

Reduced Tillage in Vegetables (Northeastern United States)

GEORGE AYRES, FARMINGTON, NEW YORK

Location: Farmington, Ontario County, NY

Annual Precipitation: 32 inches

Reduced Tillage Method: Zone Tillage

Crops: Sweet Corn, Pumpkins, Strawberries, Raspberry, Soybeans, Field Corn, Alfalfa, Small Grains



Description: 620 acres in both vegetables and field crops with established zone-tillage practice.

BACKGROUND AND PREVIOUS TILLAGE METHODS

GROWERS BACKGROUND

George started farming in 1977 when he bought the family dairy business. Prior to this, George had work in agricultural engineering extension in Iowa State University for 13 years. He had his bachelor's degree from Cornell University in 1964, his masters and doctorate degrees in agricultural engineering from Iowa State University in 1966 and 1973 respectively. Pat, George's wife, has a bachelor's degree from Cornell in home economics.

The family farm that George bought in 1977 was in Orange County. However, in 1988, he sold the farm in Orange County and bought the farm at his present location. He finally sold all the cows, gave up dairy farming in 1995, and then switched over totally to crop farming.

FARM SIZE & CLIMATE

The total cropland is 620 acres. Out of the 620 acres, George owns 132 acres and rents 480 acres. The farm is located in Farmington, NY south of Rochester, about 25 miles south of Lake Ontario. The annual rainfall is about 32 inches; however, the lake-effect rainfall can often increase the amount of precipitation in this region.

SOIL TYPE (CHALLENGES)

Palmyra Gravelly Loam: Well-drained soil and good land to grow crops especially vegetables. This soil tends to be very dry in years of drought. The soil also drains quickly after rains and relatively easy to work with tillage equipment.

Plain Sand: This sandy soil can be severely affected by drought. Otherwise, if the rainfall is normal, it is a very good soil for early sweet corn and alfalfa.

Muck Soil: George has 16 acres of muck soil

Schoharie Clay: This is a very productive clay soil but with poor internal drainage. It performs very well especially in relatively dry years. It works well with zone tillage.

PREVIOUS CROP/SOIL MANAGEMENT BEFORE REDUCED TILLAGE

Crops: The farm was formerly a dairy farm. The crops grown were alfalfa, field corn for silage, soybean, some wheat and sweet corn. The dairy farm went out of operation in 1995. Since 1995, George has switched totally from dairy farming to crop farming. The crops grown are diversified to include strawberries, raspberries, pumpkins and more acreage of sweet corn.

Tillage Management: About half of the field was moldboard plowed and the other half was chiseled.

CROPS GROWN AND MARKETS

Crops and Acreage Distribution: Strawberries: 6 acres; Raspberry: 1acre; Sweet Corn: 70 acres; Pumpkins: 25 acres; Grain Corn: 90 -100 acres; Soybeans: 200 acres; Alfalfa 120 acres; Small Grains: 100 acres.

REASON FOR ADOPTING REDUCED TILLAGE & INITIAL EXPERIENCES

The primary reason for George's decision to switch over to reduced-tillage was his concern about soil health. While in Iowa, George did a lot of research on reduced tillage and no-till systems. When he eventually left Iowa for New York State to start the farming business in 1977, he tried to grow his crops with no-till. However, the results he got then were rather disappointing. The equipment were not adequate and the crops did not consistently produce good yields. After this initial setback, George went back to chiseling. He then realized that he spent much time in spring tilling the soil instead of planting. He sought for a method that will reduce the time, area and intensity of tillage. He learned about zone tillage from the extension educators around his area and visited some farmers using this method for crop production. He then realized that zone tillage would perform well in his Schoharie clay since the crops are planted in the tilled zones having optimal seedbed condition, in contrast to no-till where the plant roots are restricted by compact untilled layers. He also found that zone tillage would solve the problem of poor germination, poor emergence and poor fertilizer distribution he experienced while practicing no tillage. George bought his first zone tillage machine in 1996. He then started growing his field corn and soybean with zone tillage. He was not yet convinced that sweet corn and pumpkins would do well with zone tillage because of the sensitive nature of their roots. They were still grown by chiseling up until 2001. George tried to experiment on his farm and observed that in drought years, his sweet corn did not produce a good crop under chiseling compared to sweet corn planted by zone tillage. After this observation, he the switched his entire farm to zone tillage in 2002 except for strawberries. Although it took some time get George convinced that, he could grow vegetable crops with zone tillage. He was finally able to make this transition in 2002. He was initially having problems with getting good stands for sweet corn. He had to modify his planter for the sweet corn to have good stands. George indicated that there is much to learn while setting up reduced tillage on your farm. It takes time and patience to work out a system that will work very well for you. For instance, it took three to four years before he could figure out how to adapt zone tillage for sweet corn on his farm.

