Evaluation of carrot wild relatives as resistance sources to *Alternaria* spp.

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Within a recent wild relatives project of the ECPGR Umbellifer Crops Working Group (Maggioni et al. 2014), the German Julius Kühn-Institute (JKI) was substantially involved in the evaluation of a subset of the European collection of carrot wild relatives (*Daucus carota* subsp. *carota*) from European genebanks for resistance to the leaf fungal pathogen *Alternaria dauci* and the root fungal pathogen *A. radicina.* Because of an increasing number of reports and our own observations suggesting that *A. alternata* (Fries and Keissler) may be pathogenic on carrots (Bulajic et al. 2007, Shtienberg 2012), we decided to test the plant material additionally for the response to *A. alternata.*

We obtained seeds of altogether 36 accessions from various European genebank collections and members of the ECPGR Umbellifer Crops Working Group (Table 1). The geographic origin covered an area between 30 and 60 degrees of latitude, from Portugal in the West to Tajikistan in the East. The two cultivated carrot cultivars 'Rotin' (Sperling, Germany) and 'Nevis' (Bejo, The Netherlands) were used as controls. Seeds were sown in a sandy humus mixture (3:1) in plastic pots (19 cm in diameter) and were cultivated under optimized glasshouse conditions.

Table 1. Accessions used in the study

Source	**Carrot Wild Relatives**	
	Obtained	Evaluated
Agrocampus Ouest-Institut de Recherche en Horticulture et Semences (ACO-IRHS), Angers, France	7	7
Leibniz Institute of Genetics and Crop Plant Research (IPK), Gatersleben, Germany	4	4
Nordic Genetic Resource Center (NordGen), Alnarp, Sweden	5	5
Warwick Genetic Resources Unit (Warwick GRU), Warwick University, Wellesbourne, Warwick, UK	12	12
N.I. Vavilov Research Institute of Plant Industry (VIR), St. Petersburg, Russian Federation	7	1 (2)
Vegetable Breeding Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry (LRCAF), Lithuania	1	1
Total	**36**	**30 (2)**

All accessions were evaluated for morphological traits which probably influence the resistance reaction such as bolting tendency, leaf dissection, waxy layer on the lamina, anthocyanin coloration on petiole, root branching and others using the IPGRI *Descriptors for wild and cultivated Carrots* (IPGRI 1998). Additionally, the genetic distance was estimated on the basis of carrot SSR marker bands (n=405) in a cluster analysis.

In conclusion, as expected, a broad morphological variation was observed for the carrot wild relatives. From the seven accessions of the VIR genebank one did not germinate, two were classified as *Conium maculatum* and one as *Pimpinella peregrina,* and two accessions were identified as orange-coloured landraces and were used as additional standards in this study.

To estimate the resistance response of the carrot wild relatives, plants were cultivated for approximately 90 days under optimized glasshouse conditions. Exclusively non-bolting plants were used for the tests. The evaluation was carried out via bioassays for the resistance response to *A. dauci* and *A. alternata* on leaf segments, as well as to *A. radicina* on root slices. Details of inoculation, incubation and estimation of the disease severity via digital image analysis system (DIAS) are described by Krämer et al. (2014, submitted) and Nothnagel et al. (2014, submitted).

The bioassay approaches showed for all three pathogens a broad variation and partially significant differences between the tested accessions. In comparison with the orange standards tested in parallel tested (two cultivars and the two landraces from VIR), twelve accessions showed a significantly lower disease severity to *A. dauci* and ten to *A. alternata.* Eight accessions were more resistant to both pathogens. In contrast, no accessions were found with significant lower disease severity to *A. radicina* as the standards. Only five accessions reached the resistance level of the worst cultivated carrot standards.

The data suggest no increased resistance potential to *A. radicina* in the tested accessions, but a considerable resistance potential to *A. dauci* and *A. alternata*. After further verification these accessions could be potential candidates for resistance breeding or research.

Our present research is focused on the epicuticular waxy compounds and the volatile compounds of the tested accessions. Possible associations with the resistance reaction will be investigated via multivariate statistics. The inclusion of the data set into the European Umbellifer Database (EUDB) is in preparation.

References

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