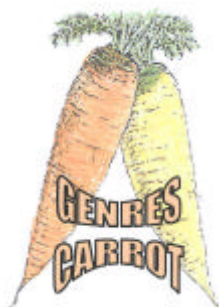


GenRes Carrot Newsletter No. 2

December 2001

CEC Contract no. GENRES-CT99-105

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



Project News and Information

The second annual project meeting was held in Edinburgh. It coincided with the New Zealand All Blacks coming to town to play Scotland (Rugby Union), which made for an interesting blend of cultures during our visit. On the first day we met at the Royal Botanic Gardens Edinburgh taking the opportunity to meet Dr Mark Watson, who described his work on the taxonomy of the umbellifers, particularly in Asia. We are grateful to Mark for providing project partners with some extremely interesting publications. One of Mark's interests is in making taxonomic information on Umbellifers available to a much wider audience using the Internet, thus he developed the Umbellifer Resource Centre web pages, which contain a mine of valuable information for the specialist and public alike.

The Umbellifer Resource Centre

<http://www.rbge.org.uk/data/URC/urc.htm>

provides information on umbellifer taxonomy, molecular research, floras and revisions, genetic resources and wide ranging publications and news and views alongside links to umbellifer research centres and people,

With a seasons characterisation "under our belts" the group revisited the question of the "agreed" minimum characterisation descriptors from the Angers meeting. There were various characters that individual partners had encountered problems with. So we took our discussion

to the field and spent a very productive time looking at the variation within and between populations of landraces. The group benefited from shared experiences and the in-depth knowledge of individual partners relating to scoring DUS variety trials, and the characterisation of variable landrace material collected on expeditions. Teresa Kotlinska produced a very interesting series of colour plates from a Russian publication showing the classification of the internal colour of carrot roots. We did not find all the colour combinations represented in the numerous colour plates, but it has to be said, "We came very close".

A new Compendium of Umbelliferous Crop Diseases Edited by R. Michael Davis and Richard N. Raid has just been published by The American Phytopathological Society. This is an international account of umbelliferous crop diseases and practical guidelines for control. The compendium begins with an overview of the origin and domestication of carrots and celery, carrot and celery production, the causes of umbelliferous crop diseases, and information pertaining to breeding for disease resistance. In addition to carrots and celery, diseases of parsnip, cumin, coriander, parsley, caraway, and cilantro are included. The compendium describes infectious diseases caused by fungi, bacteria, nematodes, viruses, and phytoplasmas as well as noninfectious disorders caused by air pollution, allelopathy, mineral deficiencies and toxicities, pesticide-related injury, and many others..

We received a good response to last years Newsletter including requests from several commercial companies to be included on the mailing list. Also Ken Hodge, Editor of Carrot News contacted us and used various bits of our "news" in his publication.

News from Horticulture Research International, Wellesbourne

The characterisation trial was harvested and scored in late November. Again this year there were some very interesting populations exhibiting very variable

characteristics. We welcomed journalists and a photographer from a popular magazine, who were particularly interested in the range of coloured carrot harvested from this years trial. An article on the variation available in carrot roots will appear in the magazine in 2002.

The GENRES project European Carrot & *Daucus* Inventory is now available on the project web site located on the HRI Server at the URL above. Passport data can be accessed directly using a database search facility or the database can be downloaded as either an ACCESS or EXCEL file. The project web site pages also provide an overview of the technical inputs, the partner roles and the partner contact information.



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

The main point of 2001 was the evaluation of 100 accessions in parallel laboratory and semi-field tests. The ordered seeds

we obtained up to March from the partners of HRI, NGB and BAZ-GB. We had agreed with Mathilde Briard (IHN) to use a mixture of the *Alternaria dauci* inocula **I89001** (Quedlinburg) and **I189** (Angers). The inocula were propagated under in vitro conditions between January and May 2001. Nearly 20 litre of the inocula **I89001** and 12 litre **I189** could be harvested. The aggressiveness of both inocula was tested with the cotyledon test as in the year 2000. Both inocula showed more or less the same disease severity. A comparison on mature leaves is in progress.

