Reducing climatic and disease risks through minimum tillage systems for vegetables

2010 Annual Report

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Summary

Reduced and modified tillage (RT) systems (e.g. no-, zone-, strip) represent strategies to reduce soil degradation and erosion and protect water quality. We have shown that zone and deep zone tillage systems can provide the environmental and economic benefits of an RT system for many vegetable crops without the harvest delays or losses observed in straight no-till. Each season, more vegetable growers express interest or try RT on their farms. To insure continued success, we will now evaluate ability of RT systems to ameliorate large fluctuations in water supply which may result from climate change. RT systems may reduce crop losses to flooding, drought and vegetable diseases like Phytophthora capsici. We will use on-farm and on-station research, workshops, and field trials to evaluate and then promote RT systems to improve water management and soil quality while reducing disease spread and fuel and labor costs. Our team includes soil and crop scientists, plant pathologists, and vegetable growers from MA and NY. Our case studies will continue to capture grower experiences and innovation. Surveys and grower on-farm research networks will help monitor progress towards our milestones and performance target. Over 500 growers will attend training events or field days on RT systems and 150 will demonstrate new knowledge on how these systems can improve soil and disease management. As a result of this project's trainings and on-farm trials on reduced tillage systems, 40 growers new to RT will apply these systems on at least 20% of their land (2000 acres total), and report increased management flexibility and timeliness and improved profitability. These production cost savings will average $25 per acre, including fuel (2 gallons per acre or $8/acre) and labor ($10/acre) and income will increase from Phytophthora capsici susceptible crops by 20% or range from $700 to $4,000 per acre, depending on the crop and market.

Objectives/Performance Targets

Performance Target: As a result of this project's trainings and on-farm trials on reduced tillage systems, 40 growers new to RT will apply these systems on at least 20% of their land (2000 acres total), and report increased management flexibility and timeliness and improved profitability. These production cost savings will average $25 per acre, including fuel (2 gallons per acre or $8/acre) and labor ($10/acre) and income will increase from Phytophthora capsici susceptible crops by 20% or range from $700 to $4,000 per acre, depending on the crop and market.

Accomplishments/Milestones

Milestone 1: Of 500 farmers attending field days or workshops about reduced tillage sponsored over the duration of the project, 250 respond to an exit survey, and 150 demonstrate increased knowledge about how these systems can improve soil health, reduce costs and affect crop diseases. Our field days this summer and fall were well attended for the most part by vegetable growers. We had about 200 people at our meetings. The majority of attendees at UMass Center for Agriculture Field Day indicated positive changes in knowledge (87.5%) and an increased likelihood of changing their own farming systems to include deep zone tillage (88.24%),(Figure 1). We were disappointed when only six growers attended the RT Twilight Meeting on LI due to a scheduling conflict. The Small Farm Equipment Field Day was attended by conventional and organic vegetable growers even though it was promoted by NOFA-NY. Two families attended that were considering starting a farm and using DZT. Reduced tillage events hosted in 2010: Small Farm Equipment Field Day (August 5, 2010) This field workshop was hosted at the Cornell Organic Research Farm. Over 70 people attended the event, and 40 attended the in-depth discussion on applying RT to small vegetable farms and in organic systems (Figures 2 and 3). Our RT equipment was the focus of the discussion, including an Unverferth unit, our homemade deep zone unit and a Yeoman's plow for smaller growers. Forty growers were given our 'Guidelines for Deep Zone Tillage in Vegetable Production' publication. The guidelines highlighted key equipment, field preparation, fertility management and planter setup issues that should be considered for success at deep zone tillage for vegetables. One grower shared his experiences using the Cornell Unverferth DZT unit this summer. He planted sweet corn, bean, cucumbers, cole crops this season. UMass Center for Agriculture Field Day (August 11, 2010) Our work with deep zone tillage was highlighted in two tours during the UMass Center for Agriculture field day. Pits were dug through demonstration plots of field corn and a soil scientist was on hand to show and explain the differences that were visible between the deep zone tillage plots, conventional plots, and no-till plots. We also showcased our on-station trials and distributed literature about deep zone tillage in general and this project in particular, including information on how to become involved and request an equipment demonstration on their own farm. We had zone tillage equipment on hand and provided live demonstrations. Attendance at both tours was roughly 60. All of the one hundred eleven attendees were provided with an informational packet that detailed our work with deep zone tillage and contained information on how to contact us if they were interested in using UMass equipment or to request a consultation. Hadley Twilight Meeting (August 24, 2010) The meeting was hosted by two of our cooperating DZT growers. The meeting was attended by at least two dozen growers and other interested parties. Two different zone building implements were demonstrated by cooperating growers, who also shared their experiences using DZT in numerous crop families and under differing soil conditions. RT Twilight Meeting (November 10, 2010) An on-farm field day about reduced tillage was held 2010 on Long Island. The site selected for this meeting was a farm where the farmer has been using reduced tillage to grow pumpkins for about 15 years. The reason for the switch from conventional tillage was concern about Phytophthora blight. This farmer specializes in Halloween pumpkins and perennial fruit (trees and brambles), thus there is little