GENERAL APPROACH TO REDUCED TILLAGE

For all crops grown with zone tillage, the equipment used is the “Zone Builder”. The Zone Builder cuts a narrow slot within the soil between 10 to 20 inches deep depending on how far you set the working depth. The Zone Builder also does some tillage on the soil surface making a little mound 5 to 6 inches wide. Fall zone building is preferred to spring zone building. In case the zone building did not take place in the fall, it should be done in the early spring. You need to give some time between the zone building and planting so that the soil can settle within the slot created by the zone builder.

After zone-building comes the planting. The planter has coulters attached to the front, which stirs the soil in the row zones before the seeds are planted. Consequently, you make only two passes across the entire field from tillage to planting. The first pass is with the Zone Builder and the second pass is with the planter.

George does not do any zone building in sandy soils on his farm. He just goes in to plant in the spring with the planter. The only soil disturbance in the sandy soil will be those done by the coulters attached to the planter.

For pumpkins, the previous crop is always rye grass. About three weeks before planting the rye grass is killed with round-up and a week later, the Zone Builder is used to create the planting rows for pumpkins as it is done for other crops. Pumpkin is the only crop for which George does the zone building in the spring. For planting cover crops and small grains, George drills the seed directly without any zone building. The extra coulters attached to the planter takes care of the minimal soil manipulation needed for the crops to achieve a good stand.

Equipment Needed for the System to Work

According to George, two main equipment are needed for zone tillage system. The first is for zone building, which essentially is a narrow tillage in the vertical dimension. You need this deep vertical tillage to break the compacted layer down within the soil. Without doing this it can lead to the failure of the system. This compacted layer often lie between 9” and 12” especially in soils that had previously experience conventional plow-based tillage. It took a couple of years before George could figure out the importance of breaking the compacted layer within the soil in the

process of zone building.

The second component needed is 2 or 3 fluted coulters mounted ahead of your planter to do the final tillage. These coulters break up the soil in the zones and ensure that the soil being broken is kept within the planting rows. George has Unverferth two-wheel zone-till cart with planter pulled behind it. The cart is a big fertilizer tank with a toolbar under it. The coulters are mounted on the toolbars such that it can be raised or lowered independent of the planter. George uses a 13-wave one-inch wide coulters to break up large clods and chop any residue left over from the previous year. The other two coulters have 8-waves and are 2 inches wide, inclined toward the middle so that they throw some soil to the center of the zone.

However, the best way is to have the no-till coulters mounted right on the planter. This works better for farmer with hilly terrain.

In building the zones, George alternates the zones 12” to 15” every year. The mid-section of between row positions becomes the row zone for the following year.

SPECIFIC CULTURAL PRACTICES USED

ADVANTAGE/DISADVANTAGES

According to George, the advantages of the reduced tillage, particularly the zone tillage far outweighs the disadvantages. The soil health on George’s farm has improved. In addition, most of the compacted layers within the soil have been broken up. The soil is now much more friable and in a better shape than it used to be. George has also started to notice small increases in organic matter. The earthworm activities have also increased. This improvement in soil health is due to the restricted width of tillage and non-inversion of soil under the zone tillage system. While tillage takes place only in the narrow zones, a great part of the soil remains untilled. This leads to an increase in the biotic activities within the soil and less oxidation of organic matter compared to plow-based tillage.

Another advantage of zone tillage system that George has noticed is the reduced number of field passes with equipment, which may lead to savings in time and fuel.

George has also observed with zone tillage that the tilled, narrow zones warm up quickly in the spring, which allows for early planting.

A major disadvantage of zone tillage according to George may be in the area of insect pests and diseases. However, he has not had this experience on his farm.

