

## Roller Crimper No-till Processing Tomato Production



**Jack Rabin, 2013**  
Supported in part by NESARE

### **This project sought to answer grower questions, such as:**

- ❖ Can we grow processing tomatoes (or other main season vegetables) at competitive yields with reduced inputs and still build soil quality?
- ❖ Do cover crop residues increase marketable fruit quality by offering a barrier to reduce ground contact fruit defects and splash-disseminated diseases?
- ❖ Does the cover crop residue mat terminated by rolling suppress weeds sufficiently?
- ❖ Can we mechanically harvest without the cover crop residue fouling the harvester?

Sustainable farming practices aimed at building soil quality involve trade-offs between cash crops and extended cover crop fallow rotations; between herbicides vs. degrading soil tillth by mechanical weed tilling; and using mechanization vs. scale-limiting hand labor that is insufficient to satisfy farm livelihood and lifestyle goals. Whole field studies are hard to conduct while controlling all variables, which may bias results.



This evaluation compared roller crimper no-till vs. bare ground processing tomato production. It was supported in part by NESARE Grower Grant FNE11-733 to [First Field Ketchup Company](#) of Princeton, NJ owned by Terri Viggiano and Patrick Leger.

### **Materials Methods and Equipment**

Table 1 lists production practices and dates on roller crimper and bare ground adjacent tomato fields. The location was Rutgers Agricultural Research and Extension Center 305-acre farm, in fields supported for Sustainable Organic Alternatives Research (SOAR) by NESARE. Fields had been transitioned to organic in 2003 and Certified Organic under USDA NOP in 2006, but were not restricted to organic inputs in 2012. Soil organic matter tested 1.9 to 2.6% on gravelly sandy loam/Chillum silt loam and CEC meq varied from 5 to 7.

Dry composted poultry manure was applied in late summer 2011. In Sept., the field was disked, limed at 1 ½ t/a per acre, and prepared with an Unferverth minimum-till field cultivator pulling double rolling harrow baskets for one-pass seedbed. Cereal rye (Seedway Canada) was seeded on Sept. 22 at ~ 2 ¼ bu/a. with a Case IH 5300 grain drill. In 32 days a dense rye stand was established, outcompeting emerging winter annual weeds.

**Table 1. Dates, operations, and supplemental hand weeding performed in roller crimper and adjacent bare ground processing tomato field.**

Date & Crop Mgt. Activity	Roller crimper field	Bare ground field
Sept. 22 2011	Dry composted poultry manure applied June Seed rye cover crop @ 2 ¼ bu/a	
May 22 2012	Roller crimp rye followed by Roundup @ 1qt/a	
May 24		Flail mow rye disk incorporate
June 8		Field tillage
June 18		Disk tillage, preemergence Devrinol 50DF @ 3lb/a
June 18	Transplant Heinz H5108, 60 x 15 inch spacing, transplant water 100 ppm 20-20-20, set up drip irrigation	
June 20, 22, 27	Irrigation for 1-4 hr	
June 26	Bravo WS @ 1qt/a + Presidio 4SC @ 4 oz/a Protectant + translaminar late blight fungicides	
July 9, 16, 19, 23, Aug. 8	5-0-10 fertigation; 2, 1, 1.5, 1.5, 1.5 gals, respectively	
July 13	Bravo Weather Stik @ 1 qt/a; Voliam Xpress @ 9 oz/a 1 CPB defoliated plant/1,200 row ft observed	
July 5, 26	Irrigation for 1-4 hr	
July 16 Supplemental hand weeding time; species; assessment	~ 30 min/row = 22 hr/a; ivy leaf morning glory, smooth pigweed; easy removal but required bending	~ 43 min/row = 31 hr/a; ivy leaf morning glory, jimsonweed, lambsquarters, smooth pigweed; removal standing hoeing and bending
July 18		Cultivation tillage
July 19		Postemergence Matrix 25DF @ 1 oz/a + Metribuzin (Sencor) @ 8 oz/a
July 27, Aug 3	Bravo Weather Stik @ 24 oz/a + Quadris @ 15 oz + Kocide 3000 DF @ 1 lb/a	
July 30 Supplemental hand weeding time; species; assessment	~ 22.5 min/row = 16.4 hr/a; ivy leaf morning glory, smooth pigweed; easy removal but required bending	~ 3.3 min/row = 2.4 hr/a; ivy leaf morning glory; removal by hoeing;
Aug 8 Supplemental hand weeding time; species; assessment	~ 4 min/row = 2.9 hr/a; ivy leaf morning glory mow over rolled borders, minor hand weeding	Unnecessary
Aug 9, Sept. 6	Voliam Xpress @ 8 oz/a for CPB or Lepidoptera	
Aug 10, 17, 23, 30, Untreated strips	Bravo Weather Stik @ 24 oz/a + Quadris @ 15 oz + Kocide 3000 DF @ 1 lb/a	
Aug. 23, 27, 31	Irrigation for 1-4 hr	
Sept. 6, Untreated strips	Bravo Weather Stik @ 24 oz/a + Kocide 3000 DF @ 1 lb/a	
Sept. 25	Hand-harvest yield and foliar disease visual ratings	
Oct. 2	Mechanical harvest to determine if roller crimped rye residue fouled or interfered with mechanical harvest.	



