

Seed Beds: Bare-Root, Field-grown Brassica Transplant Production

Bare-root transplants grown in outdoor seedbeds can be a money and labor saving option for vegetable growers. Before inexpensive plastic greenhouses it was a common practice to produce cabbage, broccoli, kohlrabi, onions, tomatoes and peppers as bare root transplants in hot-beds, the garden, or in the field.

Martin and I used both greenhouse-container and field-grown, bare-root transplants. The earliest plantings were started in March in a heated greenhouse. Bare-root cabbage and broccoli transplants were started outside weekly in seedbeds from May 1 to mid-July. This saved us labor and materials and enabled us to manage the farm with significantly less greenhouse space.

Comparison Of Container-Grown And Bare-Root Transplant

	Advantages	Disadvantages
Container-Grown Greenhouse Transplants	<p>There is less transplant shock</p> <p>It is easier to maintain a consistent growing environment inside a heated and weather protected greenhouse.</p> <p>Seeds can be started earlier, when it is still too cold outside.</p>	<p>Cell trays require a slightly root-bound condition if plants are to be removed without damaging soil-to-root contact.</p> <p>Root-bound transplants generally reestablish more slowly than younger transplants.</p> <p>Taproot development can be affected for the life of the plant affecting head size.</p> <p>More expensive and more labor.</p>
Bare-Root Field-Grown Transplants	<p>Lower cost per plant.</p> <p>Roots are not “root-bound” by the plastic container.</p> <p>Plants are “hardier,” less “soft” than greenhouse-grown plants. They are already accustomed to the weather.</p> <p>No greenhouse is needed.</p>	<p>Requires advance skills. Challenging for beginners.</p> <p>Requires more seed.</p> <p>Requires more care at planting time to reduce transplant shock.</p> <p>Not suitable for all crops.</p> <p>Requires advance planning and weed preparation.</p> <p>No protection from inclement weather.</p>

Bare-Root, In-Ground Transplant Production Systems.

In-ground Field: Seeds are planted at close spacing directly in the field and grown to transplant stage, when they were pulled, and replanted in the production field.

In-ground Hotbeds: In-ground hotbeds were commonly used for early transplant production before heated greenhouses were an affordable option. A cold frame is built with wooden sides a foot tall and glass windows to cover. Inside the cold frame the soil is dug out about two feet deep and filled with six-eight inches of fresh horse manure from a stable where urine, manure and straw are collected together. (The urine increases the heat.) The manure is then covered with the topsoil. Seeds were planted in the soil. The glass windows are used to cover the beds, hold in the heat generated by the fresh manure, and protect from frost. A modern day hotbed can also utilize other sources of ground heat. (Hot water running through pipes, geothermal, electric heat coils.)

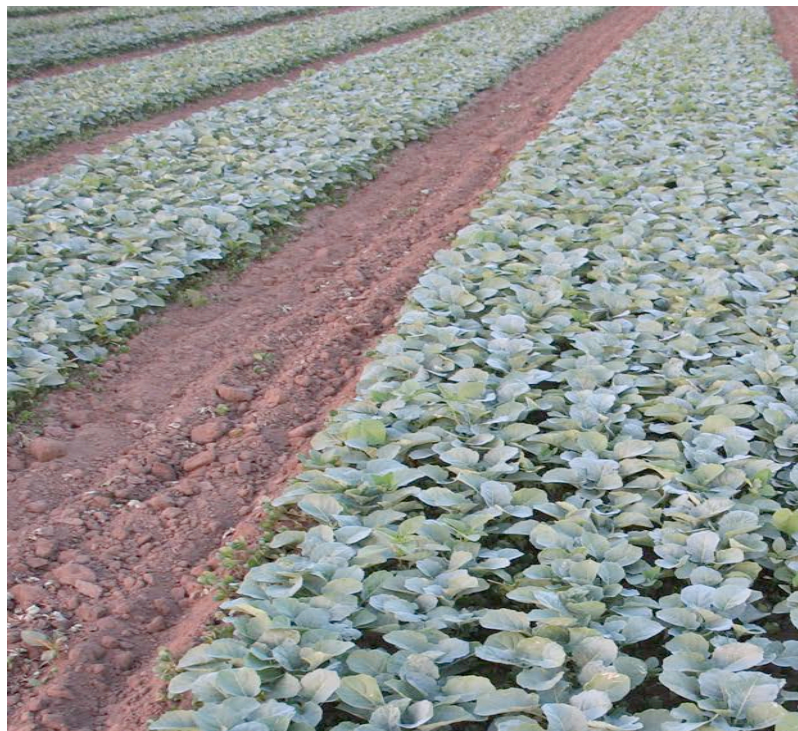
Relative Ease of Transplanting Bare-Root Vegetable Seedlings

Easy	Medium Difficulty	Difficult: Not Recommended
<ul style="list-style-type: none">• Beet• Broccoli• Brussel Sprout• Cabbage• Kale• Kohlrabi	<ul style="list-style-type: none">• Cauliflower• Celery• Eggplant• Pepper	<ul style="list-style-type: none">• Cucumber• Muskmelon• Squash• Sweet Corn• Watermelon

Production Process

1. Site Selection
2. Primary Tillage
3. Stale Bed Preparation
4. Fertility
5. Seeding
6. Covering With Row Cover
7. Irrigation
8. Pre-Planting Preparation

Proper Site Location is a crucial criterion of a successful seedbed. Ideally the site should be chosen one season in advance and prepared with soil building crops and a weed bank reduction fallow period the season before.



