Alternative Tillage Methods for Cucurbit Crops

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No-till and Strip-tillage methods have been utilized for the production of field crops for many years. Alternative tillage methods for vegetable crops is not always an option. Research has shown feasibility in planting vegetable transplants into no-till systems. Seeded vegetable crops generally need a clean seed bed for germination. Seeding vegetable crops into fields with surface residues can be a challenge. However, large seeded vegetable crops, like cucurbits, can be successfully established in alternative tillage systems.

Seeding methods for no-till or strip-till vegetable production do not differ greatly from no-tilling field crops. Planting cucurbit seeds into a no-till field may be as easy as changing seed plates on a no-till planter. For small acreage fields a shallow trench can mark out the row for hand seeding. The most important factor is to establish good seed to soil contact. When seeding with a machine stop to check seeding depth, row closure, and seed to soil contact. Seed will sometimes be pressed into the mulch rather than the soil. If this occurs the mulch may dry out and the seed will not germinate or survive in the dry residue. To help ensure an adequate stand, increasing the seeding rate of the cucurbit crop may be needed. Seeded cucurbit crops can be planted into a small grain cover crop or stubble, hairy vetch, or a combination of winter rye and hairy vetch cover crop. Irrigation may be needed to establish the cucurbit crop if spring rainfall is limited. Additionally, the growth of the cover crop may deplete soil moisture, also warranting supplemental irrigation. The cover crop residue will act as a buffer between the air and soil to decrease evaporation of water from the soil surface, however, irrigation may be needed even when the crop is established if lack of rainfall prevails.

Fall planting a small grain cover crop before the frost-free date (October 15 in New Jersey) is ideal to establish the crop and to gain maximum growth. When using hairy vetch alone or in a cover crop mixture with winter rye it should be planted 3 to 4 weeks before the frost-free date. Seeding rates may differ for planting dates and soil types, but generally the seeding rates for hairy vetch are 20 to 25 pounds per acre and 2 bushels per acre for winter rye. When planting in combination the rates can be lowered. The cover crop seed needs to be drilled or broadcast with light incorporation for establishment. Higher rates of germination will occur with drilling.

This publication was made possible through a cooperative effort between Rutgers, The State University and the United States Department of Agriculture Environmental Quality Incentives Program.

Allowing the cover crop to attain maximum growth in the spring before setting hard seed is important in producing a thick mulch for covering the soil surface. Additionally, applying fertilizer to the cover crop in early March to accelerate spring growth is a good idea.

The cover crop will need to be killed with a non-selective herbicide in spring (preferably glyphosate) and mowed or chopped level before seeding. Hairy vetch should be killed when the first flowers form and definitely before seed in the flowers harden. When flowers are seen on the vetch vegetative growth is hastened and it is time to kill the vetch. With strip-till planting, traditional seeders can be used since a seed bed strip is first tilled in the row. The benefits of strip-tillage systems are to prevent erosion in the row middles and avoiding disturbance of the soil between the rows that could bring weed seed to the surface to germinate, while still creating a tilled seed bed strip.

The more crop residue left on the soil surface, the more barrier material is provided for smothering of germinating weeds on the soil surface. Weed control is a major problem with producing vegetable crops with no-till systems. Seeding should be done into a weed-free field. Preplant or preemergence herbicides can be used, but may not be as successful in a no-till field covered with previous crop residues. There are very few herbicides labeled post-emergence for vegetable crops. Halosulfuron is labled for some cucurbit crops post-emergence. It can control some broadleaf weeds including common cocklebur, redroot pigweed, smooth pigweed, ragweed species and galinsoga. It will also control yellow nutsedge. Halosulfuron must be applied when the crop has at least 2-5 true leaves but before the plants begin to bloom or run. Gramoxone is labeled for post-emergent non-selective control of weeds, but must be applied without drift to the crop. The use of spray shields during times with no wind can assist in successfully applying gramoxone in the row middles. To control annual grasses and certain perennial grasses, sethoxydim, can be applied at labeled rates postemergence without harming the cucurbit crop. Once the vine crop is established, plant

competition can work to hinder weed growth.