opportunity for rotation. Pumpkins are grown every other year with sorghum sudangrass grown in rotation. The meeting activities included examining two soil pits and running their zone builder through the field (Figures 4 and 5). The soil pit revealed roots extending deeper into the soil than the farmer expected, and numerous worm holes. Unfortunately it was not realized until just before the meeting was held that the date selected for the meeting conflicted with another meeting (Farm Credit) that several farmers interested in reduced tillage were committed to attending. Six farmers attended the meeting. Two are project cooperators. Other Outreach The UMass Vegetable Program website receives ~165,000 hits annually. The site is currently undergoing a complete overhaul. The new site will include a section dedicated to reduced tillage. We will also include a grower forum in this section if there is sufficient interest. In addition, this project will be showcased on the UMass Extension IPM Facebook page, launching this winter. Both the Facebook page and the project section of the website will offer clear instructions on how interested growers can contact us for consultation, and will be updated regularly with project activities. Articles on Deep Zone Tillage and an invitation to the project were published in the Vegetable Notes newsletter on April 15 and September 16 (subscription base 1,023). We upgraded our Cornell reduced tillage website (http://www.hort.cornell.edu/reducedtillage) and added additional case studies, publications and presentations, to further disseminate information on these systems. The website gave us an opportunity to reach a wider audience. Updates on reduced tillage research and progress of our project are presented on this website. Future Events NEVBGA Annual Meeting We will be participating in a half-day session on reduced tillage at the New England Vegetable Growers Association meeting in Waltham, MA on January 29 2011. Expected attendance is 70 growers. Empire State Vegetable Expo Meeting, Syracuse, NY On January 27, 2011 at the Reduced Tillage Session, several presentations will highlight grower's progress thus far. A grower panel will discuss how they were introduced to zone tillage, their equipment, crops grown with zone tillage, fertility management and modifications they have made over time. They also will give tips for 'new' reduced tillage growers. Expected attendance is 100 growers. Milestone 2: 100 growers will request additional information on reduced tillage practices for their farms. In each year, these requests will come between June and October, after summer field days, and again between December and March, after winter workshops. Ongoing Followup & Recruitment We use our mailing list extensively to provide information to growers in the form of newsletter articles and updates about meetings and events in MA and NY. Growers who have expressed interest in DZT by attending a meeting or responding to one of our project announcements are given the opportunity to subscribe to the list; our subscription base has grown roughly 10% over this growing season. Growers who are interested in experimenting with the system are offered support in the way of farm visits and phone consultation, as well as the use of our equipment, access to reference materials, and probably most importantly, access to our growing network of grower-collaborators. We are currently scheduling conference calls with growers who have expressed interest in experimenting on their own farms in the 2011 season. Of the seven growers who have expressed interest in using DZT on their farms for the first time in 2011, four have firmly committed and will be using equipment provided by UMass. In return, these growers will allow us to document and evaluate their experiences with the system and participate in educational outreach to other interested growers. In addition, we are in contact with one of the major equipment dealers in NY and MA (Padula Bros., Inc, Unverferth dealers in NY) to ensure that customers interested in purchasing DZT equipment know that there is technical support available through UMass and Cornell Extension. We are expanding this relationship to other equipment dealers. We have developed a tracking system for recording names and inquiries for follow-up and verification of adoption or testing of RT. We currently have seven farmers in MA outside of our initial 3 cooperating growers who are have started using DZT on their farm or are interested in experimenting with DZT in the coming season. In NY, we have We will be working with these growers to

