Northern NY Agricultural Development Program
2014 Project Report

Evaluating Crop Establishment and Future Needs of NNY Vegetable Growers

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- Amy Ivy, CCE Essex and Clinton Counties
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Cooperating Producers:
1. Doug Lamoy, Lamoy's Produce – Clinton County
2. Beth Spaugh, Rehoboth Homestead – Clinton County
3. Melissa Monty-Provost, Country Dreams Farm – Clinton County
4. Tom Tucker, Tucker Farms – Clinton County
5. Dan Kent, Kent Family Growers – St. Lawrence County

Background:
Healthy soils are the basis for good crop productivity. Soil health in vegetable systems is, however, prone to decline as growers push early planting and harvest late into the fall when soils are wet, increasing soil compaction and limiting cover cropping. Reduced tillage (RT) systems, such as deep zone tillage, have been shown to improve soil quality and reduce fuel use and labor hours while maintaining vegetable yields for several crops when tested in other parts of NY. In a survey of RT growers in NY, over 90% reported reduction in soil compaction, labor hours, and fuel consumption. Growers also report the greater flexibility afforded early in the season. All of these factors have significant impact on farm profitability.

Similarly, the advantages of plasticulture have been shown in other regions of the state with intensive vegetable production. However, adoption of this field-based risk management strategy has not been as widespread among fresh market growers in NNY.

A plasticulture system that integrates drip irrigation includes improvements in water and nutrient efficiency, earliness, improved weed control, greater crop quality and yields.

Greater adoption of these two crop establishment practices could reduce grower risks to climate fluctuations and increase farm profitability. In 2014, we continued our work to facilitate grower adoption of reduced tillage systems for vegetables and we expanded our efforts to engage others that have expressed interest in plastic mulches and drip irrigation. We offered 4 grower workshops, 5 targeted on-farm demonstrations and 2 on-station research trials while facilitating equipment sharing to increase grower knowledge and capacity to adopt improved soil and crop management practices.

Methods:

Grower Trials

Cornell Cooperative Extension collaborators identified growers interested in conducting on-farm trials (Clinton and St. Lawrence counties) in late winter 2014 to consider fields, crops and management considerations. Considering the challenges and logistics of equipment sharing, we chose to concentrate our reduced tillage on-farm trials in Eastern NNY and transported our unit to 5 farms based on grower needs. Peter Hagar, CCE Clinton, transported and maintained the unit, and provided on-farm technical advice in equipment adjustment and unit operation with individual growers. We provided a custom-built unit with lightweight tool bar, two Yeoman's shanks mounted for deep ripping beneath planting rows, and discs and finishing baskets for seedbed preparation. This same deep zone tillage unit was used at the Willsboro Research Farm to establish research trials in sweet corn and pumpkins.

Our plasticulture on-farm trial and demonstration was focused to St. Lawrence County. We provided a RainFlo bedding mulch layer to interested farmer collaborators to establish on-farm trials. Brent Buchanan, CCE St. Lawrence, supported one grower in trialing the mulch layer across various crops but a late, wet, cold spring reduced the number of growers we could coordinate with for on-farm trials. Our efforts were then focused on establishing a demonstration at the CCE St. Lawrence Extension Learning Farm for subsequent field days.

On-Station Reduced Tillage Research Trials

Many RT growers in NY first transition to reduced tillage with large seeded vegetable crops to overcome the management challenges associated with not preparing a fine seed bed. In our trials, we established two experiments, sweet corn and pumpkins, to compare the effects of deep zone and conventional tillage on crop quality and yield.

Evaluating tillage and nitrogen rate in sweet corn

This experiment compared deep zone and conventional tillage in sweet corn at two locations: the Willsboro Research Farm in Willsboro, NY, and the Miner Agricultural Research Institute in Chazy, NY. At both locations, sweet corn cultivars (Montauk and Temptation) were split into a low and high side-dressed nitrogen fertilizer rate, 60 and 120 lbs N per acre. The experiment was established with four replicates of each treatment combination (tillage-cultivar-nitrogen rate) in a split-split plot design.

