Root Crops - General Information

- 63 cultivated root crops (plus 23 tuber crops and 11 bulb crops)
- Taxonomically diverse group - mostly dicots
- Derived from many plant families

Important Root Crops

**Ranked by production:**
- Cassava
- Parsnip
- Sweet potato
- Canna
- Carrot
- Jerusalem artichoke
- Taro
- Jicama
- Yam
- Kudzu
- Beet
- Many others
- Radish
**Root Crops - General Information**

Vital for hunter/gatherer cultures
Important worldwide, critical source of nutrition in developing countries
Complete crop failure rare
Important contributor to food security

**Root Crops - General Information**

Can be produced with low levels of inputs
Leaves and stems often utilized during root growth
Easily stored – year long food supply
Widespread and valuable use in market gardens

**Root Crops – Nutritive Value**

Carbohydrates – moderate to high
Protein – low to moderate
Fat – very low
Minerals – moderate to high
Vitamins - high
Root Crops - General Information
Many tropical root crops are perennial – can be harvested over a period of several years
Many temperate root crops are biennial – grown as annuals but require sophisticated seed production systems

Root Crops - General Management
Soil - generally do best in sandy or friable soils
Fertility – generally require moderate levels of phosphorus and low levels of nitrogen
Seldom transplanted as seedlings – disruption of normal root development
Except for the tropical roots, stored best at 32 degrees F and 96% RH

Carrot
Use and importance
Ranked third in production among succulent root vegetables
Cultivated throughout the world
Adapted from arctic circle to tropical highlands
Produced in multiple seasons
Easily produced, long harvest time, ships well, stores for extended periods
Carrot

Domestication
Native to western Asia, possibly Afghanistan
Related species found in Asia, Europe, Africa, and North America
Cultivated in Europe prior to 900 AD
Introduced into China (1200) and Japan (1600)
Introduced into US by first settlers and became a staple of the American Indians

Domestication
Major production classes due to a divergent domestication process

Eastern (middle Asia, China) – selected for adaptation to warmer climates, mild flavor, colored roots (became subtropical types)
Western – selected for biennial habit, white and yellow roots (led to orange temperate types)
Carrot

**Modern Temperate Types**

- Derived primarily from western germplasm
- Strong biennial growth habit
- Resistant to cold-induced bolting
- Adapted to cool climates
- Usually dark orange roots (white forms cultivated)

Carrot

**Modern Subtropical Types**

- Derived primarily from eastern germplasm
- Annual growth habit
- Adapted to warm, tropical climates
- Roots purple, red, dark orange, or any combination of these

Carrot

**Taxonomy**

- Dicotyledon
- Family: Umbelliferae
- Genus and species: Daucus carota var. sativa
- Related species: celery, parsnip, parsley, hemlock, cow parsnip, dill
Carrot

Production – Climate and soils

Grow best in cool, temperate climates
Adapted to subtropical highlands
Roots develop best in deep, friable soils, sandy loams or organic soils
Grow poorly in saline soils

Temperate Types:
Optimum daytime temps <75 degrees
Zero net photosynthesis at 83 degrees
Hot temps cause short roots with strong flavor

Subtropical Types:
Withstand warmer temperatures without quality loss
Carrot

Propagation
Grown from seed (very small, 800 per gram)
Direct seeded

Seed Production (dedicated):
Temperate Varieties:
Seed production requires 2 years; seed-to-seed in a mild climate or transplanting of roots (require 5-12 weeks at 37-45 degrees F)

Subtropical Varieties:
Seed production requires <2 years; seed-to-seed (require short exposure to 60 degrees F)

Production Issues: Stand Establishment
Age of seed important (<3 years)
Seed small, planted shallow
Emergence period very long (1-3 weeks)
Requires a good seed bed, good soil contact
Critical to control soil moisture
Carrot

Production – Disease and Pest Control
Diseases and pests are usually not serious
Phytoplasma
carrot yellows – affects yield and quality
Insect
carrot rust fly – affects quality

Carrot

Post-harvest handling
Cooling required if harvest temps above 45 degrees
No washing prior to storage

Carrot

Storage
Optimal at 32 degrees F and 95% RH
Controlled atmosphere not recommended
Stored best with tops removed
Can be stored for 7-9 months
Carrot

Production - Harvest

Timing determined by end use
Harvest 2 ways
  With tops (bunch carrots) – not as common
  Without tops (bulk carrots)
Most harvesting done mechanically
Bruise prevention important if stored

Carrot

Production – Modern Intensive

Disease control
  Fungal – preventative foliar fungicides
  Phytoplasm – insecticidal control of leafhopper vector
Insect control
  Soil insecticides applied at planting
Weed control
  Cultivation, post-emergent herbicides