both provide them with support and information generated by this project, and to use their experience to inform our work and ease the path for growers who are considering making the transition to DZT. Four farmers are already using reduced tillage to produce crops on Long Island. Phytophthora blight has routinely occurred on these farms in pumpkins and many other susceptible crops produced. Three growers have recently purchased Unverferth units. Two growers started using DZT in 2010. They grew pumpkins and sweet corn. Nine more growers expressed interest in using DZT at the Reduced Tillage Twilight Meeting in November. Milestone 3: Three discussion groups of farmers are formed (Western NY, Eastern NY/Long Island and MA) to review RT research results and growers innovations in RT systems. New-to-RT growers report greater confidence in implementation of RT systems on their farms. Meetings start in November 2010 and continue for duration of project. New members may be added each year. On February 11, we hosted a videoconference with four participating locations, titled “Planning the Transition to Reduced Tillage Systems: Equipment, Fertility and Weed Control.” Sixty people attended including 46 growers, 6 Cornell Cooperative Extension Educators, 3 Cornell staff, 4 Cornell Faculty and one University of Vermont Extension Educator. Attendance may have been higher with better weather on this day. The program included the following presentations on Incorporating Cover Crops into Reduced Tillage Systems; Setting Up a Reduced Tillage Trial on Your Farm; Equipment Options: A Quick Overview- ; Deep-Placed Nitrogen Experiences; Equipment for Liquid Fertilizer Application; Weed Management in Reduced Tillage Systems; and Disease Management in Reduced Tillage Systems. Two growers described their fertilization programs for vegetables on their farms. The videoconference included time for discussions among participants at each location. Three locations had experienced reduced tillage growers present to share their experiences. This event was very successful. Planter clinic were held in three regions of NY in February following the videoconference. These hands-on clinics emphasized how to make your planter work optimally. Eighty-seven people attended the planter clinics. Education materials from these meetings were posted on our RT website. In February of 2011, we will repeat the videoconference format, expanding our attendees to MA. This will initiate the grower discussion groups. Six locations will be linked via videoconference, and we are targeting 10-12 growers per location. We will target both experienced and newly interested DZT growers. The primary purpose of the meetings will be to review RT research results and growers innovations in RT systems and to provide new growers with an opportunity to benefit from the experience of Extension researchers and other experienced growers. We will also solicit feedback on the most effective ways to facilitate communication and the exchange of information and ideas between interested and experienced growers and extension staff. Growers testing RT systems Grower 1 and his family have been farming in NY since 1969. A large portion of their farm is devoted to growing U-pick pumpkins and strawberries. They have tried growing pumpkins with conventional tillage and no-till system. He is interested in trying DZT tillage but has not had access to the equipment. In 2010, he used an Unverferth unit on a field with heavy sod. He had difficulties killing the sod with herbicides due to cool spring weather. The unit did not make an adequate seed bed when ripping through sod. He is planning to use a field with a cover crop for pumpkins grown using DZT next season. He also plans to apply herbicide at least one week earlier this time. He learned that planning ahead for reduced tillage is important. Grower 2 is a small organic farmer with two acres devoted to vegetables in NY. She is considering DZT to save trips across the field, conserve organic matter and reduce soil erosion. In 2010, she used the Cornell Demo unit at her farm. She found that killing a cover crop in an organic system is difficult. The unit did not make an adequate seed bed when ripping through sod. She also found that a smaller unit may be more suitable for her operation. Grower 3 farms 35 acres of mixed vegetables, including sweet corn, potatoes, tomatoes, eggplant, cucurbits, cole crops, and peppers in NY. He had wanted to try zone tillage but was unable to find a small unit to test from a dealer. All that dealers had available were 4 and 6-row units, requiring much higher horsepower than his farm

