BDN TECHNICAL GUIDE FOR FARMERS AND EXTENSION OFFICERS NO. 4

GOOD PRACTICES FOR CARROT CULTIVATION

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Introduction

Carrot (*Daucus carota*) is grown in different agroecology zones in Sri Lanka. However, it can also be grown successfully under cool climatic conditions, especially in upcountry regions. It is widely grown in Nuwara Eliya, Badulla, and Kandy districts.

Popular varieties in Sri Lanka

New Kuroda, Hercules; Teracota, Magma, and Lanka Carrot.

Nutritional importance

Carrots are rich in carotene, which is a precursor of vitamin A, and contain appreciable quantities of thiamine and riboflavin.

Soil

Being a root crop, carrot requires deep, loose, well-drained, loamy soils with high organic matter. Soil looseness promotes the development of well-shaped, round roots and ensures a maximum marketable harvest. Carrots grown in heavy soils become rough and coarse as the roots fail to penetrate the hard soil evenly. The optimum soil pH is 6.0 to 6.5. Carrot roots develop a good color under the temperature range of 15 - 21°C. Temperatures higher than 30°C, particularly in the later stages of development, induce an undesirable strong flavor and coarseness in the roots.

Seed requirement

4 kg seed /ha.

Land preparation

Plough up to a depth of 30 cm and finely prepare the soil before planting. Soil should be prepared by deep ploughing followed by cross harrowing (harrowing in two or more directions, typically at right angles to each other). Preparing the field up to a fine tilth is desirable, as the seeds are small and germinate slowly. Seeds are planted on one-meter-wide raised beds.

Planting and spacing

The seeds are directly sown in the field on raised beds. Seeds are mixed with sand in a 1:4 ratio (One part of seed and four parts of sand) and are sown in marked rows 25 cm apart on raised beds without considering spacing. Cover the seeds with a fine compost and soil mixture. The desirable distance (5 cm) is maintained by a thinning operation at the time of actual leaf formation. Thinning is very important for producing superior-quality roots.

Fertilizer

Organic manure 10 t/ha should be incorporated into the soil for at least 5–7 days before sowing the seeds. Before seed sowing, apply a soil test-based basal dose of chemical fertilizers in the rows. Chemical fertilizer recommendations are given below.

Time of application	Urea (kg/ha)	TSP (kg/ha)	MOP (kg/ha)
Basal fertilizer	-	270	-
Top dressing (3 weeks after planting)	55	-	43
Top dressing (6 weeks after planting)	82.5	-	63.5
Top dressing (8 weeks after planting)	82.5	-	63.5
Top dressing (9 weeks after planting)	110		85

Irrigation

Irrigating the field lightly before seed sowing is advisable to ensure sufficient soil moisture for rapid and uniform germination. The field should be irrigated lightly immediately after planting and then irrigated once or twice a day until germination. Under insufficient soil moisture, irrigation should be done at 3 to 5-day intervals, depending on the soil type and climatic conditions. The root enlargement stage of the carrots is the most critical stage for water. Light and frequent irrigation is required to obtain good yields.
Root splitting is a physiological anomaly that is often observed after a sudden increase in soil moisture after prolonged drought. Another phenomenon, forking, occurs when dense soil impedes the straight growth of the taproot, leading to the development of forked roots that have lower market prices. Maintaining optimal soil moisture conditions prevents root splitting and forking, and keeps the soil loose, contributing to healthier root development.

Weed control

Manual or chemical methods can also be used for weed control. Apply pre-emergent herbicide; metribuzin, at the rate of 0.35 kg/ha before the germination of seedlings (2-3 days after sowing). Subsequently, weeds are controlled through intercultural operations. Weeds must be controlled before applying the top dressing of the fertilizer.

Pest management

i. Leaf miner-*Liriomyza huidobrensis*

Become a serious pest during the dry period.

Damage symptoms
Adult punchers leave for both feeding and oviposition. This may cause a spotted appearance on the foliage. Larvae make irregular mines, which result in the drying and withering of leaves (Figure 1). Damaged plants succumb to secondary infection by late blight.

