GROWING CARROTS IN COLORADO

or

Colorado Carrot Culture

By A. M. Binkley, Horticulturist

Carrots have increased in importance as a war crop because of their recognized value in the diet. They are a valuable source of vitamins A, B, and C, being especially rich in vitamin A. The crop is grown for commercial canning, for winter storage, and for selling on the fresh market as bunch carrots. Carrot production deserves the attention of all growers having favorable growing and marketing conditions.

The crop belongs to the Umbelliferae family and is a biennial. The first year a thickened root is formed and at the beginning of the second year the flower stalk develops from the crown of the root.

Soil Preferences.—Carrots will grow on a wide range of soil types but make their best growth on a deep, fertile, loose-textured loam. Heavy clay soils are not as desirable because of the difficulty in obtaining stands and the rough development of roots on such soils. The texture of the soil should be loose enough to allow the roots to penetrate and develop normally. This is very important for good growth of the long-rooted bunching types. Soil that is highly alkaline and that has poor drainage should be avoided. Soils that are retentive of moisture are to be preferred.

Deep plowing for carrots is advisable. A depth of 10 to 12 inches is preferable.

Manures and Fertilizers.—Carrots are known as heavy feeders on the soil nutrients, and the first requirement for successful production is fertile soils. Applications of from 15 to 30 tons of well-rotted manure per acre are not too heavy. This amount could well be applied to the crop preceding carrots, and some growers prefer that method.

Coarse, strawy manure that is not well rotted will foster the development of prongy, irregular, forked or branched roots if applied just previous to planting. Manures containing many weed seeds should not be used because of the increased cost of weeding. This can be one of the expensive items of production.

No general recommendation can be given on the commercial fertilizers to apply under all soil and climatic conditions in Colorado. Under most conditions it is safe to supplement the addition of manures with the application of 150 pounds of treble superphosphate per acre. This fertilizer may be broadcast previous to the final preparation of the seedbed.

Planting.—The amount of seed to plant per acre depends on the spacing used between rows. From 2 to 3 pounds per acre is sown when the crop is to be cultivated by hand in rows 18 to 24 inches apart. An ounce of carrot seed contains from 17,000 to 18,000 seeds and since it is light in weight, careful attention must be given to proper adjustment of the seed drill. Careful spacing of the seed in the row will reduce thinning. The depth to plant will vary with the soil type and moisture conditions. However, a covering of \( \frac{1}{2} \) to 3/4 inch is usually
satisfactory. The carrot seedlings are delicate and grow slowly at first, and all precautions should be taken to see that the seedbed is well prepared. Crusting of the soil injures the seedlings and reduces stand.

It is generally better to plant a little more seed than necessary to obtain good stands. This practice makes some thinning necessary, although with better seed drills that space seed uniformly, thinning is not always necessary; 12 to 15 carrots per 12 inches of row is all that is necessary for good yields. The number of plants to leave will vary with the variety used and soil fertility and other factors.

Research has shown that carrot seed will not germinate below 39 degrees F. However, the speed of germination increased as the temperature increased from 46 degrees to 86 degrees F. The final percentage of germination was about the same on all temperatures where the seed germinated.

Frequent watering is said to delay germination of carrot seed.

Successive Planting of Carrots.— Carrots can be grown at relatively low temperatures and yet will withstand considerable heat in midsummer after they have become well established. At Fort Collins the early crop can be planted from April 1 to April 15 and harvested as a midsummer crop. A second crop can be planted from July 1 to July 15 for a fall crop or for winter storage. These dates can be changed to meet conditions where the growing seasons are longer than the average of 145 days at Fort Collins.

Irrigation.— No general rule can be followed in the irrigation of carrots because of the differences in soil types, slope of the land, drainage, organic matter content of the soil, and other factors. It is important, however, to apply sufficient irrigation water to keep the plants growing uniformly. Unpublished reports of the California Experiment Station indicate that carrots grown on dry soil (not frequently irrigated) produced roots that were significantly longer than those grown on relatively moist soil. Excessive application of irrigation water following a period of water shortage frequently results in corky outgrowth at the point of side root emergence and may cause development of cracks along the roots. Color of roots is also reduced by this practice. Where excess moisture has been applied to some soils, it is not uncommon to find carrots of lighter color than under low moisture conditions.