tractor. He borrowed the Cornell 2 row Unverferth in the spring of 2010 and tested deep zone tillage on 2 acres of soil. He planted sweet corn, beans cucumbers and planned to test cole crops and garlic later in the season (Figure 6). He sees this tool as fitting into his field preparation on his multiple soil types. He plans to buy his own unit next year. Grower 4 grows many vegetables on his farm in NY. He is interested in saving organic matter, reduce compaction, improve drainage and save time/money by using DZT. He has fields with wet spots that could be improved with DZT. Rich thinks at some point in time he could save time with field preparation. He really likes the whole concept of reduced tillage system for producing his crops. In 2010, he put one field of late sweet corn into our split-field trials. DZT and conventionally tilled plots had similar total yields. Rich plans to plant another crop in this field next season. We plan to continue our on-farm paired comparison trials between deep zone and conventional tillage at this location. Grower 5 and his family grow vegetables, U-pick fruits and grain in NY. Mike grew 5.5 acres of vegetables with DZT this year. He grew sweet corn, pumpkins and winter squash with DZT. He feels he was able to get his crops planted in a timelier manner. He would like to add fertilize as he rips the rows. Grower 6 is an organic vegetable and grain grower in NY. He has six acres of organic vegetables. In the past, he has been moldboard and chisel plowing. He is concerned with improving nitrogen conservation, drainage and drought tolerance of his soils. He learned about reduced tillage through Cornell Cooperative Extension meetings last winter. He grew sweet corn, snap beans and broccoli using DZT. He felt his biggest challenge was weed control as he had difficulty cultivating in this system with his tools. He plans to increase his acreage of DZT vegetables next year. He thinks buying a DZT unit would be cost prohibitive for his size operation. Milestone 4: After learning of research and grower trial results about impacts of DZT on soil water and P. capsici, 20 growers work with the project team to plan small trials on their own farms each year, between March and May each year. Local equipment dealers or the research team create plans to move RT equipment among demo sites. As we received notice and funding for this project after most growers had finished their initial tillage, we did not directly support growers in deciding to use DZT in the 2010 growing season. However, as this project builds on work done previously by UMass, Cornell, and Connecticut extension, we do have a number of growers who tried the system for the first time in 2010 as a result of previous exposure through extension sponsored events and meetings. We are documenting the experience these growers had in their initial season, and will be supporting them through farm visits and access to the collective experience of our growing network of DZT growers via discussion groups and meetings. Grower 7 in MA. He began using DZT in 2010 after hearing about it at the NEVBGA meeting in Manchester, NH. He was impressed by what he heard from other growers and from Extension presenters. He used the system on over 30 Acres of sweet corn in 2010, as well as smaller acreage of carrots. In 2011 he plans to increase the acreage and expand the system to cucurbit crops. Many of his fields have a history of Phytophthora blight and he hopes that this system may mitigate losses to this disease. He feels that his crops in DZT fared better than the conventionally planted crops during the drought conditions that persisted for much of the 2010 growing season. He found that weed management and the timing around killing the cover crop were challenging in the DZT system, but that the benefits of the system in terms of decreased labor time and possible improved drought tolerance far outweighed these issues. We are supporting him by sharing the information from this project (both directly and through presentations at grower meetings) and bringing him into a discussion group with other DZT growers. Grower 8 in MA. He got interested in DZT after hearing a grower friend of his from NY talk about it. He attended a number of extension meetings and presentations on the subject, and borrowed two different zone builders from other local growers. He planted 3 acres of sweet corn with DZT in 2010 and was pleased with the results. He purchased a 4-row zone builder with help from the AEEP farm grant program, and plans on growing 50 acres of DZT sweet corn in 2011. He also grows pumpkins and other cucurbit crops, and may try the system in those crops as well. He has had problems with

Phytophthora rot in some of his fields and is interested in the potential of DZT to mitigate some of the risk from that disease. He is considering committing one or more of his fields to split-field trials starting in 2011. Four farmers on LI used reduced tillage to produce sweet corn. Information will be obtained about their experiences after the 2010 production season when they have time to discuss but some initial feedback has revealed that weed management was slightly challenging as well as cover crop management such as best way to kill. Milestone 5: Of the growers doing on-farm tests, 6 will be collaborators for in-depth research in years 1 and 2 to conduct on-farm paired comparison trials between deep zone and conventional tillage on two fields. These growers will have had a history of P. capsici and will examine transition to RT. Growers and team collect detailed yield, disease and economic/cost data to document changes in crop performance and profitability in P. capsici infested fields. Cooperating Grower Profiles Grower 9 in MA. He has been experimenting with zone tillage on his own since 2009. In 2010 he put three of his fields onto our split-field trials, all of which have some history of Phytophthora blight. Two of the fields were planted to butternut squash and one to sugar pumpkins. Soil health in all fields was ranked 'low' or 'very low' by the Cornell soil health tests with low organic matter, active carbon, aggregate stability, and extractable phosphorus as well as high subsurface hardness being the common constraining factors. He is very interested in seeing how deep zone tillage may affect changes in these metrics in comparison to conventional tillage, as well as any potential effects on losses to Phytophthora blight. Grower 10 in MA. He began experimenting with deep zone tillage in 2010 after seeing a demonstration of the equipment at the 2009 UMass Extension field day cemented his growing interest in the system. This was his first year using the system. He hopes that DZT will reduce the time it takes to prepare fields, improve the timing of planting, and help to rehabilitate some problem fields. He has two fields in the study; both are in an area with a long history of Phytophthora blight. In both fields soil health was ranked 'low' or 'very low' by the Cornell soil health tests with low organic matter, active carbon, aggregate stability, and extractable phosphorus as well as high subsurface hardness being the constraining common factors. Grower 11 in MA. This farm is a diversified fruit and vegetable farm in Sunderland, MA. Nine generations of this family have farmed here since the 1720's, and the grower continues that legacy by employing sustainable growing practices and implementing Integrated Pest Management to manage disease and insect pressure. He became interested in DZT after hearing about it at meetings and from other growers who were finding advantages to the system. In 2010 he put one of his fields into our split-field trial. This field was the only trial field that didn't rank as 'low' or 'very low' on the Cornell soil health test, scoring a medium. He is interested to see if using the DZT system will improve his soil health further, as well as possible benefits to yield and field preparation time. Each of the above growers has committed 1-3 fields to a three year trial (total of six fields). Each field is split between DZT and conventional tillage; the fields are otherwise treated identically in terms on fertility, pest management, and other production practices. Before tillage treatments were applied, a battery of tests was run including infiltrometer and penetrometer readings and Cornell Soil Health tests. These serve as our baseline measurements. After the treatments were established and the crops planted, the infiltrometer readings were repeated in each treatment area, as well as sampling above-ground crop biomass and crop emergence. There were no discernible difference between emergence and biomass in any of our fields, but there were some interesting trends in the soil data and the yield in on-farm experiments. Please see attached summary for examples of the data generated over the 2010 growing season. Grower 12 in NY. He considered changing to reduced tillage system due to low organic matter, low water holding capacity, crusting and compaction of his soils. Increasing losses due to diseases was another reason why Lynn wanted to try reduced tillage. He had a serious problem with Phytophthora capsici in 2004 which led to significant losses in his pepper and tomato crops. Since Phytophthora is water borne infection, a poor soil drainage condition will favor a rapid spread of this pathogen. He started experimenting with DZT

