Another grower would make two separate close passes with the Zone Builder if the bed was to have two rows of crops (i.e. peppers). He would then run the bed-maker over the slots created by the Zone Builder. He used extra-large disks on his bed maker to gather enough soil to make a firm bed.

Some growers only prepare beds on land where DZT has been used for several years to break up plow pans and relieve compaction. Instead of disturbing the entire field surface using conventional tillage (plow and harrow), they may simply loosen a strip of soil for the bed-maker using chisel plow shanks.

Cultivation A Reigi Weeder can be used to remove weeds in the row for widely spaced crops (e.g. pumpkins or peppers). Lilliston rolling cultivators or spider cultivators can be used through light residue. Traditional shank and shoe cultivators will also work.

For more information on DZT please contact Jude Boucher at 860-875-3331 or jude.boucher@uconn.edu.
Deep Zone Tillage (DZT) is a type of reduced-tillage that combines the best features of no-till, conventional-till and sub-soiling. Instead of tilling up the whole surface of a field, with DZT you prepare narrow seed beds for planting and leave the area between rows protected with a cover crop residue (Fig 1). As one grower stated, “a seedbed between the rows is only a weed bed!” Some of the reasons growers switch to DZT include: faster field preparation, reduced fuel and fertilizer use, less machine hours and maintenance, erosion control, elimination of plow pans and soil compaction, building soil organic matter, improving soil health, and much more.

When ordering a DZT machine, it should come set up with a front coulter to cut through dead crop residue, a straight (not a curved) sub-soiling shank (Fig. 2), so that it shatters the ground instead of lifting it, two wavy or scalloped coulters (Fig. 3) to work up the ground on either side of the shank, and a rolling-basket (Fig. 4) to break up soil chunks and prepare the seedbed. In New England, the sub-soiling shanks must have automatic spring resets (Fig. 5) to allow the shank to trip over rocks or ledge. Depth wheels allow you to control how deep the shank penetrates. The shanks should come with protective, hardened points and side wear plates.

**Planting**  
Planting can be done the same day as DZT or at the same time. Following the prepared seedbeds with the planter is easy. Because it doesn’t take a week to prepare the field, and moisture is retained under the mulch, DZT results in better seed emergence and stands when planting during dry spells.

One grower created a fifth-wheel style hitch for his planter (Fig. 19) so that he could prepare the field and plant in one pass. He developed the fifth-wheel style hitch that connects to the front of the Zone Builder (rather than the back) to distribute the weight of the planter closer to the tractor to avoid levering the front of the tractor up and decreasing steering.

**Raised Beds/Plasticulture**  
An effort should be made to pass a shank directly under each crop row on the bed. One grower prepares raised-beds using conventional tillage and bed-making techniques. He simply passes DZT shanks through the tilled soil at 14-inch spacing prior to making the bed and laying plastic (Fig. 20).
dressing equipment may be retrofitted with no-till disk openers (Fig. 15) to allow for placement of nitrogen below the soil surface, even outside of the tilled zone. Sidedressing may also be followed by cultivation to help prevent volatilization (Fig. 16).

For sweet corn, a tank can be added to the tractor or DZT machine (Fig. 17) and liquid nitrogen (28-32%) can be placed 8-inches below the seed through a tube running down the back of the DZT shank (Fig 18). Liquid potash (K) is also available. A nitrogen stabilizer (slow release N) should be used if you will not be sidedressing additional N. If the rye cover crop is killed at about 8 inches, 20 pounds of N should be credited towards the total needed by the crop.

**Field preparation with DZT** The Zone Builder should be operated at 3 to 4 mph. Row markers or foam markers can be used to space rows. Fields can be prepared without sinking equipment even when they are wet because the cover crop provides support. Over several years, pulling the Zone Builder becomes easier because compaction is reduced over time.

Unverferth builds a machine with a straight shank and automatic resets called a Zone Builder (Model 132). It should be ordered with a Strip Builder attachment for each row (coulters and rolling basket).

Residue managers (Fig. 7) should also be purchased and mounted on your planter in front of the planting shoe to remove any crop residue or stones and provide a final cleaning of the seedbed. Cleaning or sweeping the seed bed is necessary unless you plan to kill all cover crops at less than 8 inches high or mow and remove rye after it matures.

Since an equipped 2- and 4-row Zone Builder weighs approximately 2,000 or 3,600 pounds respectively, you will need a 70 hp or 120 hp tractor to pull the machine. The tractor should have 30-inch rear wheels to allow the hitch to lift the shanks off the ground. The tractor should also have front weights to help offset some of the weight of the Zone Builder and help improve steering.
Optional Equipment  Some growers mount seed firmers (Fig. 8) on their planters to assure that all seeds are tucked into the soil to the same depth and to help synchronize seed emergence. Other growers replace packing wheels with spiked closing wheels, especially when trying to close the furrow in clay soils.

The Zone Builder can be ordered with concave baskets (Fig. 9) to provide a slightly raised seedbed or cultipacker-type press wheels (Fig. 10) to help crush blocky soils. Some growers, with very stony ground, get shims (Fig. 11) to reduce the spring pressure on the re-sets so that the shanks trip easier when they contact a rock or ledge. One grower even purchased peg plates (Fig. 12) that attach to the top of the rear coulter posts to help him align the rear coulters to the same angle in every row. You can also replace the pair of rear coulters with a housing of three or four coulters for more aggressive seedbed preparation, again, usually only necessary on clay soils. Liquid or dry fertilizer attachments are also optional. Finally, one grower installed hydraulic lifts on his depth wheels to allow him to roll the machine across town instead of lifting it on his three point hitch (Fig. 13).

