

# Meet the Radical Roots: Growing Great Carrots, Beets, Radishes, Turnips, Parsnips, Celeriac, Daikon and More!

John Biernbaum, MSU Horticulture and Student Organic Farm

## Common Vegetable Crops in the families Amaranthaceae, Apiaceae and Brassicaceae

Usually cool season vegetables that provide valuable dietary fiber, minerals, vitamins and phytonutrients. We can start with a general listing of worldwide root vegetables classified as either “taproot”, “tuberous root”; modified plant stems such as “corm”, “rhizome”, “tuber”; or “bulb”.

[http://en.wikipedia.org/wiki/List\\_of\\_root\\_vegetables](http://en.wikipedia.org/wiki/List_of_root_vegetables)

1. **Carrots** – Central Asian Center, Persia; *Daucus carota* (taproot) Family Apiaceae (biennial) <http://en.wikipedia.org/wiki/Carrot> originally grown for aromatic leaves and seeds, similar to dill, parsley and fennel; early colors were white, red and purple with orange not appearing until the 1700's in the Netherlands. Large variation in size.
2. **Beets** – Mediterranean Center *Beta vulgaris* (taproot) Family Amaranthaceae (biennial) [http://en.wikipedia.org/wiki/Beta\\_vulgaris](http://en.wikipedia.org/wiki/Beta_vulgaris) also multiple colors including purple, red, white, yellow or golden, and striped red and white. Higher requirement for the mineral boron. Once called “blood turnip”. Also used for leafy greens, sugar production and animal fodder.
3. **Radishes** – Chinese Center *Raphanus sativus* (taproot) Family Brassicaceae (biennial) <http://en.wikipedia.org/wiki/Radish> Also used for microgreens or spouts. Skin color ranges from red, white, purple, pink, yellow with normally white flesh; size can vary dramatically. Very fast growing.
4. **Turnips** – Mediterranean Center - *Brassica rapa (campestris?)* (taproot) Family Brassicaceae <http://en.wikipedia.org/wiki/Turnip> traditional and salad turnips
5. **Rutabaga** Scandinavia or Russia *Brassica napus* (taproot) Family Brassicaceae also known as Swedish turnip; <http://en.wikipedia.org/wiki/Rutabaga> cross of turnip and *Brassica oleracea* (cabbage, kale, etc)
6. **Parsnips** – Mediterranean Center – *Pastinaca sativa* (taproot) Family Apiaceae Slower growing than carrot, but easier; long storage in ground. <http://en.wikipedia.org/wiki/Parsnip>
7. **Daikon** Asian Center *Raphanus sativus var. longipinnatus* (taproot) Family Brassicaceae larger rooted radish <http://en.wikipedia.org/wiki/Daikon>
8. **Celeriac** – Mediterranean Center *Apium graveolens rapaceum* (taproot) Family Apiaceae Outer portion is peeled and white inner portion is eaten raw. <http://en.wikipedia.org/wiki/Celeriac>

## Covered elsewhere or not covered here but worthy of mention

1. Potato (tuber) *Solanum tuberosum* <https://en.wikipedia.org/wiki/Potato>
2. Sweet Potato (tuberous root) *Ipomoea batatas* [https://en.wikipedia.org/wiki/Sweet\\_potato](https://en.wikipedia.org/wiki/Sweet_potato)
3. Sugar beet (taproot) *Beta vulgaris*
4. Horse Radish Brassicaceae *Armoracia rusticana* <https://en.wikipedia.org/wiki/Horseradish>
5. Sunchoke (tuber) *Helianthus tuberosus* [https://en.wikipedia.org/wiki/Jerusalem\\_artichoke](https://en.wikipedia.org/wiki/Jerusalem_artichoke)
6. Ginger (rhizome) *Zingiber officinale* <https://en.wikipedia.org/wiki/Ginger>
7. Burdock (taproot) <https://en.wikipedia.org/wiki/Arctium>
8. Dandelion (taproot) <https://en.wikipedia.org/wiki/Taraxacum>
9. Salsify [https://en.wikipedia.org/wiki/Scorzonera\\_hispanica](https://en.wikipedia.org/wiki/Scorzonera_hispanica)
10. Root parsley (taproot) <https://en.wikipedia.org/wiki/Parsley> Also known as Hamburg Parsley

## General Questions to Address when planning, scheduling and practicing vegetable production:

1. What to grow? (crop and varieties)
2. How many/much to grow?
3. When to grow them?
4. Where to grow them?
5. How to grow them?
6. How to harvest?
7. How to store / protect?
8. How to market?