Carrot

Production – Organic and Subsistence

Disease control
  Fungal – rotation + isolation, residue plowdown
  Phytoplasm – varietal resistance
Insect control
  Isolation, delayed planting (after 1st gen. adults)
Weed control
  Cultivation, hoeing
Carrot

**Planting and Harvest – Modern Intensive**
- Planting: Mechanical precision planters
- Harvest:
  - Bulk harvest for processing
  - Bunch harvest for fresh market

Carrot

**Planting and Harvest – Market Garden/Subsistence**
- Planting: Hand planted or small planting machines
- Harvest: Hand-harvested, washed and bunched

Carrot

**Fertilization – Organic/Market Garden**
- Manure applications can cause split-root
- Fall applications
- Never apply fresh manure
**Carrot**

**Marketing – Modern Intensive**
Minimally processed (baby carrots)
Revolutionized the carrot industry

**Parsnip**

**Consumer use**
Fresh market
Boiled, used in soups, or fried
Processed
Canned or frozen

Primary production in the cool temperate northern hemisphere

**Parsnip**

**Production**
Hardy, cool season, can withstand considerable frost
Grows best in climates with cool summers
Growing methods similar to that of carrots
Slow to germinate, anti-crusting measures needed
**Parsnip**

**Market Garden Production**

Easy to grow organically
Can be stored for 8-10 months at temperatures near 32 degrees F – long market opportunity
Success requires a northern European ethnic market

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**Beet**

**Taxonomy**

Dicotyledon
Family: Chenopodiaceae
Genus and species: Beta vulgaris
Related species: spinach, Swiss chard, lambsquarter, (same species as sugar beet)

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**Beet**

**Domestication**

Originated in Europe or the Mediterranean area
Cultivated by the Romans in the 4th century
Thought to be derived from the sea beet
Distributed throughout Europe by invading armies
Beet

**Use and importance**

Ranks 22nd in worldwide production among vegetable crops

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**Major producing countries**

<table>
<thead>
<tr>
<th>Country</th>
<th>Production Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>Mostly produced in northern Europe and North America</td>
</tr>
<tr>
<td>France</td>
<td>Mostly produced in northern Europe and North America</td>
</tr>
<tr>
<td>United States</td>
<td>Modern intensive production is mostly for processing</td>
</tr>
<tr>
<td>Germany</td>
<td>Subsistence production is mostly supplementary garden production</td>
</tr>
<tr>
<td>Poland</td>
<td>Subsistence production is mostly supplementary garden production</td>
</tr>
<tr>
<td>Italy</td>
<td>Subsistence production is mostly supplementary garden production</td>
</tr>
</tbody>
</table>

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**Varieties**

Beets come in many colors, from white to purple and shapes from long to round. Only the dark red, globular types are commercially important.

- Detroit Dark Red
- Early Wonder
- Ruby Queen
Beet

Production – Climate and soils

Cool-season, hardy crop, withstands frost
Optimal daytime temps at 60-70 degrees
Does not tolerate heat or drought
Best quality in sandy, deep, well-drained soils
Optimal pH 6.0-7.0 but tolerates alkalinity

Beet

Propagation

Grown from seed
Direct seeded into the field
Biennial growth habit
Seed production in cool climates with mild winters

Beet

Production – Harvest and handling

Hand harvest for bunching
Machine harvest for processing
Cooling necessary if harvest root temp above 45 degrees F
Beet

Storage
Store at 35 degrees F, 90 % RH
Storage life
Market garden: bunched beets 10-15 days
Commercial: topped beets 8 months

Beet

Advantages:
Organic and Market Garden Production
Few diseases and problems
Color variation creates unique marketing opportunities

Radish

Use and importance
Very important in Asia
Top producing countries: Japan (daikon), Taiwan, and China
Radish

Use and importance
Four types grown in Asia:
winter radish (white form called daikon)

Usually served as a cooked vegetable

Radish

Use and importance
Four types grown in Asia:
summer radish

Usually served as a cooked vegetable or pickled in brine

Radish

Use and importance
Four types grown in Asia:
rat-tail radish

Seed pods are eaten fresh, steamed, boiled, stir-fried (often hot and spicy)
Radish

Use and importance
Four types grown in Asia:
fodder radish

Grown for livestock; leaves can be boiled or stir-fried (glucosinolates)

Radish

Use and importance
European spring radishes (typical US form)

Usually eaten fresh

Radish

Taxonomy

Dicotyledon
Family: Crucifereae
Genus and species: Raphanus sativus
Related species: mustard, turnip, rutabaga, cabbage, broccoli
Radish

**Production – Climate and soils**

Hardy, cool-season crop
Usually grown in early spring, late fall, or winter
Tend to bolt under long days, high temperatures
Becomes woody and pungent in hot weather

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Radish

**Market Garden Production**

Important source in Asia
Organic production feasible
(weed control difficult)
limited production and marketing window