EQUIPMENT & OPERATION

Three pieces of equipment that George uses for his zone tillage system are –

Zone Builder (Figure 1),

Zone Till Cart (Figure 2)

and **No-Till Planter (Figure 3).**



Figure 1. Zone Builder equipment with rolling basket behind



Figure 2. Unverferth Zone-Till Cart

George has Unverferth ripper-stripper with rolling baskets behind the coulters (Figure 1). He decided to attach the rolling baskets to achieve an even breakdown of soil clods in the row zones. The zone-till cart is a big fertilizer tank with a toolbar (Figure 2). Attached to this toolbar are the fluted coulters. George has a John Deere 7000 planter (Figure 3). The planter has undergone several modifications to be well adapted to reduced tillage. Planter modification that George has made included changing the gauge wheel alongside the openers. He has removed John Deere's tires and put KSIH tires on the planter. John Deere's tires were made for the loose ground in the Midwest to compress the soil on each side of the seed opener. This was not beneficial. However, KSIH tires have different shapes and work better for the zone tillage. Another modification to the planter was to take off the John Deere's closing wheel and replace them with Martin Spading closing wheels, which are more appropriate for reduced tillage since it removes trash from planting rows.



Figure 3. J.D. 7000 Planter

CROPS, COVER CROPS & ROTATION

George feels that there is nothing different in the practice of rotation in zone tillage compared with other methods of tillage.

George's rotations depend on his soil type and cover crops. The rotation sequence including the cover crops in different soil types on his farm are as follows:

On heavy clay: Field corn-soybean-rye (combined for grain and straw harvested to mulch strawberries)

On sandy clay: Field Corn-soybean-rye (combined for grain and the straw left on the ground)

On gravelly soil used for vegetables: sweet corn - (rye and hairy vetch) – pumpkins – (rye) - sweet corn - (rye) - soybeans – wheat - alfalfa for 5 years.

RESIDUE MANAGEMENT

George leaves most of his crop residues on the soil surface. Some rye straws are removed on the

heavy clays to mulch the strawberries. Wheat straw are also baled and sold.

WEED MANAGEMENT

George has no peculiar problem controlling the weed on his farm. He has observed fewer weeds between the untilled rows in his farm. More weed are concentrated at the in-row positions. George controls weeds on his farm with low rates herbicide. Another observation made by George was the shift in the weed types under zone tillage from annual to perennial weeds. He has seen increases in perennial weeds such as dandelions and milkweed. With these perennial weed, George believes that a fall weed control is more effective than weed control in the spring. The perennials are better controlled in the fall. For soybeans and many other crops, George plants the beans and sprays them with round-up 25 days later. For the field corn however, George sprays the rows with regular rate of Lasso Microtech or Duo. He uses only one third of the chemical required for an acre because only the zones are sprayed.

For sweet corn, George still uses a regular rate of Microtech herbicide across the entire field because the crops are further apart (about 18,000 plants per acre) and grow more slowly compared to field corn (32,000 plants per acre) which grows faster with the canopy smothering the weeds in between the rows.

In small grain crops, George sprays 2,4D in the spring to control broad leaves weeds.

DISEASE AND INSECT MANAGEMENT

George occasionally gets incidents of white molds on the snap beans and soybeans. However, there has been no major breakout of pest or diseases on his farm. There seem to be no special tillage effects on plant diseases and pests.

CROP SEEDING STRATEGY

All the crops grown on George's farm are either by zone-till or by no-till.

REDUCED TILLAGE TRIAL

There has been no particular trial targeted specifically to compare zone-till to plow-till. The only experiment George could remember which was carried out about ten years ago was the comparison between nitrogen applied upfront with inhibitor and nitrogen applied as side dressing. The trial concluded that there was no significant difference in the yield of Corn between the two

different methods of N application in his soil.

George made an observation in 2001 which was a dry year. He observed that the sweet corn yield he had from zone-tilled fields was about 7.5 ton/ac compared to 5.2 ton/ac for the chiseled field. The zone-tilled field had retained more moisture than the chiseled field and the plants were able to make use of this moisture during the drought periods.

BENEFITS FROM REDUCED TILLAGE

POSSIBILITY OF INCREASING PROFIT

The yields that George has from reduced tillage are about the same that he used to have when he was practicing conventional tillage. However, the cost of production from conventional tillage is about 21.63 dollars per acre more than that of the reduced tillage. The extra cost arising from conventional tillage is associated with more tillage needed for the system. You have to make more passes through the field with conventional tillage and you have to till a larger area of land.