In Willsboro, deep zone and conventional tillage treatments were both applied in the spring in a Cosad sandy loam soil. At the Chazy location, conventional and deep zone tillage treatments were fall applied in Raynham silt loam soils. An additional spring deep zone tillage treatment was included for comparison (May 12). Sweet corn cultivars, Montauk F1 (79 days, Harris) and Temptation (72 days, Stokes), were planted at 26,000 plants per acre with 250 lbs per acre 6-24-24 starter fertilizer at 30 inch row spacing (June 9 Willsboro, June 23 Chazy). Stands were thinned to 20,900 plants per acre and plantings were sidedressed with liquid UAN (July 7, Willsboro and July 25, Chazy). Corn was harvested at cultivar maturity (Temptation, Aug 25-26 in Willsboro and Sept 10 in Chazy; Montauk, Sept 5 in Willsboro and Sept 17 in Chazy) and weighed for total unhusked yield weight. Harvested ears were subsampled and husked for measurements of length (in) and proportion of ear filled (%). Yields were expressed as tons acre^{-1} fresh unhusked yield.

Comparing deep zone and conventional tillage in pumpkins
This experiment compared three pumpkin cultivars planted with deep zone and conventional tillage at the Willsboro Research Farm in Willsboro, NY. Deep zone and conventional (moldboard) tillage treatments were applied in spring. Four replicates of each treatment combination (tillage-cultivar) in a split plot design. Three pumpkin cultivars (Super Herc, Gladiator, and Summit) were each seeded in the greenhouse (May 13) and plants were transplanted at 3,485 plants per acre at 3 ft in-row spacing and 5 ft between-row spacing (June 1). The planting was sidedressed by hand four weeks after planting with calcium nitrate, 27-0-0, at a rate of 120lbs N per acre prior to plant vine-out (July 3).

Pumpkins were harvested for marketable yields and graded based on uniformity, diameter, and color (Sept 22). Yields were expressed as tons acre^{-1} and mean pumpkin weight based on marketable fruit counts. A soil penetrometer was used to measure resistance (depth to 300 psi) as an indicator of subsoil compaction (Sept 23).

Results:

2014 Willsboro and Chazy Research Trials

Pumpkins
Tillage had no effect on marketable fruit yield or average pumpkin weight (Table 1). Averaged across cultivars, conventional tillage yielded 34.6 tons per acre compared to 38.9 tons per acre in deep zone tillage. As expected, Gladiator fruits were 30% smaller than both Super Herc and Summit cultivars but these differences in fruit size were not reflected in lower crop yields. In both tillage treatments, the depth to subsoil compaction was similar (14 in) as measured by soil penetrometer resistance above 300 psi.

Sweet Corn
In Willsboro, tillage did not have a significant effect on unhusked corn yield (Table 2). Unhusked fresh corn yield averaged 9.4 tons per acre in conventional and 9.9 tons per acre with deep zone tillage. Similarly, there were no differences in corn ear length and the proportion of ear filled. There were no interactions among tillage, nitrogen rate, and

cultivar. A high side-dressed nitrogen rate (120 lbs N/acre) did not increase yield when compared to a lower rate (60 lbs N/acre). There was no difference in yields when comparing Montauk (9.9 tons/acre) and Temptation (9.4 tons/acre) cultivars.

Similarly, tillage treatments did not have a significant effect on unhusked corn yield, ear length, or proportion of ear filled at the Chazy location (Table 3). Fall deep zone tillage (6.1 tons per acre) averaged 10% less than either fall conventional tillage (7.0 tons per acre) or spring deep zone tillage (6.9 tons/acre) but this difference was not significant. Nitrogen rate and cultivar also had no effect on yield or quality. There was no significant yield response to added nitrogen across tillage and cultivar. Regardless of site-level differences in yield (9.7 tons/acre in Willsboro, 6.7 tons/acre in Chazy), tillage, nitrogen rate and cultivar had no effect on yield at either location.

On-farm trials

Extension collaborators coordinated the sharing of the zone tillage and mulch layer units among growers throughout the growing season. Weather conditions and planting schedules have always created management challenges for equipment sharing, but interested growers' were able to trial the equipment in varying capacities. As we have found in our earlier work with zone tillage, the primary obstacles were coordinating the delivery of the implement at the time of grower need and ensuring growers had the tractor capacity to operate the zone builder. Although this unit was designed for less horsepower (30 HP per shank with 4WD), our small growers could not operate the equipment with their own tractor. In some cases, an additional level of coordination was required to borrow a tractor from a neighbor.

Zone-till sweet corn and tomatoes

Doug Lamoy farms 50 crop acres, including sweet corn, tomatoes, cucumbers, squash and cabbage. He had never used trial zone tillage but had an interest in reducing compaction and increasing drainage capacity on the farm. The zone till unit was trialed in both his sweet corn and tomato crops. It was difficult to observe the effect of zone tillage on field drainage, mainly because of last year's exceedingly wet conditions. He found it challenging to handle the different spacing between the zone-till unit and his own planter.

