

## TILLAGE, BED FORMATION, AND PLANTING TO MOISTURE: A Guide for Beginning Specialty Crop Growers



**T**his short guide reviews tillage, bed formation, and planting to moisture practices used on small- and medium-scale specialty crop farms.

### Tillage Sequence

Understanding tillage sequences is critical for good soil and bed preparation prior to spring planting. Ill-timed or poorly executed tillage will lead to frustration and soil cloddiness. This is especially true for more challenging soils higher in clay content. The specific sequences you use will depend on soil type and implement selection.

Here are two examples of common tillage and bed formation sequences used on California's Central Coast. One uses a mechanical spader to incorporate cover crop residue, the second an offset disc.

#### Spring incorporation of cover crop residue and bed formation

##### TOOLS: flail mower, mechanical spader, rolling cultivator

- 

Flail mow cover crop at appropriate soil moisture to minimize compaction. With a tall cover crop (3–4' or more), do an initial "high mow" pass with the mower set 1–2' above the ground, then mow at ground level to further chop and shred the crop into small pieces prior to incorporation to facilitate the breakdown process.
- 

Immediately after flail mowing cover crop, use a spader to incorporate residue.
- 

Immediately after spader incorporation of cover crop, form beds with rolling cultivator.
- 

Allow adequate time for breakdown of cover crop residue. If rainfall is not adequate after bed forming then pre-irrigate to maintain enough moisture to facilitate residue breakdown.
- 

Shortly after weed emergence re-work the beds with rolling cultivator. Beds are now ready for shaping and planting.

**TOOLS: flail mower, heavy offset disc, chisel, rolling cultivator, rototiller**



Flail mow cover crop at appropriate soil moisture to minimize compaction (as described on page 1).



Disc and cross disc cover crop until residue is adequately cut and mixed into the top 6 inches of soil.



Chisel and cross chisel to break up compaction from disc and open up ground. It may be necessary to disc again after chiseling.



Form beds with rolling cultivator.\*  
Shortly after weed emergence re-work the beds with rolling cultivator.

Beds are now ready for shaping and planting.

\* You may need to rototill to break up clods prior to bed formation. Moisture from either rain or sprinkler irrigation will facilitate rototilling. Once clods are mitigated then beds can be formed with the rolling cultivator.



FIGURE 1. Rolling cultivator. Photo: Jim Clark

## Bed Shaping



Once beds are raised with either listing shovels or a rolling cultivator (Figure 1), and assuming optimum tillage has been achieved through well-timed tillage, you can use a "bed shaper" to shape a bed suitable for precision seeding (e.g., carrots, beets), or multi-line transplanting (e.g., lettuce, brassicas), and follow-up weed management.



FIGURE 2. Bed shaper and markers. Photo by Jim Leap

Bed shapers are three-point implements that run behind the tractor and flatten out the bed top, providing a smooth, uniform, and well-defined bed for planting. Vegetable seeders can be attached directly to the shaper so that beds can be shaped and planted in one pass. Markers can also be attached to the shaper to provide distinct lines for transplanting (Figure 2).

## Planting to Moisture

This often-overlooked planting technique is an effective way to minimize weed competition when planting large-seeded crops such as beans, squash, and some cover crops, especially in California's Mediterranean climate. Potatoes and dry-farmed tomatoes can also be planted to moisture. Here is a suggested sequence (Figure 3):