Laboratory test

The laboratory test consisted of four replications. Ten plants per accession were tested for each replication and each test was replicated after 14d. A disease score was calculated for each plant as average of both evaluations. Figure 1 and 2 show the leaf segments before inoculation (1) and during the evaluation nine days after inoculation (2). Plants without disease symptoms could not be found. Only two accessions were classified as 'tolerant' and 27 accessions as 'moderate tolerant' (Fig. 3)



Fig. 1+2: Leaf segments before inoculation (top) and 9dpi (bottom)

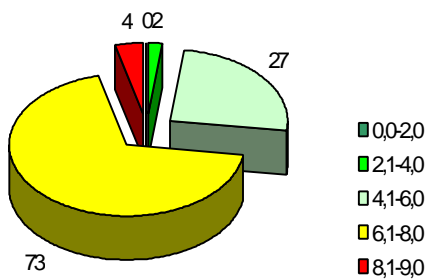
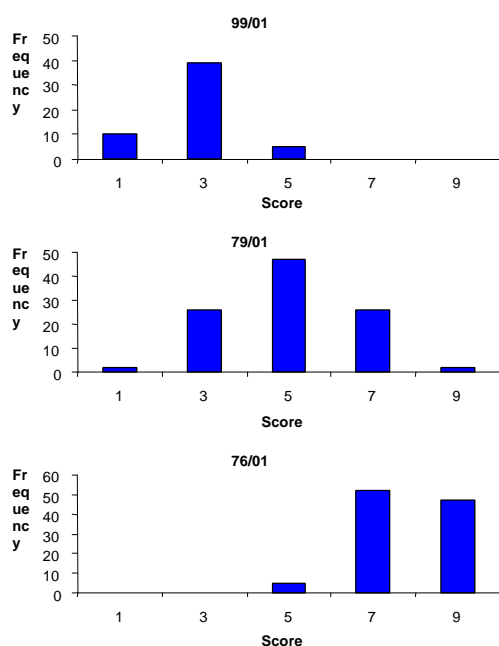


Fig. 3: Evaluation of the carrot accessions with the laboratory test (based on three test replications)

Semi-field test

The semi-field test was performed under a plastic tunnel. Two replications of 1,5 meters per accession (2 blocks) with ~150 seeds/m were sown. The plants were inoculated by means of a garden sprayer when the plants were 75 days old. All plants were harvested manually and evaluated 25 days after inoculation. Following scale was used for rating: 1-resistance; 3-tolerant, 5-moderate tolerant; 7-susceptible; 9-high susceptible (see 1st technical report also). Figure 4 shows the variation of the disease severity of the 'tolerant' accession 99/01(top) and 'susceptible' accession 76/01(bottom) as well as the varying accession 79/01 (middle).



Only a few 'resistant' single plants without symptoms could be found. Generally the accessions showed a large variation of resistance reaction analogous to the laboratory tests. An average of disease severity was calculated for each accession. No accession were classified as 'resistant', 11 accessions as 'tolerant' and 69 accessions as 'moderate tolerant' (Fig. 5).

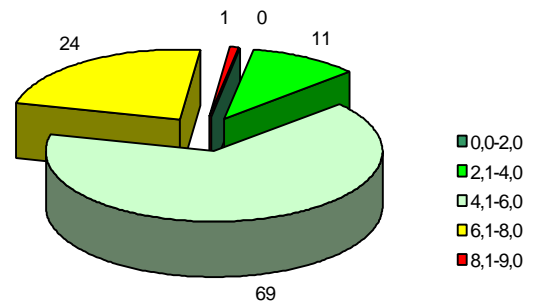


Fig. 5: Evaluation of the carrot accessions in the semi-field test 2001

Detailed results of the *Alternaria* evaluation 2001 will be prepared for the second technical report. Further 100 accessions will be evaluated in 2002.