Carrots grown where excess moisture is present are often rough and of poor color. Excessive application of irrigation water previous to harvesting may favor the development of soft rots, if temperatures and other conditions are favorable for the disease.

Irrigation water must be applied carefully to avoid washing soil away from the top of the roots and to avoid leaving an over supply of moisture in the field. When the crown of the root is exposed to the sun for a period the carrot is unmarketable because of greening of the crown of the root.

Thinning.— Many attempts have been made to adjust drills so that carrot seed can be planted uniformly enough to make thinning unnecessary. However, in most cases it is still found to be better to thin carrots. Most growers plant seed a little heavier than necessary to obtain good stands. Thinning is necessary on some soil types and not on others. If a heavy clay soil is being used, thinning will be more necessary than on lighter sandy loam soils. Overcrowding produces most off-shape roots, but in turn prevents roots from becoming too large. Thinning
should be done when the seedlings are small. The distance between plants will vary according to varieties used, size of roots preferred, and soil types. For small varieties 12 to 15 roots per foot of row may be left, while for larger varieties 1 root every 2 inches is sufficient. In the home garden carrots can be thinned later as larger roots are ready to use.

Cultivation.—Since carrots grow very slowly when small, it is very important to keep early weed growth down. Cultivation should start early to control weeds. Deep cultivation is injurious since carrot roots grow close to the surface. Shallow cultivation is the general practice.

Effect of Temperature on Root Color and Growth.—Research carried on by the New York Experiment Station under controlled temperature conditions indicates that carrots grown at 50 degrees to 60 degrees F. developed poor color, those grown at 60 degrees to 70 degrees F. had good color, and those grown at 70 degrees to 80 degrees F. had poor color. Roots were shortest in length when grown at the highest temperature and shortest when grown under the coldest temperature.

Factors Affecting Root Weight and Shape.—The weight of roots is related to the ability of the foliage to manufacture and to store the materials in the root not needed for the maintenance of the plant. Any factor which interferes with leaf size can be expected to have some effect on the root weight. Any soil deficiency or any other unfavorable growth condition that checks leaf growth will reduce the amount of root growth and development. Nitrogen deficiency may reduce leaf growth and this in turn reduce root growth. Phosphorus deficiency also can affect size of roots. Other plant-food elements can likewise affect growth of tops and roots when deficient or unavailable in soils.

Soil moisture, temperature, organic matter in the soil, and soil types all affect root weight and shape.

Hereditary factors influence root size, weight, and shape. Different varieties produce different sizes, shapes and colors of roots. Poorly selected varieties may also produce more branched or forked roots. Branched roots can be produced also by undecayed coarse menures in the soil, hardpan, or plowpan, or any other condition that will prevent normal downward growth of the roots.

Carrot varieties have been improved in recent years by selecting varieties for deeper orange color and for special uses. Most commercial varieties have large foliage size and medium to large neck sizes so they can be bunched and handled without breaking off the top. All varieties listed in the following table except Nantes will show green skin color when the roots are exposed above ground. Nantes will show dark red color above ground. Color changes in carrot varieties generally are due to the accumulation of carotene in the roots. The carotene content increases as the root color changes from yellowish orange to deep orange. Carotene is stored first in the oldest cells of the cortex or phloem and then in the core or xylem. Older roots of the same size usually will have more carotene in them than roots that are younger but of the same size.