FIGURE 3. Planting to moisture sequence

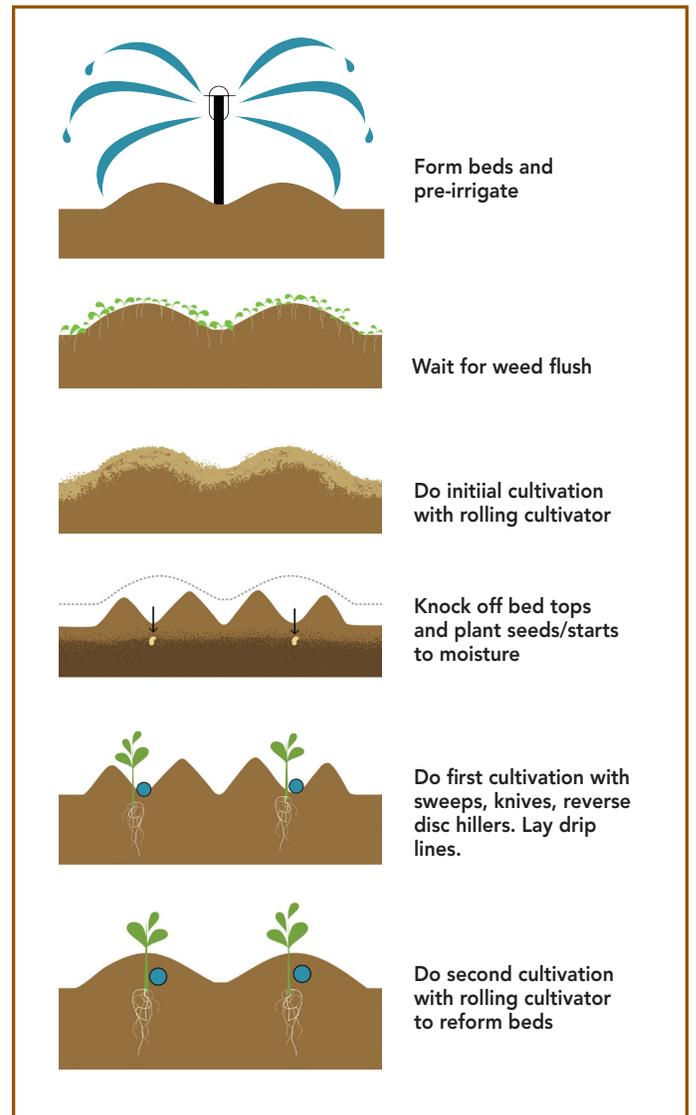


Illustration by Laura Vollset



### Step 1: Pre-irrigation

When planting to moisture –

- Form beds prior to planting (see above)
- Pre-irrigate with drip or overhead irrigation to flush weed seeds and get deeper moisture into the root zone. Apply approximately 1–1.5" on most soils, assuming there is good moisture deep in the soil either from irrigations on previous crops or from winter rains.
- If water is limited, drip can be used to pre-irrigate, but drip lines must then be retrieved before planting.
- On rare occasions, a well-timed rain event of an inch or more can provide adequate moisture to flush weeds.



### Step 2: Initial cultivation of fallow (unplanted) beds

Once you see weeds emerge on the beds and in the furrows (about a week after pre-irrigation), make a quick pass with a cultivating implement such as a rolling cultivator to knock out the newly emerged weeds (Figure 4) and newly germinated weed seeds that have not yet emerged. This pre-emergent weed growth stage is referred to as "white thread," because the radical (first root) of the newly germinated weed seed literally looks like a white thread. At this stage of growth weeds are extremely susceptible to light cultivation. Avoid deeper cultivation, as this would bring up new weed seeds from lower in the soil that have not yet germinated.



FIGURE 4. Cultivate pre-emergent (white thread stage) and newly emerged weeds (bottom in photo) with rolling cultivator. Photo: Jim Clark

Note that the "fallow bed" cultivation following pre-irrigation must be timed well to minimize tractor tire soil compaction from soil that is too wet in the furrow bottoms. Timing is critical as well in terms of the maturation level of the emerged weeds: once true leaves are formed on many weed species they can become much more difficult to terminate/kill when relying on mechanical cultivation. This is especially true for purslane.

On many soils, the best guide for timing of this fallow bed cultivation is when the soil in the furrows starts to dry down to a similar color as the bed tops about an hour after sunrise. This cultivation, if done well, will kill all germinated weeds, leave the beds intact, and mulch the soil surface—effectively inhibiting deeper soil moisture loss through surface evaporation.

The only weeds that will continue to emerge at this point will be problem perennials such as field bindweed (*Convolvulus arvensis*). Bindweed management requires diligent, repeated cultivations to keep it in check.