Zone-till to reduce compaction

Beth Spaugh manages 3.5 crop acres with her primary vegetable crops including tomatoes, peppers, cabbage, broccoli, and greens. She had tried zone tillage in the past but found it difficult in her heavy soils and had concerns with managing weeds and irrigation. However, she recognizes that a plow pan has developed with repeated rototilling. She used the unit in the fall to break up subsoil compaction ahead of garlic planting. For her small operation, she needed to custom-hire a tractor. She is very interested in future management options with the zone tillage but the timing and coordination will remain complicated. She sees an opportunity to spread compost prior to using the zone builder as another way to amend and improve her soils.

Zone-till pumpkins

Melissa Monty-Provost manages 40 crop acres with pumpkins and other cucurbits as her primary vegetable crops and sees zone tillage as an opportunity to save labor and improve drainage on the farm. She used the unit for the first time to plant her pumpkin crop. It worked to till and make a seedbed for her pumpkins while and improving drainage, even on tiled ground. She would like to adopt zone-till practices in the future but sees the cost of equipment as a major barrier. She now has an interest in custom-building a unit for her farm.

Zone-till to improve drainage

Tom Tucker manages 400 crop acres, including potatoes, row crops, grains, and vegetables. He had never tried zone tillage and wanted to reduce compaction and improve drainage on the farm. He chose to use the unit mid-season, prior to establishing an oat cover crop, to break up subsoil compaction. He observed that drainage improved and fall rainfall events had better infiltration. However, it was a difficult to coordinate the delivery and he observed that the unit pulled up many rocks from the subsoil. In the future, he would consider adopting the practice with the goal of improving drainage and reducing compaction but the expense of an implement is too high and sharing is challenging with his own distance from other farms.

Plastic mulch in curcurbits

Dan Kent farms 117 acres of mixed vegetables and strawberries. He trialed the black plastic mulch layer in cucumbers and learned the difference a good machine can make. He bought an implement a couple years ago and it never worked right, so he felt plastic mulch was not the right direction. This year, after borrowing our unit, he found huge labor savings by not weeding in the mulch. The heat from the plastic brought early cucumbers and they reached maturity before powdery mildew arrived. This made a big difference, he got a much larger yield than in past years. After this year, he plans to expand the use of mulch across the farm, including strawberries, peppers, eggplant, tomatoes, and all cucurbits. He will continue to have access to our mulch layer for 2015.

Conclusions/Outcomes/Impacts:

This NNYADP project has facilitated grower experimentation with reduced tillage and plasticulture systems for improving soil health and farm profitability. Through research experiments, on-farm trials, and field days, growers were advised on the benefits of transitioning to these systems in various crops.

Our research trials showed that zone tillage has the potential to yield similar to conventional tillage in pumpkins and sweet corn and results from the Willsboro and Chazy trials will be combined with 2013 results and shared with growers through newsletters.

By making our equipment available for growers on their own operation and providing technical advice, this project reached growers managing over 600 acres and helped them consider new crop establishment and improved soil management practices that work for their own farm.

Several growers reported the benefit of using deep zone tillage for alleviating soil compaction and improving drainage on their farm.

Our mulch layer trial showed how plastic mulch can reduce weed pressure, improve plant health, increase yields, and improve farm profitability.

Demonstrations and workshops also showed field applications and appropriate equipment adjustments and allowed us to share expertise on zone-till and plasticulture systems with more than 100 growers in the region.

Outreach:

We held 4 educational grower meetings to discuss crop establishment strategies and the benefits of reduced tillage and plasticulture, and to demonstrate use of both the zone-till and plastic mulch layer units for growers.

In spring, we held a workshop on Optimizing an Intensive Vegetable Production System Using Drip Irrigation, Mulch Films and Covers (April 12, presented by Anu Rangarajan) at the CCE St. Lawrence County Extension Learning Farm. The workshop focused on irrigation systems and the use of pest excluding mulches including care, use, and adjustment of plastic-laying equipment. In a follow up workshop, we held an in-field demonstration of the plastic mulch layer at the Extension Learning Farm (July 29, presented by Anu Rangarajan) as part of a vegetable grower field day on leek moths, plasticulture and irrigation, cover crops between plasticulture rows and other relevant topics for local growers.

