Why does he have a hot water bottle on his head?

He's committing suicide.
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
Root Crops

Ranked by production:

Cassava
Sweet potato
Carrot
Taro
Yam
Beet
Radish

Parsnip
Canna
Jerusalem artichoke
Jicama
Kudzu
Many others
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

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

Nutritive Values

Carbohydrates – moderate to high
Protein – low to moderate
Fat – very low
Minerals – moderate to high
Vitamins - high
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

Taxonomy

Dicotyledon

Family: Apiaceae

Genus & species: *Daucus carota* L. var. *sativa*

Related species: celery, parsnip, parsley, hemlock, fennel, dill, cumin
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 800 AD

Introduced into China (1000) and Japan (1300)

Introduced into US by first settlers (1600s) and became a staple of the American Indians
Carrot

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

Wild carrots growing in Germany
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)
Western Carrot Types
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
Eastern Carrot Types
Carrot

Typology

Parisian: small and sweet

Nantes: cigar-shaped roots w/ blunt tips, popular in Europe

Chantenay: wedge-shaped, perform well in heavy soils

Imperator: long, slender, light soils, baby carrots and industrial production

Kuroda: similar to Chantenay, bulkier and more rounded tip, Asia
Carrot Varieties

**Early Varieties**
- Adelaide
- Caracas
- Nelson and Yaya
- Mokum
- Napoli

**Main Crop and Storage Varieties**
- Atlas
- Romance
- Cordoba
- Bolero
- Nectar
- Sugarsnax

*Dimensions may very significantly due to culture and environmental conditions.*
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

Grows poorly in saline soils
Carrot

Production – Climate and soils

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

*Subtropical Types:*
  - Withstand warmer temperatures without quality loss
Carrot

Fig. 19.3. Effect of temperature on the shape of carrot roots. Plant on left was grown at 50 to 60°F, the one in the center at 60 to 70°F, and the one on the right at 70 to 80°F.
Carrot

Propagation

Grown from seed (very small, 800 per gram)

Direct seeded
Carrot

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)
Carrot

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
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 °F

No washing prior to storage
Carrot

Storage

Optimal at 32 °F and 95% RH

Controlled atmosphere not recommended

Stored best with tops removed (WHY?)

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
Carrot

Production – Modern Intensive

Disease control
  Fungal – preventative foliar fungicides
  Phytoplasma – insecticidal control of leafhopper vector

Insect control
  Soil insecticides applied at planting

Weed control
  Cultivation, post-emergent herbicides
Carrot

Production – Market Garden and Subsistence

Disease control
  Fungal – rotation + isolation, residue plowdown
  Phytoplasma – 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

Manure applications can cause split-root
Fall applications
Never apply fresh manure
Carrot

Marketing – Modern Intensive

Minimally processed (baby carrots) Revolutionized the carrot industry
Carrot

**World carrots: Share of production, average 2003-05**

- China—34%
- Other—45%
- Russia—7%
- U.S.—7%
- U.K.—3%
- Poland—4%

Source: Prepared by ERS from FAOStat, Food and Agriculture Organization, United Nations.
Carrot
Carrot

Fresh Market Carrot Production 2005 - 2009 (1000 cwt)
Fresh Market Carrot Production 2005 - 2009 (1000 cwt)
Parsnip

Taxonomy

Dicotyledon

Family: Apiaceae

Genus & species: *Pastinaca sativa* L.

Related species: celery, carrot, parsley, hemlock, fennel, dill, cumin
Parsnip

Consumer use

Fresh market
  Boiled, used in soups, or fried

Processed
  Canned or frozen
Parsnip

Production

Primary production in the cool, temperate northern hemisphere

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 °F – long market opportunity

Success requires a northern European ethnic market
YOU'VE BEEN HITTING ROCKS IN THE HOUSE?!

WHAT ON EARTH WOULD MAKE YOU DO SOMETHING LIKE THAT?

POOR GENETIC MATERIAL?

BAD GUESS.
Beet

**Taxonomy**

**Dicotyledon**

Family: Amaranthaceae

Sub-family: Betoideae

Genus & species: *Beta vulgaris* L. var. *vulgaris*

Related species: spinach, Swiss chard, lambs-quarter, sugar beet
Beet
Beet
Beet
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 22\textsuperscript{nd} in worldwide production among vegetable crops
Beet

Major producing countries

Russia

France

United States

Germany

Poland

Italy

Mostly produced in northern Europe and North America

Modern intensive production is mostly for processing

Subsistence production is mostly supplementary garden production
Beet 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

Chiogga
Beet
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 °F
Beet

Storage

Store at 35 degrees F, 90 % RH

Storage life

Market garden: bunched beets 10-15 days (WHY?)

Commercial: topped beets 8 months
Beet

Advantages:
Organic and Market Garden Production

Few diseases and problems

Color variation creates unique marketing opportunities
On the other hand, the neighbors keep planting nice big trees next to us.
Radish
Radish

Taxonomy

Dicotyledon

Family: Brassicaceae

Genus & species: *Raphanus sativus* L.

Related species: mustard, turnip, rutabaga, cabbage, broccoli
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

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
Radish

Market Garden Production

Important source in Asia

Organic production feasible
Weed control difficult

Limited production and marketing window