Seed production and supply

The Gene Bank provided the Institute of Horticultural Crops (BAZ, Quedlinburg) with 29 accessions for screening of resistance to *Alternaria dauci* at. Another 20 accessions were sent to the University of Bologna and were included into the quality screening programme.

A non-governmental organisation called 'Verein zur Erhaltung der Nutzpflanzenvielfalt (VEN)' publishes each year a seed list of old varieties. The list published in 2000 notes that the carrot varieties Guerande, Saint Valery and Küttinger Rübli taste very well. A seed sample of the Küttinger Rübli was donated by the VEN to the Gene Bank. A successful seed increase provided, the sample can be included into quality test programme in the year 2003. In the period of 2000/2001 seeds were produced of 5 accessions. Twenty accessions were sown in 2001 for the next years seed production.

A new set of material to be evaluated at Quedlinburg is currently prepared as is the set of 25 accessions for the field trial planned for the year 2002.

Characterisation

Twenty-five accessions and the standard varieties were sown in two replications at Braunschweig. All wild types of German origin, two landraces from Turkey and two of unknown origin bolted very early and could not be described in detail. Of the remaining biennial germplasm (14 entries plus 3 standards) all plants were lifted in the first week of October and rated following the minimal descriptor list.

The data will be passed on to the central crop database. To improve the data quality and to allow comparison between data set originating from different years and locations, the project group decided to include 3 standard varieties into the field trials. However, since the standards themselves are subjected to year x location x variety interactions it can be discussed whether the use of standards will really allow meaningful comparisons in particular in the case of quantitatively inherited characters like root length and diameter or colour intensity. An example is depicted in Fig. 6. The root length (7.4.6) and diameter (7.4.7) of the standard varieties (AM= Amsterdam 2, AU= Autumn King 2, PA= Parmex) differ between the year 2000 and 2001 which is – considering the small sample size per accession and the different sowing dates – not really surprising.

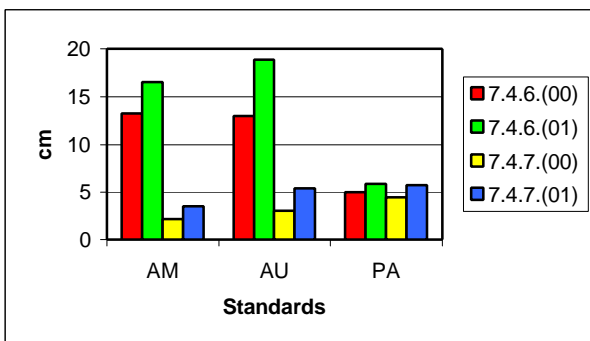


Fig. 6: Measurements of standards in 2000 and 2001 at the location of Braunschweig

The experiences gained in both years suggest that particularly colour intensity traits cannot be rated precisely under the experimental conditions arranged by the project work plan. While highly heritable colour traits like skin colour can be easily recognised colour intensity scores are much more influenced by sowing date or light conditions during scoring. It should therefore be discussed whether colour intensity traits really meet the criteria of a minimal descriptor list (highly heritable, easy to observe).

When there are differences between accessions within a set - as in the case of the root length - variation can be visualised. Fig. 7 shows the variation of root length and diameter in the set of material measured in the year 2001. Since there is currently no statistical method available to compare heterogeneous data sets it is up to the data base user to assess the data quality, to draw conclusions and to select germplasm from collections apparently meeting the needs.