## Crop Topics:

### 1. History, background and folklore

- Generally from Mediterranean, Eastern Asia, or Asia regions.  
[http://www.hort.purdue.edu/newcrop/hort\\_306/text/lec05.pdf](http://www.hort.purdue.edu/newcrop/hort_306/text/lec05.pdf)
  - Mediterranean: beets, turnips, parsnips, celeriac
  - Middle or eastern Asia: carrots rutabaga
  - Asia: Daikon, Radishes
- Radish Latin name translates as “easily reared”. Quick and simple, although “spicy” for many pallets. Can also be grown as microgreens or spouts or edible flowers and seed pods. Frank Tozer reported that in Japan, a quarter of all vegetables are radishes. Storage radishes are also known as “winter” radishes, as “winter” squash is used for storage.
- Parsnips were more common in Europe prior to the introduction of the potato from South America.
- Most of the root crops listed are biennials (grow and complete the life cycle from seed to seed in two seasons). Exception is radish which is an annual and will bolt as root ages or in long days.
- Complete or perfect flowers, either white or colored. Flowers are insect pollinated? For varietal seed collection a distance of 1 mile from related crops is necessary.
- Good source of dietary fiber (cellulose), minerals and health promoting phytochemicals;
- Established by direct seeding, rarely transplanted. Celeriac is the exception with transplants grown for about 10 weeks, similar to celery. Beets reportedly can be transplanted but why bother, unless using thinned plants.
- Best in high light and cool temperatures
- Most able to be stored for weeks or months at low temperatures (32 to 35°F) and high humidity (90 to 95%).
- Also used as livestock or wildlife food, particularly in cold climates.
- Rutabaga is an example of a hardier turnip – able to withstand more cold and store longer due to a lower moisture (water) content. Grown in colder climates and also called Swedish Turnip.
- Seeds can be collected for future plantings from non-hybrid cultivars; Radish would be hastened to flower by warm temperatures. Biennials require extended cold dormant period and will begin “bolting” or flowering in the spring.
- High on my list of preferred winter culinary treats is a mixture of roasted root vegetables listed here along with potato, sweet potato and onion.

### 2. Crop and Cultivar selection – (What?) how many types? Possible priority if space limited?

- How much garden space is available? Selecting which crop to grow will depend on personal eating preferences or for commercial sales the market preference and possible selling price.
- Carrots, beets, radish and salad turnip can be very productive per square foot if the soil is well prepared and plant population or density is high.
- Varieties to consider – there are many so these are just examples. Do you have a favorite?

Crop	Popular Cultivars	Raw or cooked?	Greens also eaten?	Lbs Yield /100 ft	Yield/sq ft
Carrot	Early – Nelson, Mokum Storage- Sugarsnax	Both	Edible	150	1 to 2 lb
Beet	Detroit Dark Red, Red Ace Early Wonder Tall Top for greens	Both - cooked	Recommended	65 lbs root 45 lbs greens	2 to 3 lb
Radishes	Rover, French D'Avignon	Raw - Both	-	100 bunches	1 to 5 lb
Turnips	Salad type: Hakurei and Scarlet Queen; Traditional: Purple Top White Globe	Both	Recommended – but depends on variety	50 lbs root 100 lbs greens	2 to 4 lb
Rutabaga	Heleno, Laurentian	Cooked	-	150 lbs	2 to 4 lb
Parsnips	Albion, Javelin, Lancer (OP)	Cooked	-	75 lbs	1 to 4 lb
Daikon		Raw	-	200 lbs	?
Celeriac	Mars, Brilliant	Raw	Edible for flavoring and cooking	?	?

### 3. How many plants per person or family? (or yield per plant) (How much?)

- One author recommended 25 plants per person for beets and parsnips and as many as 100 per person for carrots. My personal experience is that carrots are a valuable crop that can be used many ways.
- An estimated yields are 1 to 4 lbs per square foot or for is 30 lbs per 100' of row with 15' of row per person for 4 lbs.
- For radish, turnip, carrots and beets, succession plantings (2 to 4 weeks between sowings) are recommended for extended harvest season. While for parsnip, celeriac and rutabaga, a single planting for late season harvest is more common.
- Most of these crops can be held for a day or more after harvest without refrigeration in a cool place without serious loss of quality if moisture is maintained with plastic bags, buckets or containers. However, rapid cooling to 34 to 40 °F is preferred for best quality and flavor. Parsnips, rutabagas and fall carrots can be stored in the ground if protected from animal predation and freezing.
- What type of preservation is possible besides eating fresh?
  - Beets can be pickled.
  - Drying or dehydration is an option for carrots and beets.