We hosted a grower meeting at the Willsboro Research Farm (July 28) to discuss reduced tillage, zone-till research trials, and show the custom unit. Anu Rangarajan presented to 24 attendees about the zone till research trials in sweet corn and pumpkins and discussed equipment application, set up, and adaptability for various crops. The program also included on-going vegetable production projects, including season extension and inter-row cover crops.

We offered a reduced tillage and zone-till systems presentation at the Soil Health Workshop in Chateaugay, NY (August 22, presented by Peter Hagar, CCE Clinton County). This event was attended by 60 farmers, crop advisors, and agency personnel and featured live demonstrations of conservation tillage equipment, soil health experts, a panel of farmers practicing different tillage methods and cover cropping, and highlights of local cost share opportunities and programs. Our workshop included a field demonstration of the zone-till unit in a recently harvested cereal rye field.

Next steps:

Many growers expressed interest in using a deep sub-soiler to reduce compaction and improve water management on their farm. We are considering the appropriate equipment for these growers and how to facilitate future equipment sharing.

Growers are also interested in learning about custom-built equipment that can be used for reducing tillage on smaller scales. We plan to develop a resource guide to share grower innovations in using custom-built equipment.

Given the diversity of crops grown among small vegetable growers and the lack of appropriate tractor horsepower, we also need to support other management systems that may work better for very small farms, e.g. permanent beds, intensive mulching.

We also see potential for increasing the adoption of plasticulture systems. Based upon the 2014 weather conditions, we were unable to implement the full set of on-farm experiments for the plastic mulch layer. However, our 2014 grower has already made plans to scale up his work with the unit for the coming year. The mulch layer and accompanying trailer will be available for St. Lawrence County extension to work with additional interested growers in 2015.

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For More Information:

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Tables:

Table 1. Marketable fruit yield and mean fruit weight for 3 pumpkin cultivars with conventional and deep zone tillage, Willsboro, NY

Tillage	Cultivar	Marketable Pumpkin Yield tons acre $^{-1}$		Mean Pumpkin Weight lbs per fruit	
Conventional	Gladiator	31.4	a	14.9	c
	Super Herc	34.7	a	23.3	ab
	Summit	37.8	a	20.0	b
Deep Zone	Gladiator	35.2	a	15.0	c
	Super Herc	39.5	a	25.2	a
	Summit	42.0	a	19.9	b

Values with same letter are not significantly different *P<0.05*

Table 2. Sweet corn yield and quality with conventional and deep zone tillage for 2 cultivars under low (60 lbs N per acre) and high N (120 lbs N per acre) fertility rates, Willsboro, NY

Tillage	Fertility	Fresh Unhusked Corn Yield	Corn Ear Length	Proportion of Ear Filled
		tons acre^{-1}	in	%
		Montauk		
Conventional	**Low**	10.8	8.21	0.92
Conventional	**High**	9.5	7.38	0.92
Deep Zone	**Low**	9.4	7.42	0.96
Deep Zone	**High**	10.0	7.40	0.96
		Temptation		
Conventional	**Low**	9.4	7.54	0.95
Conventional	**High**	7.8	6.70	0.97
Deep Zone	**Low**	10.5	7.52	0.96
Deep Zone	**High**	9.9	7.39	0.90

No significant differences among treatments at P<0.05

Table 3. Sweet corn yield and quality with fall-conventional, fall-deep zone, and spring-deep zone tillage for 2 cultivars under low (60 lbs N per acre) and high N (120 lbs N per acre) fertility rates, Chazy, NY

Tillage	Fertility	Fresh Unhusked Corn Yield	Corn Ear Length	Proportion of Ear Filled
		tons acre^{-1}	in	%
		Montauk		
Fall Conventional	**Low**	7.3	7.75	0.97
	High	7.7	7.55	0.98
Fall Deep Zone	**Low**	6.3	7.45	0.99
	High	6.2	7.50	0.99
Spring Deep Zone	**Low**	7.8	7.40	1.00
	High	6.9	7.55	0.99
		Temptation		
Fall Conventional	**Low**	6.4	6.23	0.96
	High	6.8	6.43	0.99
Fall Deep Zone	**Low**	5.8	6.80	0.98
	High	6.3	6.80	0.97
Spring Deep Zone	**Low**	6.1	6.45	0.94
	High	6.9	6.45	0.97

No significant differences among treatments at P<0.05