SOIL QUALITY IMPROVEMENT

George has observed more earthworms' activities in his fields. He can work his soil more easily than before. Equipment now pulls more easily within the soil compared to some years back. In the same soil, he is now pulling a 6-shank deep tiller easily with the same tractor that he used to pull a 4-shank deep tiller with difficulties. It would have been impossible to pull a 6-shank deep tiller with the same tractor in the same soils some years back.

ENVIRONMENTAL CONSERVATION

NRCS counts George's zone-till system as a system with zero soil loss. The ground is covered for most part of the season and due to earthworm activities, water easily infiltrates into the soil. No evidence of erosion or soil crusting is found on any of George's fields.

REDUCED COMPACTION

Since the beginning of zone tillage systems, George has been able to break up most of the compact layers within the soil on his farm due to deep ripping that accompanies his zone building.

LESSONS LEARNT

CROP ESTABLISHMENT AND SECURITY

George has not experienced any crop failure with zone tillage. However, he has had experience with crop failure due to conventional tillage in dry years.

FALL VS. SPRING ZONE BUILDING

George advises that if you have a clayey soil, it is important to do the zone building in the fall to give the soil clods time to weather down over the winter. For gravelly loam soil, it does not make any difference if you do it either in the fall or spring. If you are going to build your zones in spring, do it early a few weeks ahead of planting so that the soil in the slot can settle before seeds are planted. Failure to allow the soil to settle properly can lead to poor crop establishment. If George has to do zone building in the spring, he normally starts as soon as the frost gets out of the ground. In some years, George is able to get out in March to do zone building if the weather permits. In some other years, it is more difficult. He may have to wait until middle of April before he can start with zone building. For spring zone building, George works on the field where the corn will be grown first before the fields where the beans will be planted since the beans are planted later than corn. According to George, the key issue with spring zone building is to start as early as possible and as soon as the soil moisture permits.

Zone tillage also helps to get around too wet weather. George was able to get a good crop of pumpkins in 2004 despite a very wet season. The zone-tilled soil was able to drain better than many other soils in the neighborhood. There was however, some lower yield with beans because his planting was delayed due to the wet weather in 2004. During this same year, his sweet corn crop did very well. The excess moisture did not affect the growth and yield of sweet corn.

Another challenge is the shift in the weed types from annuals to perennials in zone tillage. These perennial weeds are better controlled in the fall. George therefore advises the growers transitioning to zone tillage to have a fall weed control program.

Due to many activities that take place in the fall such as planting cover crops, zone building and weed control, it becomes a very busy part of the year for those transitioning to reduced tillage.

However, the benefits show up the following spring, during which you can plant early, since you

have created a good condition for crop establishment in the fall.

ADVICE FOR NEW FARMERS WILLING TO ADOPT REDUCED TILLAGE

The first thing George will advise a grower willing to transition to zone tillage or any form of reduced tillage will be to start small. There is a steep learning curve associated with adapting reduced tillage to the grower's individual field and management conditions. Growers are advised to start out with a small part of their field and as they get more proficient with the new tillage system, they can expand zone tillage to more acreage. George also advises growers to start from a field that has been under alfalfa for about 3 or 4 years. Such soils will have good quality and present least problems to zone tillage method.

If a grower wants to start zone tillage in a field that has been under long-term conventional tillage, he needs to apply deep ripping to break up the compacted layer in the planting zones. Without breaking this layer, zone tillage is bound to fail.

It is also important to network with those who are already practicing reduced tillage to learn from their experience and possibly borrow their reduced tillage equipment at the initial stage.

Finally, new growers need to modify their cropping practice to incorporate cover crops. George believes that cover cropping is an important key to the success of zone tillage since they can help to improve soil health and control weeds.

PLANS FOR THE FUTURE AND CONSTRAINTS

George intends to have a new planter mounted at the back of the cart rather than being a separate entity towed at back of the cart as he currently does. This will prevent drifting of the planter on side hill.

George would also like to buy a new tractor that is more versatile and adjustable to his cultivation practice.

The above plans are dependent on the farm finances.