in 2004. He hopes that with deep ripping, zone tillage, and the use of resistant varieties, he may be able to prevent a future outbreak of this disease in his farm. Recently, he purchased a two row ripper with zone tillage finishing attachments. In 2010, he put one field into our split-field trials, which had a history of Phytophthora blight. The trial was conducted in a commercial field of pumpkins on 1.1 acres. Plants in the trial were rated for disease incidence and severity on July 15, 29, and September 10, 2010. There was no evidence of disease on July 15th. However, by September 10th the field was nearly a total loss due to the disease. In the conventional tilled section of the field most plants displayed symptoms of the disease while in the reduced tilled section more than half of the plants had died, and the remains had blown away. In addition, there was heavy weed pressure in the reduced tillage section. He has been looking for solutions to overcoming their heavy losses due to high populations of Phytophthora capsici. Because of such heavy disease pressure it may take more than one season to be able to determine if reduced tillage is assisting in reducing the population of this pathogen. Grower 13 in NY. This grower is interested in saving organic matter, reduce compaction, improve drainage and save time/money by using DZT. He has fields with wet spots that could be improved with DZT. He thinks he could save time with field preparation. He really likes the whole concept of reduced tillage system for producing his crops. In 2010, he put one field of late sweet corn into our split-field trials. DZT and conventionally tilled plots had similar total yields. He plans to plant another crop in this field next season. We plan to continue our on-farm paired comparison trials between deep zone and conventional tillage at this location. On-farm trials were conducted at three farms on Long Island in 2010. Sweet corn and pumpkins were grown in these fields. Symptoms of Phytophthora blight were not observed in any of the fields with pumpkins that were monitored for this project. Conditions in 2010 were hot and dry and thus were not highly favorable for this disease. However, at two of the farms blight did develop in a low area in another field that was not part of the study. University of Massachusetts On Station experiments: In addition to the six grower fields, a long term small plot trial was established at the UMass Crops Research & Education Center. These two treatments, DZT and conventional were replicated four times. In addition to the metrics above, we also installed moisture sensors at 6” and 9” in three of these plots. These sensors read the soil moisture at those depths every 30 minutes, allowing us to closely track the soil water dynamics in the two systems. Due to unusually dry weather, none of the experimental fields showed signs of Phytophthora blight. Soil tension measurements were made with a watermark soil moisture sensor and a watchdog 1000 series data logger, and recorded every half hour from July 28th to September 7th 2010 (Figure 7). Soil tension responded to precipitation events as would be expected. Location of the sensors produced considerable variation, so that while it appears that the deep zone tillage plots held more moisture (lower soil tension) than the conventional tillage plots, the standard deviations indicate that the differences are not statistically significant. Graphs of the individual measuring units (data not shown) indicate that one Deep Zone Tillage (DZT) sensor more closely paralleled the conventional tillage sensors than the other 3 DZT sensors. As the DZT treatments are offset in successive years this should not continue to occur. The differences in soil tension measurements in early August were similar to the visual differences shown in Figures 8 and 9. These photographs were taken at the South Deerfield station prior to the Agronomy Field Day (August 10, 2010). Corn planted by deep zone tillage in early June. Notice the distinct tillage markings (red circle) and the darker soil color at depth, indicating moister soil beginning at a 4” depth. Infiltration rates were measured in all plots using a Guelph Permeameter (Soil Moisture Equipment Corporation, Santa Barbara, CA) following manufacturer’s directions. The depth for measurements was established using a penetrometer to identify any potential plow pan present. Figure 10 shows that there was an increase in infiltration rate for 3 of the 4 deep zone tillage plots from pretreatment to post harvest. The conventional tillage plots all showed a decline in infiltration rate. Bulk density measurements were made by the core method (Blake and Hartge, 1986).