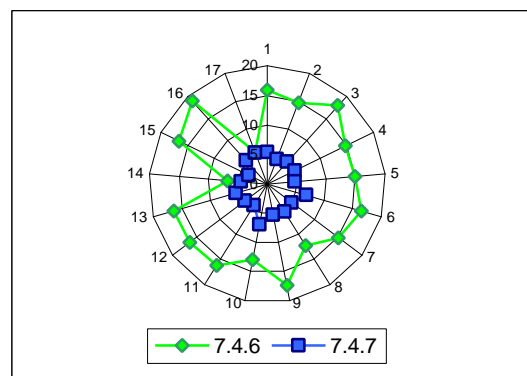


Fig. 7: Variation of root length (7.4.6) and diameter (7.4.7) in the set of accessions grown in 2001. Cipher on the circle's margin point to entry numbers.

Plans, perspectives and links

Since the establishment of the German Ministry of Consumer Protection, Food and Agriculture (BMVEL, former BML) research is being focussed on food quality aspects and needs of organic farming systems. Currently, the BAZ is keeping contact with potential partners in the organic farming sector interested to investigate carrots under organic and

conventional production systems. It has been discussed to compare no more than 6 varieties. The candidate varieties could be selected using data from the GENRES CT99 105 project and/or based on the experience of breeders developing carrot varieties for organic farming systems.

Organic farmers prefer tolerances rather than strong specific resistance genes. It could also be interesting to compare the 11 varieties identified as 'tolerant' to *A. dauci* under these specific production conditions. If the links to the organic farming sector can be intensified as planned, the GENRES project group will be invited to suggest material for this specific research work.

News from the Scottish Agricultural Science Agency, Scotland

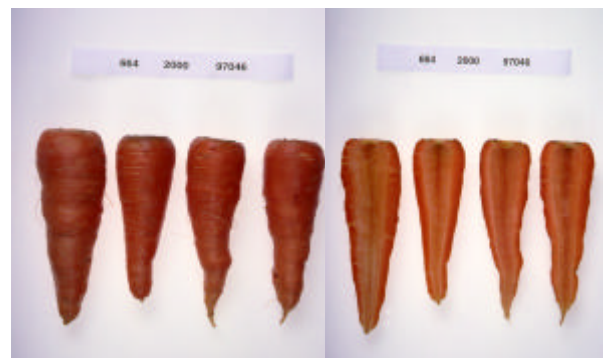
This was the second year of characterisation work at SASA, with 80 accessions grown and characterised for the minimum character set. The populations grown comprised 22 open-pollinated cultivars from the SASA collection, 5 from Henry Doubleday Research Association (HDRA), 50 landraces and cultivars from the HRI Genebank and 3 cultivars which were used as standards (also grown by other partners).



There was much greater foliage variation (leaf colour, leaf habit, petiole/lamina hairiness) in HRI & HDRA material compared to the more modern cultivars in the SASA collection. As much of this variation could not be described using the minimum character set, several additional characters were recorded. Photographs

were taken of foliage in plots and a representative sample of leaves, leaflets and sub-leaflets. In December all field plots were scored for *Alternaria dauci* susceptibility and the data forwarded to Mathilde Briard (IHN).

The assessment of roots involved harvesting a bulk of plants from the plot followed by the characterisation of up to 10 representative roots of each discrete type in the population. The roots were topped, washed and laid out for observation. Harvest dates ranged from early September to the end of November. Following characterisation, 4 typical roots of each discrete type occurring in the population were selected for photography. These were then sectioned longitudinally and re-photographed. All photographs have been scanned and stored as JPEG images.



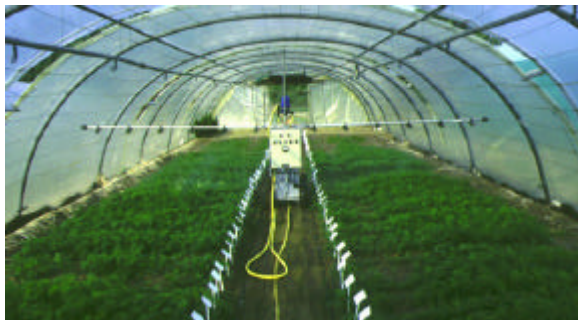
News - Institut für Pflanzengenetik und Kulturpflanzenforschung, Gatersleben

According to the milestones of the GENRES-project 17 accessions of *Daucus* characterised in 2000 were grown for regeneration during the season 2001.

