Carrot Breeding

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Carrot is probably the most familiar member of the diverse Apiaceae (Umbelliferae) family, which also includes celery, dill, parsley, cilantro, and many herbs and spices. As a cross pollinated, biannual species, carrot provides some challenges for plant breeding. But in many ways, carrots are favorable for good breeding progress. They are prolific seed producers, are widely adapted to many environments, have a very diverse genetic base for use in trait development, and many individual plants for selection purposes can be grown in a small area (100+/m^2). Carrots suffer from inbreeding depression when self pollinating to develop inbred lines. On the other hand, hybrid vigor/heterosis can be quite dramatic between unrelated inbred lines. It is this ability to inbreed, and subsequently make hybrid crosses between inbred lines, that make hybrid performance so valuable in commercial situations. Making controlled hybrid crosses in carrot is done by using CMS (cytoplasmic male sterility) which was a revolutionary discovery first made in onions (Henry Jones, 1930s) and later in carrot (1946 Welch and Grimball, brown anther type; 1953 Henry Munger, petaloid type). Carrot breeding and hybrid variety development depend on the use of CMS. As in most vegetables, use of hybrids in carrot is a relatively new phenomenon (30-40 years) relative to the hundreds of years of classic mass selection used in cultivar development. Carrot has a very diverse global base of germplasm from which to improve traits. Breeding can access that diversity to develop hybrids with a wide range of shapes and colors, which, in turn, can expand the areas of commercial production and use. Breeding for improved performance in carrot is focused around disease resistance, root uniformity and recovery, root quality, and adaptation to target production sites. Carrot is a highly versatile crop for human use as it can be stored or used fresh, can be presented in many ways, and is very nutritious.