Figure 11 shows that there were no significant bulk density differences in the Massachusetts fields prior to tillage treatment, thus any differences, which develop, will be from the tillage treatments. Soil moisture content at field capacity (.3 bars or 30 kPa) and permanent wilting point (15 bar or 1500 kPa) was measured using a pressure plate apparatus (Soil Moisture Equipment Corporation, Santa Barbara, CA) following manufacturer's directions. All Massachusetts sites are included in Figure 12, which demonstrates that there were no statistical differences in water holding capacity between the deep zone tillage fields and the conventional fields at the start of the study. Thus any differences that develop during the course of the 3-year study will be attributable to the tillage treatments. Figure 13 shows the water holding capacity of the four plots at the South Deerfield research station used in this study. References: Blake, G.R. and K.H. Hartge. 1986. Bulk density. In Klute, A. (ed.) Methods of soil analysis, part 1, Physical and mineralogical methods (2nd. edition). Agronomy 9, Am. Soc. Agron., Madison, WI On-farm trials were conducted at three farms on Long Island in 2010. Sweet corn and pumpkins were grown in these fields. Symptoms of Phytophthora blight were not observed in any of the fields with pumpkins that were monitored for this project. Conditions in 2010 were hot and dry and thus were not highly favorable for this disease. However, at two of the farms blight did develop in a low area in another field that was not part of the study. Results from replicated on-station trials Long Term Conventional RT Experiment. (Freeville, NY) This two acre experiment was set up in 2004 under our previous NESARE grant, to examine three tillage systems (conventional, shallow zone tillage and deep zone tillage), three weed control strategies (conventional, banded herbicides, no in-season herbicides) and two direct seeded crops (sweet corn, dry beans, or winter squash). An Unverferth Zone Builder (Figure 14) was used to establish all deep zone tilled areas. In 2010, sweet corn cv. 'Temptation' was grown with three fertilizer rates (0, 120, 180 lb N/A) placed either deep as a liquid or dry sidedressed in the three tillage systems (DZT, ZT, plowed) established in 2004. The full amount of N was placed 8" deep, via a tube mounted on the back of the shank of the zone builder. Starter fertilizer was applied to all plots at planting. Deep placed liquid N (UAN) and conventional dry fertilizer N were compared for impacts on growth, yield and tip fill. A few ZT plots had areas with poor stands due to high residue in the seeding zone. While there was no effect of tillage and type of fertilizer on the yield of sweet corn, rate of fertilizer did affect sweet corn yield significantly. As expected, plots with starter fertilizer only produced fewer tons per acre (23%) than other treatments. In conclusion, all tillage treatments produced similar yields with dry and liquid fertilizer with 120 and 180 lbs N/A (Figures 15 and 16). Organic RT experiments (Freeville, NY) An organic reduced tillage system experiment was established in 2007 at the Freeville Organic Research Farm. Conventional tillage was compared with deep zone tillage. Three cover crop/mulch combinations (Rye/vetch mow killed, oat/pea winter killed, oat/pea winter killed plus spring applied straw mulch) were used with both tillage systems. Two levels of soil disturbance from weed management (High and Low) were then applied to these plots. The treated areas were identical over all three years in this field. In 2010, peppers cv. 'Ace' were transplanted into the treated areas. Management of the organic RT system with hairy vetch/rye killed cover crop was challenging for several reasons. This cover crop was chosen because of the high amount of biomass it can produce, the potential for weed control from the cereal rye and the nitrogen contribution of the hairy vetch. While this mulch was flail mowed prior to zone building, there were some plants that re-grew after mowing. This was due to having a rear mounted flail and tractor tires laying down some of the cover crop, so it was not mowed. In some cases, the re-growth of rye interfered with cultivation and with plant growth. Peppers in oat/pea winter killed plus spring applied straw mulch plots were devastated by Bacterial Leaf Spot. Plants grown in DZT rye plots were significantly smaller on the first sample date (19DAT). Oat pea plots (DZT and conventional) and RV conventionally tilled produced the highest yields in the experiment (Table 1 and Figure 17). Total marketable yields were similar in oat pea and oat pea mulched plots regardless of tillage treatment. Mulch