Regeneration took place in small glass houses used at IPK for the multiplication of cross-pollinating species. The seed set was good and seeds of each accession are stored in the cold store facilities. For characterisation, 26 accessions and the 3 standard genotypes used by all project partners were grown in the field. All updated Minimum Descriptors were scored. The List of the carrot accessions tested and the results of the description are available as an excel file. The roots of the 26 accessions are stored over winter in a frost-free greenhouse and will be used for seed production in 2002.

News from Institut National d'Horticulture, Angers

At INH we screened a range of material for resistance to *Alternaria dauci*. The trial was carried out in 2 polythene tunnels (see illustration). 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 grown as positive controls and homogenizers of the disease. Seven (7) rows of Bolero, which is a tolerant cultivar, were used as negative controls. In total 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.



A robot has been used for irrigation and inoculation in both tunnels providing irrigation of the crop with a high homogeneity and a constant ambient humidity. The robot works automatically.



News from the Greek Gene Bank

In the Greek Gene Bank there are 74 accessions of wild carrot collected in 1999 during a joint expedition with USA and Poland. From these accessions, 20 were sown in the year 2000 and 16 accessions together with 3 local landraces in 2001 for characterisation and regeneration. From the accessions sown in 2001 8 belonged to the species *Daucus carota* subsp. *Carota*, 5 accessions to species *D. muricatus* and 3 accessions to species *D. bicolor*. All were sown in 9 litres pots and characterised according the agreed list of minimum descriptors. The accessions of *D. bicolor* were shown to be annuals, since they produced flowers in the first year. Also the 3 accessions of *D. muricatus* flowered in the first year. It shows the variability that exists among the different populations of the wild species. The rest will remain in pots for seed production and further characterisation in year 2002.

News Department of Agro-environmental Science and Technology, Universita' di Bologna, Italy

The 2001 programme comprised the characterisation of 60 accessions, and the evaluation of 30 of them for carotenes, sugars and nitrates. In fact 71 accessions were received from INH, Angers (10), BAZ, Braunschweig (20), HRI, Wellesbourne (31). Five commercial varieties (Parmex, Autumn King, Amsterdam, Bolero and Rubrovitamina) were included as controls. All accessions were characterised for the agreed minimum morphological descriptors plus root length, diameter and weight, and all were evaluated for carotene, sugars and nitrate content. Digital pictures were taken of intact roots, longitudinal and radial root sections and foliage. The plants were grown at Bellaria (RN) on a typical coastal sandy soil. No insecticides or fungicides were applied. Fifty (50) plants were used for characterisation and the remainder were either measured or subsampled for chemical analyses and dry matter determinations.

The external root colour was orange in 56 accessions, although with different intensity, 5 were yellow, 5 white and woody (bolting plants); purple roots were

present in 9 accessions, although always together with yellow or orange roots; the other were mixed colour accessions. In 13 accessions the percentage of bolting plants was very high.

One replication is available up to now for the analytical characters, except nitrates. Preliminary patterns reported in Fig. 1 indicate interesting variability. White roots were of course without carotenes; the distribution of carotene of the pigmented accessions was substantially skewed to the left (prevailing low-carotene types); most high carotene accessions were commercial varieties. Most accessions had balanced ratio between α and β carotene. Nitrate content was low in most accessions, included in the normal range for commercial carrots; high nitrate accessions were almost exclusively bolters, which roots did not develop in size.

About 50% sugars were represented by sucrose in most accessions; fructose was slightly more abundant than glucose. No clear relation between sugar and carotene content existed, although most high carotene accessions were also rich in sugars.

