



## CARROT SEED PRODUCTION



Carrots are reproduced by seeds. Carrot cultivars differ in their seed production habits. Those originated in Asia are annuals; they need low or no cold temperature to induce flowering and produce seeds. They can produce seeds under tropical (Ethiopian) conditions. eg. DZARC-5 and AUA-108. On the other hand, cultivars originated in temperate regions of Europe and North America are biennials. They need cold temperature in order to induce flowering and produce seeds. eg. Nantes and Chanteney

### Climatic and soil requirements

Carrot roots to be used for seed production (stecklings) can be produced in a similar climate and soil as roots produced for consumption. Stecklings transplanted into a field and which have developed three or more leaves need cold temperature (4-10°C) for 4 to 8 weeks to initiate flowers and produce seeds depending on the cultivar. Elongation of inflorescence, flowering and seed development requires warm temperature. Whereas seed maturity and harvesting needs dry weather.

Well drained light soil is preferred to avoid development of bacterial soft rot which may lead to rotting of stecklings and low plant population.

### Methods of Seed Production

Carrot seeds can be produced in two different methods: “root-to-seed” or “seed-to-seed”.

#### Seed-to-seed method

Carrot seeds are directly sown in field and mature roots are produced. The mature roots are retained in the same field to grow further and produce inflorescences, flowers and seeds. In this method, carrots can be sown as densely as for root production. At harvest they are thinned to 100 cm inter-row and 50 cm intra-row; the thinned roots can be sold or consumed. The retained roots cannot be uprooted, inspected and selected. Instead, inspection is limited to rouging of plants with different foliage. The quality of seed to be produced relies on quality of initial seed and maintaining the recommended isolation distance.

#### Root-to-seed method

Carrot seeds are sown in the first season to produce mature roots (‘stecklings’) on a smaller land. Mature roots raised on 1 m<sup>2</sup> can be enough for 5-10 m<sup>2</sup> of seed crop depending on the extent of rouging. The seed rate is 6-8

kg ha<sup>-1</sup>. At harvest, stecklings characteristic of the variety are selected and then transplanted into a seed production field. The stecklings should be irrigated every 2-3 days and should never be left to lose water and wilt. Wilted stecklings may die leading to poor crop establishment.

Low chill (annual) cultivars can be transplanted 2-3 days after lifting under tropical environment during the cold period of the year. The root-to-seed method is the most practiced method because it enables continuous improvement of the variety through selection of the best roots.

### Preparation and establishment of stecklings

- Lift mature roots carefully. Any damage to the roots may expose roots to bacterial and fungal infections and eventual rotting.
- Discard misshapen, diseased, or mechanically damaged roots
- Remove the tops before or after lifting, leaving about 5 cm of the top, the growing point (Fig. 1).
- Transplant the stecklings so that the growing point is placed just below the surface of the firmed soil.
- Mulch to protect them from desiccation or frost.
- Irrigate every 2-3 days to avoid desiccation until most stecklings regenerate shoots. But care should be taken not to soak and rot the stecklings.
- Earthen up with about 10 cm of soil when the plants are re-established.

### Production Calendar

**Root production:-** sow seeds in early June and harvest mature roots at the end of August or early September. In case of seed-to-seed method harvest most and retain the desired number of plants during this period as described above.

**Transplanting of stecklings:-** Transplant between mid-August and mid-September so that the plants will be exposed to low temperature between October and December and to warm temperature between February and April under the mid- and high-altitudes of Ethiopia. This period is dry and the seed crop must be supplemented with irrigation

**Spacing:-** Flowering plants of DZARC-5 and AUA-108 are very vigorous thus space stecklings 50 cm between plants and 100 cm between rows.

**Fertilization:-** 175 kg DAP ha<sup>-1</sup> at transplanting, the recommended rate for root production of fresh market carrots (ARARI, 2005).



Fig 1. Stecklings prepared for transplanting

### Rouging

- Remove plants which show atypical foliage, bolt during the seed-to-root phase or early during root-to-seed phase.
- Lift the roots and inspect for trueness-to-type to the cultivar based on root shape, color, size, etc and discard roots showing different color, split or fanged roots or those with rough (hairy) surface.

### Pollination

Carrots undertake both cross and self-pollination.

- **Cross-pollination**- individual carrot flowers are normally protandrous and much cross-pollination occurs between plants in a seed crop.
- **Self-pollination**:- occurs because of the extended flowering period, resulting from several successive umbels per plant and the succession of flowers on individual umbels
- Honeybees are efficient pollinators of carrots and placing beehives in seed production fields can enhance seed yield and quality.

### Isolation

- **Basic seed**:- isolation distance between varieties should be at least 1600m.
- **Commercial seed crops**:- isolation distances should be 1000 m.
- Wild carrots Queen Anne's Lace (*Daucus carota* var. *carota*) can contaminate the seed crops if found growing near seed production fields. Wild carrots are found growing in some highlands of Ethiopia such as Ankober (ARARI, 2005) and Arsi.

### Seed maturity and harvesting

Carrots have a distinct order of flowering and maturity depending on umbel position (Fig 2). The king or primary umbel is the first to flower and ripen followed by secondary and tertiary umbels.

Under Debre Zeit conditions (1900 masl) the king umbel of AUA-108 flowered, seeds were matured and harvested in 110, 128 145 days after planting the

stecklings, respectively. Secondary and tertiary umbels flowered and matured 1-2 and 3-4 weeks after the king umbel, respectively. At maturity, seeds turn from dark green to brown and remain suspended on the umbel because of the racemes (little hooks that cover a seed).

- Harvest early in the morning, avoid periods of high wind and rain to reduce shattering of seeds.
- Under small-scale or high-value seed production and where labor is cheap, the umbels can be cut by hand as they ripen.
- Dry the harvested umbels in windrows on a canvas.
- Remove (debeard) spines or 'beards' on the seed to improve seed flow and reduce the volume of the seed lot.

### Seed yield and quality

According to George (2009) seed yield of open-pollinated cvs is about 600 kg ha<sup>-1</sup> in temperate zone. However, in tropical regions, the European cultivars yield about 300 kg ha<sup>-1</sup> whereas Asian cultivars produce only about 250 kg ha<sup>-1</sup>. The 1000 seed weight of seeds obtained from primary, secondary and tertiary branches of AUA-108 at Debre Zeit (Ethiopia) was 1.66 g, 1.61 g and 1.54 g, respectively. Good quality seed is plump, heavy and does not get crushed or break apart when rubbed against the palm of one's hand.



a

b

Fig 2.a) Succession of umbels in a flowering carrot plant. P = primary, S = secondary and T = tertiary. b) a mature umbel

### Seed storage

Well dried seeds can be stored either in cotton bags or air tight plastic bags or glass jars and stored in cool and dry room.

### Reference

- ARARI. 2005. Technical guide for technicians on production of vegetables. ARARI, Bahir Dar, Ethiopia.
- George A. T. Raymond. 2009. Vegetable Seed Production. 3<sup>rd</sup> Edition. P226-237.
- Organic Seed Alliance, 2010. Principles and Practices of Organic Carrot Seed Production in the Pacific Northwest. Port Townsend, USA. 18 pp