### 4. What location and how much space per plant? (Where?)

- Garden location in regard to soil type selection is one of the key criteria for success, particularly for deeper rooted carrot and parsnip. Looser sandy or “muck” soils are preferred over heavy or clay soils. Organic matter additions can improve both sandy and clay soils. Presence of rocks or obstructions in the soil can lead to splitting or irregular shaped roots for carrots and parsnips.
- Root crops (carrots, beets, turnip, parsnip, rutabaga, celeriac) are successfully produced at the MSU Student Organic Farm in what would generally be considered less than desirable soils, ie heavier clay loam soil type.
- Deep soil preparation / loosening to 12 inches or more is also considered beneficial, particularly for carrots. An exception is Daikon radish that is able to penetrate the soil and is sometimes planted to loosen the soil. Rutabaga may be able to produce a good yield on heavier clay soils.
- Neutral pH is generally recommended along with avoiding acidic soils.
- Full sun is best.
- Plant spacing is very important. The more fertile the soil and the more water provided, the less space needed per plant. If your soil is less fertile and you don't water very often, use the wider or larger spacing recommended.
- Usually planted in rows. Can be 12 to 24 seeds per foot for carrots, radishes and beets.
- When thinning, there is a recommendation given to complete the process in two or three stages to allow selection of the most vigorous plants and anticipation that some seedlings may be loss to insect (herbivore) damage.
- Hoopouses and Crop Protection: radishes and salad turnips are good winter crops and can be seeded as late as September. Carrots for winter harvest generally need to be seeded by early August for Michigan. Carrots, radishes and salad turnips can also be sown in February for early spring sales.

### 5. Rotation Considerations: With, Before or After What Crops? (Where?)

- Recommended to grow in an area where the soil is fertile and well prepared.
- Application of compost prior to planting is recommended.
- Can follow any plants in the rotation.
- With direct seeded crops at dense plant spacing, having reduced weed seed pressure from the “weed seed bank” is highly recommended. Seed beds can be prepared using a stale seed bed technique - allowing weeds seeds to germinate followed by very shallow cultivation of flaming to remove the emerging seedlings.

6. How Long a Crop Time and **When** to Plant? (Cool or Warm Season?)

- The shortest crop time is for radish at under xx days. Carrots and beets can be in the 50 to 70 day range, and rutabaga can be as many as 100 days.
- For spring planting outside in Michigan, peas are typically sown the first two weeks of April if soil temperature and moisture allow. Later spring plantings and higher temperature during root development of carrot may result in reduced quality (color, flavor/sweetness, texture).

Crop	Seeding (Zone 5)	Soil Temp	Catalog Days	Plants per Person	Harvest
Carrot	Late March, Early April	45°F	55 to 70	100	Late May and June
Beets	Late March, Early April	45°F	40 to 55 (50 avg)	25	Late May and June
Radishes	60 days before frost	45°F	21 to 30 days	20	End of Sept, Beginning Oct.
Turnips	Late May, Early June; successions	45°F	40 to 60 days	5	June, July, Aug, Sep; hoophouse in winter
Rutabaga	Late May, Early June;	45°F	75 to 100 days	5	Late August to September suitable for cold storage
Parsnips	Alsion, Javelin, Lancer	45°F	110 to 120 days Slow to germinate	25	Fall or cover for spring harvest
Daikon	Frost seed in March, or sow late Aug	45°F	50 to 60 days	?	
Celeriac	Seed in greenhouse 10-12 weeks before setting out late May or Early June	45°F	95 to 100 days	5	September and Fall, 3 to 5" diameter; suitable for cold storage (32°F and 95% RH)

7. Propagation/Getting Started – Seeds, Sets and Transplants (**When and How?**)

Crop	Seeds per lb	Seeds Spacing	Depth(inch)	Germination %	Viability (years)
Carrot	175,000 to 600,000	.5 to 1 inch	.25-.5	50%+	2 to 5
Beets	17,000 to 40,000	1 to 2 inch	.25-.5	60%+	5
Radishes	40,000 to 60,000	1 inch	.5 to 1	75%+	5
Turnips	124,000 to 217,000	1 inch	.25-.5	75%+	3
Rutabaga	127,000 to 145,000	1 inch	.5	75%+	2 to 5
Parsnips	98,000 to 125,000	1 inch	.5	60%+	1
Daikon	40,000 to 60,000	2 inch	.5	75%+	5
Celeriac	60,000 to 65,000	transplant	transplant	?	?