Site Selection Criteria:

- Good surface and internal drainage.
- Protected from high winds.
- Well-drained soil that is disease and nematode free.
- No surface crusting – surface crusting can prevent seeds from emerging after germination.
- No sub surface compaction – sub surface compaction can limit root growth.
- No surface erosion – avoid sloping fields as seeds are planted shallow and can wash out.
- Low weed pressure especially grasses
- Access to irrigation.
- The best soil for seedbeds tend to be sandy or sandy loams. This type of soil is ideal for harvesting (pulling) the plants. Heavier soils such as clays can make plant harvest difficult.

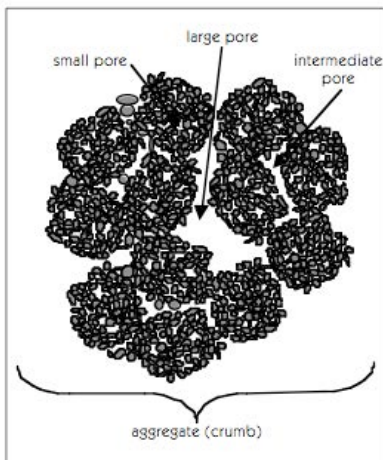


Figure 6.3 A well aggregated soil has a range of pore sizes. This medium size soil crumb is made up of many smaller ones. Very large pores occur between the medium size aggregates.

Primary tillage is best done with a field digger and drag. Avoid doing it when wet and causing soil clumping.

Avoid using a Rotovator for seedbed preparation, especially if you have clay soils. A rotovator damages the soil structure and beneficial aggregation of soil particles. Rotovating can be tempting because at first the soil is loose and friable and easy to plant, but after a hard rain rotovated soil is conducive to crusting and subsurface compaction.

Beds are 42 inches wide. After primary tillage establish bed locations by staking ends six feet apart.

Create a low weed pressure stale bed. Most weeds germinate from the top half-inch of soil. If care is taken to kill weeds as they germinate without bringing up deeper weed seeds, a relatively weed-free bed can be created. Use a basket weeder by cultivating

less than a half-inch deep when weeds are in the white thread stage. It is also possible to create stale beds with a tine weeder or flame weeder. If possible remove 2-4 weed crops in this way before planting.

Cautions. 1) If a tine weeder is used, use a light tractor to minimize compaction. 2) Keep the tractor tires in the aisles and out of the beds.

Sometimes, despite good soil practices, driving rain can cause excessive subsurface compaction. It may be necessary to bring a field digger back into the field and re-dig despite the fact that it negates the effort to create stale beds.

We use a 140 tractor with a Budding basket weeder and fertilizer attachment for stale bed making and bed prep at planting time. The tires are set at 48." The rear tine width matches the tires.



Bed Prep at Planting Time –

Cultivate with the basket-weeder at high speed. Sometimes it is necessary to work the bed twice to create a loose even seedbed. It is also possible to prepare beds by hand. If soil is clumpy it can be raked smooth before planting. In the below picture of prepared beds, notice the difference between the aisle and bed soil texture. The clearly defined furrow made by the rear tines at the bed edge makes it easy to seed without a marking wire. It also creates a furrow for laying the row cover.



Tools and Materials for Planting and Covering.

- Fertilizer (For seedbeds we use Sustane, a dried and pelleted turkey compost)
- Stakes and Hammer
- Tape measure
- Seeder (We used an inexpensive Earthway seeder with a leek seed plate. Many options exist.)
- Seeds (Plan three times the seed as plants needed)
- Measuring cups or small scale
- Tools to adjust rear cultivator tines and a crescent wrench
- Row cover
- Shovels
- Record book and pencil



Fertilizer Application – Apply immediately before planting to avoid loss due to wind or rain erosion. A fine grade is preferred as the seedbeds are densely planted and have a very short growing window. Use creeper gear. Drive in first gear, low throttle. Pressure air clean out all old fertilizer clumps cause plugging and uneven application

Seed Counts – Seed size is not uniform. Smaller seeds will plant at a denser rate than larger seed with the EarthWay Seeder. Determining plant population based on foot row is generally inaccurate.

Determine plant population by seed count. There are two ways to determine seed count, with measuring cups and spoons or with a micro-scale. It is best to prepare seed counts inside if possible rather than in field conditions. Most exact seeders can also be use.