### Step 3: Planting to moisture

#### For beans, winter squash seeds:

When planting to moisture, the bed top must be mechanically knocked off so that the planter can place seeds into moist soil. This operation is most efficiently done with a wide "Alabama" shovel mounted on the planter to run ahead and push off the dry dirt on top of the bed (Figure 5). When set correctly, the shovel should leave a flat "V" pattern down the center of the bed. At the bottom of the "V" the soil should contain adequate residual pre-irrigation moisture (or rain moisture) to initiate germination of the newly planted seed.

Planting beans and winter squash seed at the low point in the middle of the bed will conserve moisture deeper in the soil because there is still a lot of loose soil above the seed line, limiting evaporative loss of soil moisture. Planting large-seeded crops to moisture also minimizes the risk of soil borne pathogens (damping off complex) that can affect their development. Damping off is more likely to occur when seeds are "irrigated up" with either overhead irrigation or drip irrigation.



FIGURE 5. Alabama shovels knock off the dry bed top; seed is dropped into moist soil and covered by "soil cappers" run behind the tamp wheel. Photo: Jim Leap



FIGURE 6. Dry-farmed tomato planting. Photo: Carolyn Lagattuta

### For dry-farmed tomatoes:



Use an Alabama shovel as described above to create a V-shaped furrow. Hand-plant well-hydrated tomato starts deep into moist soil (Figure 6).

### For potatoes:



Drop the seed pieces into a depression or trough formed by an Alabama or furrowing shovel (Figure 7), and cover with 3–4" of soil (enough to cover the seed pieces and keep them from drying out) by pushing some of the soil pushed off the bed top back into the middle of the bed.

When the potatoes are tall enough (8–12") make a second pass with a rolling cultivator, reverse disc hillers, or shovels to



FIGURE 7. Potato seed planting. Photo: Martha Brown

re-form the bed. This process is referred to as "hilling" and will ensure that the potatoes are adequately covered with soil to minimize sun damage.

## ADDITIONAL RESOURCES

**Equipment and tools for small-scale intensive crop production**, by Andy Pressman. NCAT Publication #IP417, 2011. [attra.ncat.org/attra-pub/summaries/summary.php?pub=373](http://attra.ncat.org/attra-pub/summaries/summary.php?pub=373)

**Introduction to weed management in a small scale organic production system** (video). Produced by the Center

for Agroecology & Sustainable Food Systems.

[www.youtube.com/user/casfsvideo](http://www.youtube.com/user/casfsvideo)

**Teaching organic farming and gardening: Resources for instructors.** Unit 1.2, Tillage and cultivation. Edited by Martha Brown, Jan Perez, and Albie Miles. Santa Cruz: Center for

Agroecology & Sustainable Food Systems, 2015.

[casfs.ucsc.edu/about/publications/Teaching-Organic-Farming](http://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming)

Note: See Appendix 7 in Unit 1.2 for details on the tillage pattern for an offset wheel disc.

**Tillage, Bed Formation, and Planting to Moisture: A Guide for Beginning Specialty Crop Growers** by Jim Leap. Edited by Martha Brown and Ann Baier.

© 2017 Center for Agroecology & Sustainable Food Systems (CASFS), University of California, Santa Cruz. This information was developed for beginning specialty crop growers and is based on practices used at the UCSC Farm. CASFS is a research, education, and public service program at the University of California, Santa Cruz. Learn more at [casfs.ucsc.edu](http://casfs.ucsc.edu), or contact [casfs@ucsc.edu](mailto:casfs@ucsc.edu), (831) 459-3240. Additional Grower Guides are available online at [casfs.ucsc.edu/about/publications](http://casfs.ucsc.edu/about/publications).

This publication was supported by the Specialty Crop Block Grant Program at the U.S. Department of Agriculture (USDA) through Grant 14-SCBGP-CA-0006. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.

Photos, p. 1: Top left and right, Elizabeth Birnbaum. Bottom left, Martha Brown. Icon illustrations: Laura Vollset.

CASFS

The CENTER for  
AGROECOLOGY  
& SUSTAINABLE  
FOOD SYSTEMS

1156 High Street  
Santa Cruz, CA 95064  
[casfs@ucsc.edu](mailto:casfs@ucsc.edu)  
[casfs.ucsc.edu](http://casfs.ucsc.edu)