Carrot varieties often have individuals within the variety which differ in carotene content. Uniform varieties show high percentages of uniform root color. If light-colored varieties are allowed to cross pollinate with deep-orange varieties, a mixed color of roots may appear in the resulting stocks. However, environmental factors also can influence uniformity of color within a variety.
<table>
<thead>
<tr>
<th>Varieties</th>
<th>Use</th>
<th>Season</th>
<th>Root Length</th>
<th>Root Shape</th>
<th>Root Color</th>
<th>Core Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red-Cored Danvers Half-Long</td>
<td>Bunching, storage, freezing, dehydration</td>
<td>Midseason (75 days)</td>
<td>5&quot;-6&quot;</td>
<td>Long, conic; Deep blunt end orange</td>
<td>Deep orange</td>
<td></td>
</tr>
<tr>
<td>Red Cored Chantenay</td>
<td>Canning, freezing, storage, dehydration</td>
<td>Midseason (75 days)</td>
<td>4&quot;-5&quot;</td>
<td>Medium, conic, tapered to blunt end</td>
<td>Deep orange</td>
<td></td>
</tr>
<tr>
<td>Nantes</td>
<td>Home garden; market garden, Dehydration, freezing and canning</td>
<td>Early</td>
<td>5&quot;-6&quot;</td>
<td>Cylindrical</td>
<td>Deep orange</td>
<td>Deep orange</td>
</tr>
<tr>
<td>Imperator</td>
<td>Bunching, Dehydration, canning</td>
<td>Midseason to late (77-82 days)</td>
<td>7&quot;-8&quot;</td>
<td>Long with slight taper</td>
<td>Deep orange</td>
<td>Deep orange</td>
</tr>
<tr>
<td>Streamliner</td>
<td>Bunching</td>
<td>Midseason to late (80 days)</td>
<td>7&quot;-8&quot;</td>
<td>Long with slight taper</td>
<td>Deep orange</td>
<td>Deep orange</td>
</tr>
<tr>
<td>French Forcing</td>
<td>Forcing Home garden</td>
<td>Very early (60 days)</td>
<td>1&quot;-2&quot;</td>
<td>Short oval, Medium to round orange</td>
<td>Yellow-ish orange</td>
<td>Orange</td>
</tr>
</tbody>
</table>
harvesting.- The carrot crop is harvested for market as bunched carrots, for canning, and for winter storage.

Bunch carrots are harvested for bunching when the crown of the root is from \( \frac{3}{4} \) to \( \frac{1}{4} \) inches in diameter. The carrots are pulled and tied in bunches of four to eight in a bunch according to size. They are then washed and packed in crates or boxes for shipment to market. Established grades are used as aids in marketing bunched carrots. Information on these grades can be obtained from the Bureau of Agricultural Economics, New Customs Building, Denver, Colorado.

The late carrot crop grown for winter storage is harvested by plowing out the roots, topping them, and grading and placing them in containers for handling. Roots that are very small, extra large, crooked, branched, diseased, or injured should be discarded while harvesting or before storage.

Storage.- Carrots may be stored in outdoor cellars, outdoor pits, commercial storage rooms, or indoor storage rooms. Moist air is important for carrots to prevent shriveling and shrinkage, and temperatures should be kept at about 32 degrees to 35 degrees F. Under good storage conditions carrots can be kept for 6 months or longer.

Yields and Returns.- Late carrots often yield from 12 to 25 tons per acre and the price in normal times runs between \( \$8 \) and \( \$12 \) per ton. While the returns per acre are high, the high labor costs and keeping the soil in a high state of fertility make it an expensive crop to grow. The return per acre is high, but labor costs are also high. It is a crop that is expensive to grow and it demands a soil in a high state of fertility.

Disease and Insect Pests.- The carrot is often damaged by bacterial soft rots, fungus root rots, and other diseases. Insects such as flea beetles often damage the crop when the plants are small. Storage root rots sometimes do damage; these losses can be reduced by keeping storage temperatures low and moisture conditions proper.

For detailed information on diseases and insects, write to the Colorado Extension Service and apply for circulars on insect pests and vegetable disease control.

Cooperative Extension Work in Agriculture and Mechanic Arts, State of Colorado, Colorado State College of Agriculture and Mechanic Arts and United States Department of Agriculture, Cooperating.

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