1. Establish total number of seeds based on seed packet seed count.
2. Weigh or measure all the seed to create a formula for seed count.
3. Ex. A package containing 100,000 seed = 3.5 cups or 56 TBSP
 - a. 1 TBSP = 1,785
 - b. 2 TBSP = 3, 570
4. Follow a similar process if you use a scale.
5. Seed count must be recalculated for each lot used. Counts will vary even within the same cultivar.

Definitions:

Germination: The percent of seeds in a lot that germinate under good conditions.

Seed vigor: The speed and uniformity of emergence, especially under less-than-ideal conditions.

Seeding



6 rows, 7 inches apart, 3 inches from each edge, creates a 41 inch bed.

| 3" | 7" | 7" | 7" | 7" | 7" | 3" |

Field conditions are rarely exactly accurate. Allow extra inches for field reality.

We use a Seedway push seeder with leek plate. If you use a different seeder adjust accordingly.

1. Use predetermined seed amount. We use three times as many seeds as we need finished transplants.
2. Try to plant 6 rows wide to the same cultivar – later when it's time to pull the plants they will be less confusing to identify with accuracy.
3. Use caution while walking to not damage bed edge. Never walk in beds. Note bed edge in photo after planting.
4. Hold seeder as upright as possible
5. Start first row 3 inches from edge.
6. Depth – as shallow as possible especially if cool and wet out, but with good soil coverage. If you plant too deep it may not emerge after germinating.
7. If seedbed is not even you may have

inconsistent depth creating uneven germination.

8. Use marker to establish next row.
9. Plant three rows from each side.
10. Germination of brassicas may be reduced by temperatures in excess of 80 ° F. Temperatures in excess of 100° F can reduce seed viability.

If flea beetles are a problem, cover beds with row covers. Ideally right after planting but you can wait a few days. **Cover before germination.** Row covers also increase temperature, reduce surface crusting and preserve soil moisture. **Caution** in high temperatures, row covers are too warm, can affect germination, and should not be used.



Germination Times and Temperatures for Broccoli and Cabbage

Soil temperature for germination

Minimum	Optimum Range	Optimum	Maximum
40°	45-90°	85°	90°

General number of days from seeding to transplanting.
Broccoli: 38 days
Green Cabbage: 38 days
Red Cabbage: 45 days

Days required for Brassica seedling (broccoli, cabbage) emergence at various soil temperatures

Temperature	41°	50°	59°	68°	77°	86°	95°	104°
Number of days	----	15	9	6	5	4	----	----



Remove row covers at least ten days before planting to hard plants off. They are generally able to withstand flea beetle pressure at this size.

Laying row cover by hand: Lean one end of roll in aisle, walk in other aisle and unroll. **Do not unroll the tube laying on top of planted bed.** It will push extra soil down on seeds and bury them too deep. Have down side of roll to the wind. Tack the edge occasionally with soil to hold in proper location being cautious not to cover the seeds with soil, then fills in the gaps with soil. For best results lay cover square.

Watering

Keep the top ½ inch of soil moist until plants emerge. Generally it is best to water late in the day. Several irrigations per day during hot, dry weather. Frequent irrigations during hot weather not only supply water for growth but also help lower soil temperatures and cool young plants.

Emergence: Expect 3-6 days. Depending on temperature, depth and moisture.

After seedlings emerge, irrigate beds more thoroughly. If possible, wet the soil to a depth of 6 inches. Be careful not to injure or wash away small plants with excessive water force and do not “drown-out” transplants by allowing water to pond on the soil. Let the soil surface dry between irrigations. To help harden transplants, reduce irrigation and allow the soil to dry slightly during the five to seven days before pulling.

Remove Row Cover

7-14 days before planting. You may have to remove earlier if you have extreme high temperatures.

Pulling Plants

If soil is dry, water the night before pulling plants.

BEST PRACTICE:

- Pull plants first thing in the morning when cool and store in cooler.
- Count while pulling so you know how many you have.
- Separate roots as you pull them.
- Keep plants in the shade.

Transplanting

- If overcast and cool can be planted anytime of day.
- In hot sunny weather transplant out later in the day. Ideally after 4 pm.
- If very hot irrigate within a day.
 - We have had plants survive 4-5 days over 90° without additional irrigation but that is VERY stressful and not recommended.

Caution: Old transplants may have reached a physiological age at which reproductive growth is initiated rather than vegetative growth and may have problems with bolting.



Sources

Soil diagrams and tillage information: *Building Soils for Better Crops*: Fred Magdoff and Harold Van Es, Sustainable Agriculture Research and Education (SARE) Program.

Relative Ease of Transplanting Bare-Root Vegetable Seedlings Chart: *Knott's Handbook for Vegetable Growers*, Donald N Maynard and George J. Hochmuth, Wiley Publishing