in the Oat pea mulch plots seemed to aggravate the Bacterial Leaf Spot resulting in very low yields. Plots with rye vetch cover crop and were DZT produced fifty percent fewer fruit compared with tilling under the rye vetch. Evaluation of Reduced Tillage Production System for Sweet Corn Long Island Horticultural Research and Extension Center A replicated experiment was conducted to compare sweet corn grown under a reduced tillage system with sweet corn grown using conventional tillage in a research field that has only been used to study reduced tillage since 2004. This experiment was conducted in the north half of the field with another experiment on pumpkin conducted in the south half. The cover crop in this field was fall-seeded rye. The conventional-till plots were established by mowing the cover crop, removing extra straw, then rototilling and disking to prepare the soil for planting. In the reduced-till plots the cover crop was rolled with a coulter packer then sprayed with the herbicide Round-up, next a 2-row Unverferth zone builder was used to establish the rows. In late June sweet corn was direct-seeded into all rows with 400 lb/A 24-10-10 controlled release fertilizer. Plots were six approximately 150-ft-long rows at 34-in spacing. Herbicide was applied immediately after seeding, and then the field was irrigated. Aatrex Nine-O (1.1 pt/A) plus Prowl (2 pt/A) with crop oil concentrate was used. Over-head irrigation was used as needed based on rainfall. Plant height and biomass measurements were taken 26 July, and yield was measured at maturity. Soil health measurements including infiltration and penetration were taken. Plant growth was significantly greater in the reduced-till plots than the conventional-till plots (Table 2). Plant weight was numerically greater for the above ground portion (leaves and stalks), and significantly higher for the roots. Although plant growth was improved with reduced tillage, there was not a significant difference in yield between the two tillage practices. Ear length and diameter were similar among the tillage practices but brix levels, or the % sugar, of the ears were significantly greater in conventional tillage plots. Evaluation of Reduced Tillage Production System for Pumpkin Long Island Horticultural Research and Extension Center A replicated experiment was conducted to compare pumpkin grown under a reduced tillage system with pumpkin grown using conventional tillage in a research field that has only been used to study reduced tillage since 2004. This experiment was conducted in the south half of the field with another experiment on sweet corn conducted in the north half. The cover crop in this field was fall-seeded rye. The conventional-till plots were established by mowing the cover crop, removing extra straw, then rototilling and disking to prepare the soil for planting. In the reduced-till plots the cover crop was rolled with a coulter packer then sprayed with the herbicide Round-up, next a 2-row Unverferth zone builder was used to establish the rows. In late June pumpkin was direct-seeded into all rows with 800 lb/A 11-11-12 controlled release fertilizer. Plots were three approximately 150-ft-long rows at 68-in spacing. Herbicide was applied immediately after seeding, and then the field was irrigated. Strategy (3 pt/A) plus Sandea (0.5 oz/A) plus RoundUp WeatherMAX (32 oz/A) was used. Weed control in the pumpkins during the season was accomplished by using a hand-operated rototiller in the conventional-till plots and a hand-operated sickle-bar mower in the reduced-till plots in late July. Over-head irrigation was used during the season as needed based on rainfall. Fungicides and insecticides were applied for bacterial leaf spot, powdery mildew, downy mildew, Phytophthora blight and cucumber beetle. Plant height and biomass measurements were taken during the season, and yield was measured at maturity. Reduced tilled plots produced significantly more weight than conventionally tilled plots (Table 3). Soil health measurements including infiltration and penetration were taken. Evaluation of Reduced Tillage Production System for Fall Brassicas Long Island Horticultural Research and Extension Center The primary goals of this multi-year experiment are to investigate changes in soil health and compare crop growth during the first years of implementing reduced tillage practices. Before 2010 the field was plowed and conventionally tilled every year. A spring cover crop of triticale was seeded in late April after disking in 10-20-10 fertilizer at 500 lb/A. Limited growth occurred under the hot, dry summer weather. The cover crop was mowed in mid-August. The conventional-till plots were rototilled and disked to prepare