No supplemental spring N application was made based on visual condition of the cover crop. There is a balance between adequate N for rye biomass and causing lodging problems at maturity. The rye was rolled on May 22 with an 8 ft roller crimper from I&J Mfg. weighing 1,400 lb. Filling the 16" cylinder with water added 75 lb per linear ft, for an operating weight of 2,000 lb. The roller crimper was rear 3-point hitched mounted and driven in reverse. We do not own a front 3-point hitch, and driving forward with the roller crimper rear-mounted reduces crimping termination efficacy when tractor tires push rye down before contact with the blades.

Rolling was followed by burndown herbicide application of Glyphosate at 1 qt/a to speed termination and kill emerged weeds. Rye biomass was not measured after termination, but was about 4-inches deep after one week. Visual estimate based on previous experiences were approximately 6,000 lb biomass/a.

HeinzSeed H5108 transplants were grown in standard 338-cell 13x26 inch trays by a local tomato grower. H5108 is an early maturing high yielding variety with good color for multi-use peel/products and extended field storage characteristics (EFS) recommended for Canada, US Midwest, and Australia/New Zealand. Transplanting took place on June 18 in roller crimped and bare ground fields using an RJ plug transplanter (RJ Equipment Ontario, CN). The single row planter was modified for no-till on a heavy toolbar 3-point hitch frame with an oversized front coulter blade to cut through residues and a double disk opener in front of the planter shoe. Residue fouling of the opener occurred during transplanting and further modifications would be needed for efficient use. 100 ppm 20-20-20 Peters Professional soluble fertilizer was added to transplant water. Drip irrigation lines and filter system with fertigation injector were installed and tomatoes watered as needed during the season. Bulk liquid fertilizer, 1:2 ratio N:K 5-0-10, was donated by Plant Food Co.



Three insecticide applications were made; the first after observing light Colorado potato beetle (CPB) defoliation. Infestations remained low. The other two applications might have been skipped, but were performed during routine maintenance sprays on neighboring tomato fields. Other studies indicate cover crop residues may present a physical barrier reducing the ability of overwintering CPB adults to initially find crop host.

There were many nearby commercial tomato and potato fields with risk of Late blight based on Northeast US experiences after the [Late Blight Pandemic of 2009](#). Not treating presented unacceptable risk to neighbors and our fields. Recommended fungicide treatments, which also suppress Alternaria Early blight and Anthracnose diseases, began on June 26. On Aug 3, we discontinued treating randomly assigned strips across both fields to rate differences in late season foliar or fruit disease.

## Results and Discussion

Table 2 provides hand-harvested yields from subplot sampling on Sept. 25. Table 4 compares yield performance in subplots where later season fungicide applications were maintained or discontinued.

**Table 2. Mean tomato yield in t/a, average of six hand-harvested 5-row feet subplots (25 ft<sup>2</sup>).**

	Roller crimped rye avg. tomato yield t/a	Bare ground avg. tomato yield t/a
Red	23.8	24.8
Mature green	19.9	15.3
Total healthy fruit	43.7	40.1
Percent red	54.4%	61.8%
Rots/culls	0.8	0.5

Divide by t/a yields by 0.87 to convert back to lb harvested per 25 ft<sup>2</sup>.

Mechanical harvest on Oct 2 with a Pik-Rite harvester with an on-board electronic eye color sorter assessed whether rye residues would foul harvester operations or sorting. The operation was successful. Rye residues did not bind the harvester cutting head, clog the vine shaker or trash separator, and did not leave significant residues on the sorter belt, as shown in image. One week additional maturity increased overall average red fruit yield to ~32 t/a (8,830 lb from 6,000 ft<sup>2</sup>).

