be realised during the year 2001.

News from the Greek Gene Bank

The genus *Daucus* L. is represented in Greece by 7 species. namely

D. pumilus Ball.,
D. broteri Ten.,
D. muricatus,
D. involucratus SS.,
D. guttatus SS.,
D. gummifer Lam.
D. carota var. *maximus*
D. carota var. *sativus*

In 1999 a collecting expedition in Greece was carried out in collaboration with scientists from the U.S.A, Poland and the Greek Gene Bank. The mission covered a large area of main land Greece including Central and West Macedonia, Epirus, Peloponnesus, and a part of Central Greece, Euboea. During this exploration 5 *Daucus* species were found and collected. Unfortunately no cultivated carrot was collected, and this was due to various reasons

1. The objective of the mission was to collect wild *Daucus* species, hence no time was spent in villages.
2. Many local farmers have replaced landraces of carrot with commercial varieties because of their market quality
3. Farmers discard local selections because many of the old varieties had crossed with wild taxa thus reducing the root quality in terms of colour and form.

Of the 77 accessions collected, 20 were sown in pots for multiplication and characterization. Following the agreed number of plants per trial 50 plants per accession were transplanted. Eight

accessions were annual and set flowers in the first year and the rest were biennials. The biennial accessions will remain in the plots until next year to permit flowering.

News from the Università' di Bologna

The Department for Agronomy will undergo substantial changes, especially from the administration point of view. In fact, we are merging with other research units of Plant Pathology, Entomology, Agricultural Chemistry and Microbiology to form a bigger Department of "Agroenvironmental Science and Technology". The competence and interest of the research group involved in the project will remain unchanged.

Our first year activity was developed along two lines: a) testing the adequacy of the agreed descriptors for characterisation; b) calibrate analytical methods for quality evaluation. Field trials were sown at a private farm of a typical carrot growing area in the province of Ferrara. Two locally widely used varieties (Bolero and Presto) and a supposed high carotene cultivar (Rubrovitamina) were added to the three project standard cultivars (Parmex, Autumn King and Amsterdam). The evaluation by means of descriptors revealed some problem in the efficacy of representing root morphology. The low number of accession allowed a parallel study conducted by measuring root length, diameters and weight, in order to try to study the currently available shape indices and calibrate descriptors against them. The data are being processed.

The methods for analysis of sugar and carotene by HLPC were revised and tested. The need to simplify the carotene analysis was envisaged. A mutual interest of the evaluation of carrot sensory properties with BAZ came out during the second meeting at Angers. The possible ways of operation within the program budget will be examined in the near future.

News from the Nordic Gene Bank

The GENRES activities in the NGB network this season has been limited to project meetings and planning the following years

activities. Thus we take the opportunity to introduce the carrot work of some of the project collaborators.

Theor Appl Genet (2000) 101:227-233

Genetic structure in cultivated and wild carrots (*Daucus carrot* L.) revealed by AFLP analysis

S.I. Shim. R.B. Jørgensen

Abstract Genetic variation within and among five Danish populations of wild carrot and five cultivated varieties was investigated using amplified fragment length polymorphism (AFLP). Ten AFLP primer combinations produced 116 polymorphic bands. Based on the marker data an UPGMA-cluster analysis and principal component analysis (PCA) separated the *Daucus* collections into three groups, consisting of the wild populations, the old varieties, and the recently bred varieties. The genetic distance between the wild populations reflected the physical distance between collection sites. Analysis of genetic diversity showed that the old varieties released between 1974 and 1976 were more heterogeneous than the newly developed F₁ hybrid varieties. The analysis of molecular variation (AMOVA) showed that the major part of the genetic variation in the plant material was found within populations/varieties. The presence of markers specific to the cultivated carrot makes it possible to detect introgression from cultivated to wild types.

J. AMER. SOC. HORT. SCI. 125(2)212-216. 2000.

Rheological Basis of Splitting in Carrot Storage Roots

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Abstract. Tissue properties may strongly influence the occurrence of harvest splitting

in carrot (*Daucus carota* L.) storage roots, a disorder generally assumed to be triggered by a high water status in the storage root. Strain within the root, as well as extensibility of root tissue by using a materials testing instrument was measured. Strain was estimated after incubation of transverse root slices in water. Measurements of the gap that developed as a result of a radial cut into the center of the slice were then used to estimate strain within the root. Extensibility of strips of carrot tissue was measured through two cycles of extension and relaxation, which allowed both elastic and plastic extensibility to be determined. Strain assessment demonstrated that carrot cells have considerable potential to increase in volume when placed in water. In some roots, phloem parenchyma adjacent to the cambium expanded to a greater extent than tissues at the periphery of the root, indicating that rigidity of cells varied across the carrot radius. Tissue extensibility was predominantly elastic, indicating the cells are unlikely to dissipate some of the strain that occurs during periods of rapid water uptake through plastic deformation. However, these measurements of extensibility were related to the properties of cells along the entire 20-mm length of the tissue strip that was used. Because we demonstrated that mechanical properties can vary within a small distance, it is concluded that future studies into the mechanical properties of carrot storage root tissue will rely on empirical strain measurements.

J. Appl. Genet. 38A, 1997, pp. 160 - 164

Harvest splitting in carrot storage roots **Lis Sørensen**

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Abstract. Harvest splitting in carrot storage roots is a serious quality defect that causes considerable losses in the carrot industry. Genotypes of carrots vary in susceptibility to splitting, but the basic factors determining the reaction of the genotypes are not known. The susceptibility to harvest splitting was evaluated in four genotypes of Nantes carrots by a drop test and

measurements of water status and tissue strength.