the soil for planting. A 2-row Unverferth zone builder was used to prepare the rows in the reduced-till plots. Weeds were controlled by applying Goal 2XL (2 pt/A) plus Devrinol (2 lb/A). A vacuum seeder was used to apply 700 lb/A of controlled release fertilizer in a band right next to the transplant row in all plots, and then a waterwheel transplanter was used to plant the rows. Each plot consisted of four rows each planted to a different cruciferous crop type at 18-in plant spacing and 34-in row spacing. Soil health measurements including infiltration and penetration were taken. Soil moisture was monitored at 4, 8 and 12 inch depths. Plants were sampled in October (5 plants/rep) and November (4 plants/rep) to determine plant growth (Table 4). Milestone 6: Working with research results and feedback from grower trials, the farmer discussion groups and project team collaborate to define recommended practices and profiles for reduced tillage to improve water management and reduce disease development. Participating farmers expand RT use to additional fields and crops. While the project is still very much in its beginning phases, we have already noticed an uptick in the interest from growers. We have had numerous requests for the use of UMass and Cornell DZT equipment for the 2011 growing season. The DZT presentation at the UMass Crops, Research, & Education field day was the most well attended session of the day and commentary on the exit survey was overwhelmingly positive. The UMASS team was invited by the New England Vegetable Growers Association to present a session on our DZT work at their annual meeting in January. The Cornell team has a DZT session planned at the Empire State Fruit and Vegetable Expo in January 2011 that includes a grower panel discussion. One of our participating growers shared his expertise at a presentation on DZT during the New York Fruit and Vegetable Expo, and has loaned equipment to other interested growers that are now considering participating in on-farm trials in 2011. The level of grower interest in these systems is high and still growing and we look forward not only to providing research based information but to facilitating the farmer to farmer exchange of practical information and skills.

Impacts and Contributions/Outcomes

UMass Field Days (August 11 and 24, 2010) The majority of attendees who responded to an exit survey indicated positive changes in knowledge (87.5%) and an increased likelihood of changing their own farming systems to include deep zone tillage (88.24%). Comments from the exit surveys were positive - “Great demo! Lots of useful information”, “Super interesting!”, “Deep Zone Tillage was the best – very informative”. All of the attendees who filled out an exit survey at the grower field day indicated a positive change in knowledge, and two of the attendees signed up to experiment with DZT in 2011 using UMass equipment. Grower Feedback Grower1 is planning to use a field with a cover crop for pumpkins grown using DZT next season. He also plans to apply herbicide at least one week earlier this time. He learned that planning ahead for reduced tillage is important. Grower 5 feels he was able to get his crops planted in a timelier manner. Mike was able to get on the ground with DZT that he would have lost a week or more with if it was conventionally tilled. He plans to try DZT on his heavier soils and double his acreage using DZT in 2011. Mike would like to develop a tool to incorporate liquid fertilizer as a sidedress for two rows of vegetables. He is considering growing strawberries with DZT next year as well. Grower 10 in MA hopes that DZT will reduce the time it takes to prepare fields, improve the timing of planting, and help to rehabilitate some problem fields Grower 12 has been incorporating reduced tillage at his farm for the last few years. Over the course of this growing season six contact trips were made to his farm. Lynn has demonstrated commitment to these trials by discussing protocols, providing equipment and labor, and planting of requested crops. Two small growers in NY feel that adopting DZT as a system is desirable but the equipment is either too large or expensive. We are investigating adapting a Yeoman plow to DZT. It requires less horsepower and may be more cost effective for small growers. Number of farmers wanting to trials next year We have had

many inquiries from growers about trying DZT on their farms for 2011. As of December, we have commitments from thirty one growers to have side by side comparison trials. University experiments in 2010 University of Massachusetts On Station experiments did not show differences attributed to tillage. Due to unusually dry weather, none of the experimental fields showed signs of Phytophthora blight. In an Organic RT experiment, (Freeville, NY) we saw that having rye vetch on the surface (not plowed) gave lower yields. Plowing the rye vetch under gave yields similar to oat pea plots (DZT or conventional). Similar yields of sweet corn were produced with DZT, conventional and zone tillage with 120 and 180 lbs N/A in the Long Term Conventional RT Experiment (Freeville, NY). At Long Island Horticultural Research and Extension Center sweet corn, pumpkins and brassicas were grown using DZT. Sweet corn and brassicas produced similar yields in the conventional and DZT tilled plots. DZT plots produced more pounds of pumpkins compared to conventionally tilled. We did not anticipated interest from small grain growers in New York and Vermont extension educators. Small grain growers attended the Reduced Tillage Videoconference and planter clinics. It is likely we will have more grain growers attend our DZT programs in 2011.

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Attachments:

Figures and Photos: http://mysare.sare.org/mySARE/assocfiles/927390Figures for SARE Report 2010.pdf
Tables: http://mysare.sare.org/mySARE/assocfiles/927390Tables for SARE Report 2010.pdf

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