Harvesting H5108 106-days after transplanting is late. The 2013 delay in maturity was due in part to a mid-summer heat wave causing split fruit set. As the crop appeared healthy, and we wanted to observe whether residues affected late season splash disseminated foliar or fruit diseases (Table 3), we let the field continue to mature, recovering a higher yield.



**Table 3. Foliar and fruit disease visual ratings on Sept. 25, 1 to 10 (worst to best), average of 3 maintenance treated and 3 untreated subplots (after Aug 3) subplot strips across fields.**

	Unsprayed after Aug 3, Mean rating	Maintenance Fungicide cont'd Aug 10 to Sept 6, Mean rating
Tomato roller crimped rye	7.2	7.5
Tomato bare ground	6.0	7.5

Leaf symptoms and fruit rots: Alternaria early blight, Late blight, bacterial spot, negligible Anthracnose

High yields were grown. While limited conclusions can be drawn from one season (random chance can produce results which appear beneficial), we were encouraged by the 7.2 visual disease ratings over cover crop residue vs. 6 on bare ground (Table 3). As expected, 7.5 disease ratings were the same on tomatoes receiving maintenance sprays from Aug 10 through Sept. 6. Overall disease pressure during the season was low, either from the season or these fields not having tomato production for many years. Long rotation time may have more impact on low disease pressure than the cover crop residue barrier. There may have been residual fungicide suppression from treatments ending on Aug 3 that bias ratings.

**Table 4. Separating yield from subplots where regular maintenance fungicide applications were discontinued after Aug. 3, or continued from Aug. 10 through Sept. 6.**

	Roller crimped rye avg. tomato yield t/a		Bare ground avg. tomato yield t/a	
Fruit harvest	Unsprayed after Aug 3	Maintenance spray cont'd	Unsprayed after Aug 3	Maintenance spray cont'd
Red	20.9	26.7	24.9	24.7
Green	19.7	20.2	13.7	16.9
Total healthy fruit	40.6	46.9	38.6	41.6
Percent red	51.5%	56.9%	64.5%	59.4%
Rots/culls	1.0	0.6	0.3	0.6

Divide by t/a yields by 0.87 to convert back to lb harvested per 25 ft<sup>2</sup>.

The dense cover crop residues in this trial adequately suppressed annual grasses, jimsonweed and common lambsquarters. The residue mat plus Glyphosate herbicide did not suppress two troublesome summer annuals: smooth pigweed and ivyleaf morning glory (shown at right 55-days after rolling on July 16).

We maintained an extremely low tolerance for weed pressure. From Table 1, a total of 41.3-hr/a supplemental hand weed removal, mostly bending labor (residues prevented standing hoeing) were used. Devrinol herbicide on bare ground did not control all jimonsweed and lambsquarters, involving 33.4-hr/a for removal mostly standing hand hoeing labor.

Farmers differ in their tolerance for weeds. But all recognize that weeds going to seed add to future weed seed banks; pressuring future labor costs upward and yields downward. Views differ on whether herbicides are needed with roller crimpers.

Roller crimpers were designed to enable organic farmers to practice no-till agriculture without herbicides. There are no OMRI approved products that aid terminating mature rye (Personal



Comm., Bill Curran, Penn State). Our previous field experiences were that roller crimping without non-selective burndown herbicide does not offer a sufficient critical weed free period for vegetable crops or season long weed suppression. Without a burndown herbicide speeding desiccation, evapotranspiration continues for about 3 weeks and may result in stand establishment moisture competition. If using burndown herbicide, reverse rolling may be unnecessary. While the roller crimper offers promise, there are no rescue weed control options and it should be used in combination with herbicides, not as an alternative.

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- ❖ Patrick Leger & Terri Viggiano of First Field, Mike Brooks for harvest operations, Katona Farms, Plant Food Co. liquid fertilizer, Frank Baitinger & Sons for transplants and pallet bins, Rutgers Food Innovation Center for processing fruit
- ❖ USDA-NRCS NJ: Fred Kelly and Chris Miller for roller crimper
- ❖ Volunteer weeding and field labor: Dave Rabin and Aaron Rabin
- ❖ Rutgers Cooperative Extension: Tom Orton, Ph.D. (Tomato Breeding), Andy Wyenandt, Ph.D. (Vegetable Pathology), Brad Majek (Weed Science); County Agents Michelle Infante-Casella and Meredith Melendez; NJAES farm staff Ed Castellari, June Sudal for irrigation and fertigation, Scott Hitchner, Jessie Smith for tractor operations
- ❖ Penn State: Bill Curran, Ph.D., Extension Specialist in Weed Science and graduate student Clair Keene for review suggestions.