Figure 1. Leaf miner damage.
Photo: Shutterstock.com

Management
- Regular field inspection.
- Yellow color sticky trap.
- Removal of other host plants surrounding the crop field.
- Removal and destruction of infected plant material.
- Augment ecto-parasitoid *Diglyphus isaea*.
- Encourage naturally found parasitoids, *Hemiptarsenus semibiclavas* and *Opius* spp.

Chemical control
- Azadiractin 1% EC - rate of application 16 ml/16 l of water.
- Abamectin 18 g/l EC - rate of application 9.6 ml/16 l of water.
- Neem seed water extract - rate of application 640 g/16 l of water.

ii. Black cutworm-*Agrotis* spp.

Adults are gray moths with distinctive dark markings on their forewings and light hind wings. The dark gray-to-black larvae have a greasy appearance and a grainy texture. Mature larvae grow to 3–4 cm in length. When disturbed, the cutworms curled up into a tight C-shape (Figure 2).

Figure 2. Adult moth and larvae of the black cutworm.
Photo: RARDC, Bandarawela.

Damage symptoms
Habitually, they are nocturnal, and shoots are damaged close to the ground, often cutting the whole plant at the base during emergence. However, cutworms can cause problems during their growth. They cut young seedlings after emergence and fed on or around the shoulders of carrots later in growth.

Management
- Plough the soil deeply to bring the larvae and pupa to the surface of the soil.
- Regular monitoring of the field.
- Hand collecting and destroying the caterpillar.
- Proper field sanitation.
- Encourage predatory birds to prey on the worms during the tillage operation.

Chemical control
Control leaf miners and other leaf-eating insects by spraying the following insecticides. Do not repeat insecticide in repeated sprays.

- Profenophos 500 g/l EC - rate of application 32 ml per 16 l of water.
- Etofenprox 100 g/l EC - rate of application 24 ml per 16 l of water.

iii. Root-knot nematode - *Meloidogyne* spp.

Nematodes live freely in soil and water, but few are parasitic and damage carrot roots.

Damage symptoms
- The following symptoms may begin as small patches and enlarge as the nematode population increases.
- Affected plants have an unthrifty appearance and often show symptoms of stunting, wilting, and yellowing.
- Uneven growth.
- Root-knot nematode damage in carrots causes galls (small swellings) on the roots, stunted growth, forking of the tap root or bunching of roots, hairy roots with nodules, and a lumpy appearance (Figure 3).

Figure 3. Root-knot nematode damage in carrots.
Photo: Shutterstock.com

Management
- Prevent entering.
- Avoid moving plants and soil from the infested fields.
- Don't allow irrigation water from the infested fields to the surroundings.
- Clean tools thoroughly before using them.
- Tilling the soil two or three times and exposing it to sunlight.
- Add poultry manure two weeks before seeding.
- Crop rotation.
- Grow mustard crops and bury them in the soil at the flower initiation stage of mustard. This will act as the biofumigant.

iv. Slug and Snail

Damage is severe under wet weather conditions, such as during high rainfall.

Damage symptoms
Damage to seedlings and mature plants (Figure 4).

Management
- Eliminate places where snails and slugs can hide and shelter during the daytime, such as weeds, stones, flowerpots, and wooden boards.
- Regular practice of trapping and removing snails.
- Removing debris and managing field sanitation.
- Proper weed management.
- Regular field inspection and hand collection.
- Encourage predatory birds by enhancing natural habitats.

Chemical control
- Metaldehyde 5% GR at the rate of 10-40 kg/ha.
- Metaldehyde 3% RB at the rate of application 10-40 kg/ha.
- Metaldehyde 4% RB at the rate of 10-40 kg/ha.

Figure 4. Slugs in the carrots.
Photo: Shutterstock.com

Disease management

i. Alternaria blight (*Alternaria dauci*)

Symptoms
The disease usually occurs in wet weather conditions. Symptoms are dark brown to black spots, some with a yellow edge, appearing on the leaves. The oldest leaves are more susceptible than the younger leaves. The petioles and roots can also be affected (Figure 5).