Sweet corn: Use a common broadleaf and grass herbicide mix (i.e. Callisto and/or atrazine + Dual Magnum or Prowl or Frontier or Lasso). Post-emergence products (i.e. Impact) can be used if needed.

Pumpkins or winter squash: Use common pre-emergence herbicides (i.e. Strategy or Curbit + Sandea). Post-emergence applications may be applied if necessary (i.e. Sandea or Poast).

After several years of using DZT, annual weed pressure may decline, but perennial pressure may increase. Control perennial weeds (i.e. dandelions) with fall applications of systemic herbicide (i.e. Roundup).

Fertilization with DZT  As with conventional tillage, all fertilizer should be banded at planting or side dressed to avoid feeding weeds between rows. Sometimes potassium is bulk spread prior to field preparation and planting to avoid burning plant roots with excess salt (N + K), depending upon how much fertilizer is recommended by the soil test. If applicators are installed to apply starter fertilizer to both sides of the row, then more than 90 pounds of N and K can be banded at planting. Side-
**Herbicides**  Glyphosate (i.e. Roundup) or paraquat (i.e. Gramoxone) may be used to kill the cover crop. Remember that it may take three weeks to kill the cover crop in cool weather, and plan ahead, so that your fields are ready for DZT and planting.

For best results, glyphosate should be applied with 10-20 gallons of water per acre, while paraquat should be applied with 80 gpa.

Sweet corn, pumpkins, squash, cucumbers, beans and peas can all be direct-seeded after DZT. Most transplants can also be set following DZT. Standard pre-emergence herbicides can be used for most crops. Post-emergence herbicides may or may not be needed depending upon weed pressure in a particular field, just as with conventional tillage. Herbicides must reach the soil to be effective. This is easy if the cover crop is dead. Rain or irrigation may be needed to improve cover-age and activate products. The soil texture and organic matter content determine the rate of herbicide to use, not the amount of crop residue on top.

Growers new to DZT should start with large-seeded crops with effective herbicide choices, such as sweet corn, pumpkins or winter squash.

**Equipment Maintenance**  Grease fittings to start season. Set front coulter to penetrate 2 inches and replace when dull and it fails to cut crop residue. Replace shank points and side wear plates as needed (Shank Protection Kit). Adjust angle of back coulters to provide more or less aggressive tillage for a smooth seed bed, depending upon soil type and residue height or thickness.

Preparing fields for DZT  Be sure all fields are limed to the proper pH before starting DZT. While some lime will be moved deeper into the soil by the shank and coulters, it is not as easy to make large adjustments in pH with reduced-tillage equipment compared with conventional tillage that mixes the lime throughout the soil in the plow layer. Plan to make maintenance lime applications more frequently to keep pH adjusted properly.

Use a penetrometer (or metal probe, Fig. 14) to check the depth to the top and bottom of the plow pan in your fields. The shank on your DZT machine should be set to till about two inches below the plow pan to improve soil drainage, allow plant roots access to the lower soil profile during dry weather and to save fuel.
Choosing, Planting and Killing Cover Crops  To further reduce tillage, instead of harrowing crop residue (i.e. sweet corn stalks) before planting a cover crop, most DZT growers mow off crop residue, before spinning on cover crop seed. Some DZT growers purchase no-till grain drills to completely eliminate tillage while planting a cover crop. It is important that cover crops are completely dead in the spring before using DZT.

Most growers use winter rye as their cover crop because it will establish throughout September and even into October during warm falls. In most cases, rye should be killed in the spring before it is 8 inches tall, to maximize nitrogen credits and for easy DZT in early spring vegetable plantings. Larger rye may take up to 3 weeks to die and be ready for DZT in cool spring weather. For pumpkins and winter squash, growers often prefer to let the rye reach 24-30 inches before killing it, which provides a protective barrier of residue to help keep the fruit clean and sound. Rolling the rye and heavy seeding rates (>150 lbs./A) need to be used to provide even minimal weed control. During or after pollination, rye can also be mowed and baled without risk of regrowth. It is easy to DZT through rye stubble, but a light dose of post-emergence herbicide (i.e. 1 pt of Roundup) may be needed with your pre-emergence herbicide to kill small weeds that emerged before the rye was cut.

Mixes of rye and other cover crop species help improve soil health by increasing populations of soil microorganisms. Some growers use a mix of rye and tillage radishes (Daikon radishes). The radishes grow up to 20 inches deep and keep hard pans from reforming. They capture and then re-release excess nitrogen when they winter kill, while the rye provides spring cover for the soil. Radish mixes should be planted in August for good fall growth. “Cocktail mixes” of up to 13 different cover crop species can be used to increase the diversity of soil microorganisms.

Oats or oats plus tillage radishes can be used and will winter kill where a grower prefers to avoid using a herbicide to kill the cover crop. Oats and tillage radishes should be established in August.

Buckwheat, sorghum-sudan or Sudex can be used as a late summer cover crop/smother crop to build up soil organic matter and to avoid additional tillage (i.e. instead of harrowing to prevent weeds from going to seed after early harvested crops, such as sweet corn). Plant in June, July or early August.