## **Grower Assessment of Roller Crimper No-Till Processing Tomato**



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In February 2013, we shared project results with a group of 16 process tomato growers and 6 professionals (plant manager, tomato breeder, IPM consultant, field men, extension specialists). This stimulated a vigorous discussion of the findings, and what they mean to growers. The 16 growers represented 1,265 acres of production, harvesting 32,000 tons per year, producing 900,000 cases of packed tomato products\*. None of the growers previously heard of a roller crimper. The farm size of the growers varied from 120 acres to 4,200 acres.

Growers raised at least 8 factors about roller crimper use that sustainable farming professionals, researchers, and soil conservationists might rarely consider:

- 1) As roller crimper fields were not plowed, growers discussed whether roller crimped fields might be less prone to severe rutting when ‘mudding out crops.’ Due to extreme fall rain and variable weather events, growers are mudding tomatoes out of their fields with large mechanized harvesters and support vehicles. Sadly, this has become frequent. Growers reported this causes soil rutting and compaction in their fields, with long-term negative consequences on soil structure and yield. Additionally, clean harvested fruit have reduced fruit-soil abrasion and washing energy used at the plant, better for the grower and processor.
- 2) Growers asked, “Might this practice help conserve mid-summer soil root zone moisture in summer? Do we have any evidence or data? Growers are interested in reducing crop stress, reducing pollination abortion from drought and reducing blossom end rot (BER) abiotic disorders from calcium stress during dry-wet-dry weather variation during tomato development.
- 3) Growers had a lively discussion about the weed species *not* suppressed by the roller crimper mat in our field: annual ivy leaf morning glory and redroot pigweed. They nodded in agreement that these are well known, difficult to control weeds in tomato–vicious competitors. They raised a question about whether recommendations can be developed for roller crimper use to with supplemental post emergence herbicide weed suppression, should ‘rescue treatment’ be necessary. Bill Curran at Penn States agrees roller crimping is definitely insufficient for season long weed control and supplemental control is usually necessary. Cereal rye or triticale and vetch seed mixtures at a 2:1 or 3:1 ratio with rye might provide better weed suppression, but few propose this tactic because of concerns for N immobilization from the cereal.

- 4) Growers were impressed with the harvested yields attained, ease of harvester head operations, the cleanliness of harvested fruit, and the lack of straw trash remaining with harvested fruit. They said these appeared among the largest size H5108 they had seen.
- 5) However, they were concerned about the fouling during transplanting of roller crimper mat on the opener shoes when using big 6-row gangs of RJ or Mechanical plug transplanters. In the spring, they have limited time, need to cover lots of ground without in-field down time, and felt we hadn't demonstrated lack of fouling to their satisfaction.
- 6) An IPM professional wondered if there was a relationship between the covered soil barrier and the observed low insect pest infestation in our field, particularly Colorado potato beetle (CPB) and thrips. The discussion was about whether roller crimped cover might interfere with overwintering adult CPB finding their way to host crop plants, and if the immature thrips that drop into cover during part of their development are later impeded from finding their way back to the host. Whatever the reasons, growers were intrigued at the low insect infestation levels.
- 7) Bacterial Spot of tomato, an endemic soil borne disease, has become an increasing problem with costly chemical controls that are only moderately effective. Rolled cover crop soil may offer some physical barrier to disease spread.
- 8) Roller crimper production can't be used for needed early harvest production fields. While rye is the earliest maturing of cereal cover crops, and the earliest September rye seeding will provide the earliest May maturity, it is still not rolled until mid May resulting in September harvest tomato fields. NJ has only a narrow 14-week summer processing window, from late July through end of September. Thus, the plant needs to open and begin operating as early as possible in July. In 2012, the 900,000 cases were processed in 56 day, about 25,000 cases per day of processing. The mean processing was 476 tons per day, with two days exceeding 700 tons per day.

\*Their tomato products supply local/regional markets. Average yields were 27.92 T/A and 22.85 T/A in 2011 and 2012, respectively, at 95% usable arriving the processing plant. Their reported yields are biased because they include unharvested fields, making reported yields impressive by comparison. Growers received \$89/T and \$95/T (\$101/T and \$111/T with bonuses). 2013 carryover stocks in are low, and their production goal for 2013 is 940,000 cases. The locally identified "Jersey Fresh" products sold 25,000 cases, up from 9,000 a few years ago. Private label tomato products are up to 125,000 cases.