Figure 5. Carrot plants affected by alternaria blight disease.
Photo: Regional Agricultural Research and Development Centre (RARDC), Bandarawela.

Management
- Practice crop rotation.
- Use of healthy seeds.
- Weed control and field sanitation.

Chemical control
Apply recommended fungicides. Do not repeat fungicides with repeated sprays.

1. Mancozeb 75% WP at the rate of 32 g per 16 l of water.
2. Mancozeb 80% WP at the rate of 32 g per 16 l of water.
3. Maneb 80% WP at the rate of 32 g per 16 l of water.
4. Propineb 70% WP at the rate of 32 g per 16 l of water.
5. Chlorothalonil 500 g/l SC at the rate of 48 ml per 16 l of water.
6. Chlorothalonil 75% WP at the rate of 32 g per 16 l of water.

ii. Soft rot

Symptoms
Soft rot can occur both in the field and during storage. Infected carrots are unsuitable for consumption and are unsellable. The disease causes a soft, watery, slimy rot (Figure 6). A foul odor may be associated with soft rot. Above ground symptoms include general yellowing, wilting, and foliage collapse.

Figure 6. Carrot soft rot disease.
Photo: Shutterstock.com

Management
- Field sanitation.
- Improve drainage conditions in the field.

iii. Powdery mildew

Powdery mildew is a fungal disease that is favored by high humidity and low temperatures in the morning and evening.

Symptoms
The symptoms appear as a white powdery growth on older leaves and petioles (Figure 7). Symptoms usually appear when leaves mature. However, the young leaves may also be affected.

Management
- Practices crop rotation.
- Avoid weather conditions that are favorable to disease.
- Avoid using excessive nitrogen fertilizer.
- Overhead irrigation.

Apply any of the following recommended fungicides.
1. Chlorothalonil 500 g/l SC - rate of application 48 ml per 16 l of water.
2. Chlorothalonil 75% WP - rate of application 32 g per 16 l of water.
3. Thiophanate – methyl 70% WP - rate of application 16 g per 16 l of water.

Figure 7: Powdery mildew disease in carrots.
Photo: Shutterstock.com

Harvesting

Large roots can be harvested by loosening soil. The roots reach the marketable stage when their diameter is approximately 5 cm at the upper end. Light irrigation is to be given before harvesting to moisten the soil so that the pulling of the root without any damage is facilitated. Cut green leaves from the roots, wash carrots with clean water, grade them, and store them in plastic trays at a cool place under shade till they are sent to the market. Keeping carrots in the soil longer after maturity makes them fibrous and unpalatable.

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Citation
Kodikara, K. M. S.; Senanayake, N. S.; Aheeyar, M.; Nisansala, D.; Hafeez, M. 2025. *Good practices for carrot cultivation*. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Better Diets and Nutrition Program. 8p. (BDN Technical Guide for Farmers and Extension Officers No. 4).

Acknowledgements
This technical guide on good practices for carrot cultivation was prepared by the International Water Management Institute (IWMI) in partnership with the Department of Agriculture (DoA), Sri Lanka. The aim is to guide farmers on the good practices for safe and sustainable cultivation.

This work was carried out under Area of Work 3 (AOW 3) of the CGIAR Better Diets and Nutrition (BDN) Program, which is grateful for the support of CGIAR Trust Fund contributors (www.cgiar.org/funders).

The CGIAR Better Diets and Nutrition (BDN) Program aims to deliver consumer-oriented solutions to ensure sustainable healthy diets for all. Area of Work 3 on End-to-End Solutions is implemented by researchers from CGIAR Centers, including the International Food Policy Research Institute (IFPRI), WorldFish, International Livestock Research Institute (ILRI), International Maize and Wheat Improvement Center (CIMMYT), Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), International Water Management Institute (IWMI), and International Potato Center (CIP), in close partnership with the World Vegetable Center, Applied Horticultural Research, University of Sydney, Institute of Development Studies, Wageningen University & Research, University of California, Davis, Sokoine University of Agriculture, Wayamba University of Sri Lanka, and the Philippines Department of Science and Technology – Food and Nutrition Research Institute.

Front cover photograph: Mohamed Aheeyar, IWMI

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