Two students of the degree in Food Science and Technology were interested in this research and asked for their thesis work to be on analytical evaluation. One of them, coming from Puglia region

(Southern Italy), provided a sample of a local carrot, which will be included in the 2002 program. Other types seem to be available in the Puglia region.

News from the Nordic Gene Bank

During the growing season 2001, the following activities were carried out at the Nordic Gene Bank. About 40 accessions were characterised in Hammenhög, which is situated in the southern part of Sweden. The carrots were harvested in October.

In autumn the material was evaluated regarding harvest quality and nutritional contents as well as for the resistance characteristics.

The carrots were evaluated for the following characteristics alpha, beta and gamma carotene contents as well as

fructose, glucose and sacharose content. But the material is also evaluated regarding dry matter and nitrate content.

In the resistance tests 37 accessions were screened for resistance to Sclerotinia rot, Crater rot and Liquorice root rot. The trials have run till the beginning of December and therefor the results have not been analysed yet.

In year 2002 about 30 accessions of *Daucus carota* will be characterised and evaluated in the same way as in 2001.

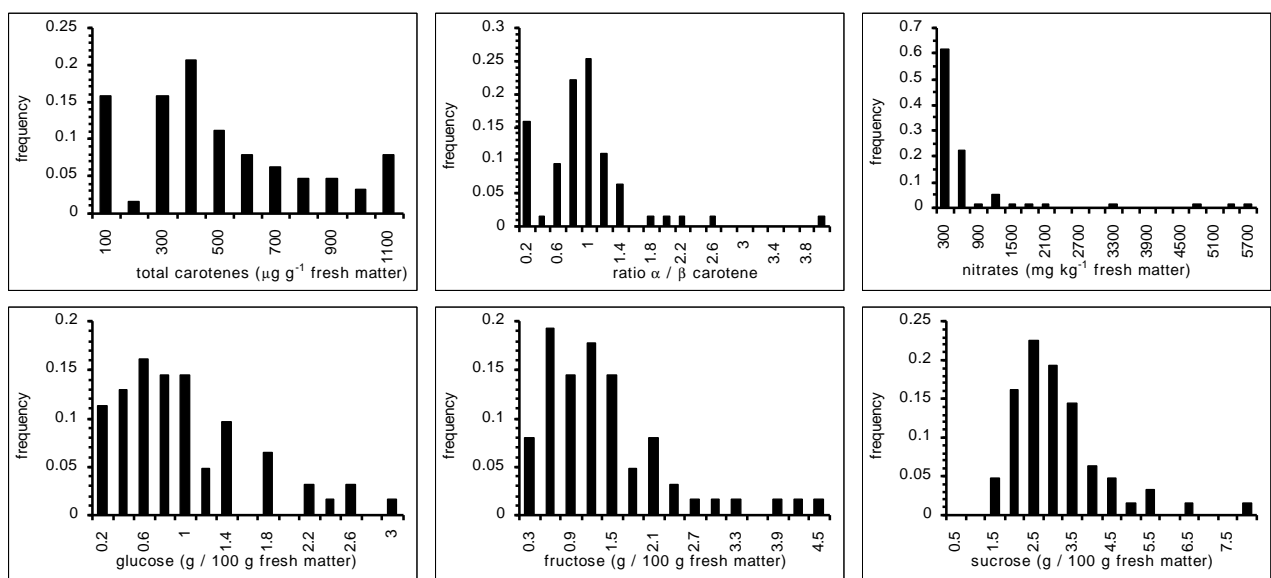


Figure 1. Frequency distribution of the analytical characters in the accessions evaluated in 2001



Our second annual meeting was hosted by the Scottish Agricultural Science Agency with our first day spent at a rather breezy and wet Royal Botanic Gardens, Edinburgh

Edited by Dave Astley at HRIGRU funded by GenRes 105 project & the UK Department for Environment, Food & Rural Affairs