The experiments showed that genotypes with a low susceptibility, to harvest splitting had a high tensile strength of the phloem parenchyma near the periderm, whereas no difference in water status between the genotypes was found. Combining these methods with anatomical investigations and experiments into the reaction of the storage root tissue at a high availability of water has increased our knowledge about the harvest splitting complex in carrots.

News from Plant Genetic Resources Lab. **Research Inst. of Vegetable Crops,** **Skierniewice, Poland.**

The Umbellifer germplasm collection at POLSKV includes 836 accessions of 9 genera including 532 accessions of the genus *Daucus* (275 of cultivated carrot and 257 of wild *Daucus sp.*). Passport data were changed in accordance with the IPGRI Multicrop Passport Descriptors. Characterisation data for 114 accessions have been included in the database.

In 2000, 19 local carrot cultivars originating from Russia, Turkey, Syria, Ukraine and Poland were evaluated in field trials for 28 morphological traits and 6 biochemical compounds based on IPGRI and UPOV carrot descriptors. Three cultivars: Autumn King, Amsterdam Sweet Heart and Parmex were used as standards for comparison. Seeds were sown in the field on June 8 in 3 replications and roots harvest on September 24, 2000. In addition, 20 carrot accessions originating from Ukraine, Moldavia and Poland were grown in isolation for seed regeneration.

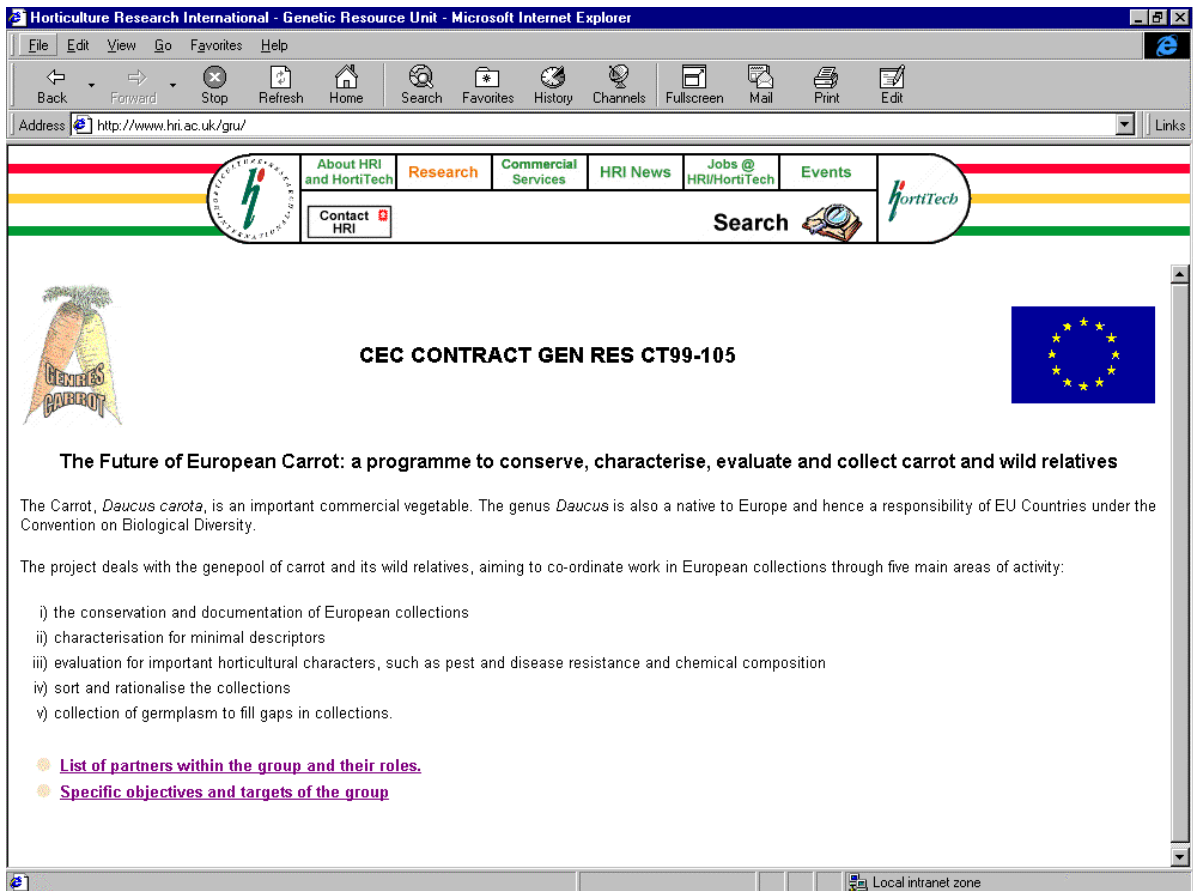
Two collecting expeditions were carried out covering the Sokolka region in the north-east and the Tarnow region in southern Poland. During these missions 264 accessions of 30 vegetable species were collected including 3 carrot landraces and 3 wild *Daucus carota*.

An estimation of the level of genetic variability in 48 accessions of *Daucus sp.* collected in 1999 in Greece, Turkey, Syria

and Poland was carried out using of DNA analyses. Evaluation of these *Daucus* accessions with RAPD and AFLP markers allowed us to distinguish groups of accessions belonging to the different *Daucus* taxa, and to determine genetic distance within and between the groups. Also 20 accessions of wild *Daucus* sp. were grown in the field for botanical identification and characterisation. Eight of these accessions were annual and set seed in the first year, 10 were biennial and 2 accessions did not germinate,. Digital images were captured, where possible, for all the *Daucus* material examined this year.



Check out the project web site at
http://www.hri.ac.uk/gru/gen_res/genres.htm



Edited by Dave Astley at HRIGRU funded by EU GenRes 105 Carrot project & the UK Ministry of Agriculture, Fisheries & Food