- Seeds – germination percentage may be less than 80%. Parsnip may be in 60 to 80% range.
- Seed is often irregular shape.
- Beet “seed”, like chard, is a dried “fruit” that contains more than one seed.
- Carrot and beet seeds can be soaked in water for a few hours or overnight to hasten and increase the uniformity of germination. Soaking and pregermination at a warm temperature (65-70F) may improve germination in colder soils.
- Carrot seed may be coated to allow easier handling. Using a seeder is key for larger scale.
- Seeds are generally sown 0.5” to 1” deep (deeper in sandy soils and dry conditions).
- Seed predation is possible after planting and before emergence by mice and ground squirrels.
- Seeds generally store well, several years, if stored cool (<40°F) and dry (< 40% RH); most authors list seed longevity at 2 to 3 years; except parsnips which is said to not store well.
- Seed germination is influenced by temperature, but can occur at soil temperature as low as 45°F.
- Celeriac is the only crop in this group that is often transplanted in the Midwest and transplant production time can be up to 10 weeks (similar to celery). Direct seeded celeriac is said to produce better, but the slow early growth would make weed management a challenge.
- Seed Keeping: Mature seeds can be collected from non hybrid varieties for future plantings. Seed stalks can reach heights of several feet and likely would need to be supported or staked.

8. Cultivation, management and training: Fertility, Irrigation, Pollination (**How?**)
- As stated previously, well drained, fertile soils that are irrigated and minimal weeds are very helpful.
  - Fertility provides for rapid early season growth and leaf development necessary for root formation. However, excess fertility may lead to an excess of foliage with reduced root formation.
  - Organic matter and fertility from compost also helps to increase water absorption and retention.
  - Water availability is a key seed germination and to maintaining growth – general recommendation of an inch of water per week applies for irrigation;
  - Cultivation to reduce weeds / competition is important for rapid development.
  - For carrots and other slow to germinate crops, flaming of weeds prior to crop emergence can provide excellent weed management.
9. Plant Protection – what herbivores, decomposers and predators to consider?
- Seed predation is possible after planting and before emergence by mice and ground squirrels.
  - Flea beetles can be damaging to brassicas at early stages. Management methods include minimizing overwintering habitat and use of row covers.
  - Aphids can be a problem in warmer weather. Natural predators can often manage or reduce the aphid population for garden plants. Another possible treatment of aphids is soap solution to wash them off the plants. Example soaps are Murphy Oil Soap, Dawn dish detergent or other dish detergents. A rate of 1 teaspoon to 1 tablespoon per gallon of water with thorough spraying.
10. Harvest, Storage, Display, Preservation
- Harvest methods are very important to the quality of roots harvested.
    - Radishes and salad turnips need to be harvested prior to becoming oversized, woody or overly pungent. Bolting can also occur and quickly make the root unacceptable.
    - Carrot and beet quality and longevity are influenced by temperature. Spring plantings need to be harvested quickly while fall plantings can remain in the soil for several weeks.
    - Celeriac, Rutabaga and Parsnips can be held the longest time in the ground with little loss of quality until spring temperatures lead to bolting.
  - Storage of fresh root crops is best at cold (34-40°F) conditions with high RH (85-95%) for quality.
  - For pickling or dehydration, highest quality freshly picked crop is recommended.
11. Marketing, Economics and Value (What is the selling price or unit?)
- Often sold by the bunch or by the pound.
  - While tops still attached is often seen as indicating freshness and quality for carrots or radishes, care must be taken to prevent dehydration of the foliage and root.
  - The market season relatively short in the spring/early summer (June/July) but long in the fall/winter.
- 12. Some Keys to Success**
- Sow first crop early in the season and grow during cool spring weather. Succession plantings.
  - Plan for second fall crop with midsummer sowing and extended fall harvest.
  - Soil preparation is important for long, normal shaped carrots and well formed roots.
  - Plant spacing and/or “thinning” is a key. Adjust based on soil quality and water availability.
  - Provide moderate fertility and regular moisture. If growth slows due to limited soil moisture or nutrients, the roots may be “tougher” or lack flavor and sweetness.
  - Harvest at the “right” time – neither too early nor too late. Most can be eaten small or as “baby” size, but doing so reduces the potential yield. Some of the crops will become “tougher” or more “woody” if left too long without harvesting.

#### **References or other sources of information**

1. Larkcom, J. 2001. The Organic Salad Garden. Frances Lincoln, London, England. 168 pgs.
2. Tozer, F. 2008. The Vegetable Growers Handbook. Green Man Publishing, Santa Cruz, CA. 216 pgs.
3. Voigt, C.E. and J.S. Vandemark. 1995. Vegetable Gardening in the Midwest. University of Illinois Cooperative Extension Service. IL. 176 pgs.