Leaving cover crop residue on the soil surface can be a benefit to managing production activities. Crop residues in contact with the soil surface provide open macropore spaces for rain water or irrigation water to infiltrate quickly into the ground. Additionally, this residue slows or prohibits the flow of water through a field, thus, decreasing erosion of soil, fertilizers, and other agrichemicals. The carpet of cover crop residue in no-till fields also allows for equipment to enter the field drive rows even under wet conditions. However, driving on wet fields will cause soil compaction. In the case of a conventionally tilled fields the timing of spray applications or harvest may be delayed until fields dry.

Cover crop residues can also add nutrients to the soil when decomposition occurs. Depending on the decomposing cover crop residues alone for cucurbit crop nutrient needs is not always an option. Although decomposition of the hairy vetch may provide an organic nitrogen source it may not be enough, especially when a small grain is present. Decomposition of the small grain, that contains a higher carbon/nitrogen ratio, may utilize much of the nitrogen provided by the vetch. In some heavier soils with a good deal of organic matter, fertilizer applied to the cover crop in the spring may be adequate to carry the cucurbit crop through the season. However, in lighter soils with low amounts of organic matter this is not true. Cucurbit crops grown in these soil types should be sidedressed before the vines begin to run. Testing the soil for fertility levels is a good idea. The use of a tissue test for plant nutrients is another option. Pre sidedress nitrogen tests (PSNT) have gained popularity and have been calibrated for pumpkins. These tests can assist in fertilizer application decision making. Over fertilization or excessive nitrogen in the soil can result in excessive vine growth, flower abortion, and smaller fruit.

Cucurbit crop growth in no-till and strip-till systems is comparable to that of conventionally grown cucurbits. In some years alternative tillage systems have out yielded bare ground tilled fields. This may be due to the more even supply of soil moisture throughout the season in fields with cover crop surface residues.

To harvest a clean fruit off of a no-till field it is best to pick up the fruit when the field is dry. When the fields are wet cover crop residues can stick to the surface of the fruit and dry on in storage.

This is the same concept for bare ground fields when soil can stick to the underside of the fruit.

The following tables provide data from research trial results that looked at alternative tillage methods for the production of cucurbit crops. Research done by Michelle Infante-Casella, Agricultural Agent, Rutgers Cooperative Extension of Gloucester County in cooperation with Dr. Stephen A. Johnston, Vegetable Pathologist and Dr. Stephen A. Garrison, Vegetable Specialist, Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey.

Table 1. 1999. Alternative tillage methods for butternut squash; topsoil loss and yields.

Tillage Method	Topsoil Loss (inches)
No-till	0.03 b
Strip-till	0.33 b
Bare Ground	1.31 a
LSD 0.05	*

Table 2. 1999 Alternative tillage methods for butternut squash; yields.

Tillage Method	Yield (35lb. Boxes/acre)
No-till	200 a
Strip-till	208 a
Bare Ground	94 b
LSD 0.05	*

Table 3. Fall Crop 1997. Comparison of black plastic mulch, bare ground, and no-till production of zucchini; yield in tons per acre.

Tillage Method	Zucchini Yield (t/ac)
Black Plastic Mulch	10.69
Bare Ground	8.73
No-till	8.66
LSD 0.05	NS

Table 4. Fall Crop 1997. Comparison of black plastic mulch, bare ground, and no-till production of yellow squash; yield in tons per acre.

Tillage Method	Yellow Squash Yield (t/ac)
Black Plastic	6.21
Bare Ground	3.99
No-till	4.30
LSD 0.05	NS

Agricultural Agent, Michelle Infante-Casella has been investigating alternative tillage systems for production of vegetable crops since 1993. She has worked with no-till and living mulch systems for broccoli production, no-till systems for pepper and tomato production, and with the following cucurbit crops: zucchini squash, yellow squash, butternut squash, pumpkin, and cantaloupe. Demonstration trials have been conducted in the area of no-till vegetables on three farms producing butternut squash, tomatoes, and melons. Research trials and demonstration trials have produced mixed yield results. However, in all cases soil erosion was reduced and soil quality was improved when no-till systems were used in production. Agent Infante-Casella will continue working on developing alternative tillage systems for the production of vegetable crops in New