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Methods for Reducing Tomato Maturity Delays When No-Tilling into Rye-Covers

R. David Myers[1], Mark Spicknall[2], Alfred Hawkins[3], Stephan Tubene[4]

[1]Extension Educator
University of Maryland
Anne Arundel Cooperative Extension
7320 Ritchie Highway, Suite 210
Glen Burnie, MD 21061

Introduction

No-tillage has been readily adopted in agronomic crop production with a high degree of success. However in vegetable production, no-tillage still remains in its infancy. Some unwillingness to adopt no-tillage vegetable production has been attributed to cooler soil conditions and their associated maturity delays. This research project investigates no-tillage tomato *Lycopersicon esculentum Mill.* production strategies, which are intended to reduce inherent maturity delays and their associated economic losses. The cool season crop, cereal rye *Secale cereale,* makes an excellent winter cover, however, by the time tomatoes are ready for transplanting, the rye-cover has exceeded a manageable growth level for transplanting into. An early pre-plant (EPP) application of paraquat 0.094 lb ai/A sprayed prior to heading will effectively stop the rye at a canopy height of 36-40". This EPP application in Maryland would generally be required between the dates March 25th-April 7th, approximately 4 weeks prior to tomato transplanting. This EPP application causes the rye and under story weeds to yellow and lose leaf area, which will allow sunlight to penetrate to the soil, thereby promoting soil warming. At planting the usage of row-cleaners, set aggressively, further exposes the soil for warming by sweeping a transplant zone 8" wide void of cover or residue. It has been observed that this EPP application coupled with row-cleaning at planting creates a “mini-greenhouse” effect. There is an apparent sheltering and heat trapping by the standing rye middles with an in-row soil warming due to sweeping and moderate zone tillage. This study was designed to document these effects in order to promote the adoption of no-till vegetable production.

Methods

The project was designed as a randomized complete block, with 4 treatments and 4 replications. The treatment plot dimension was 15ft X 30ft with the transplants spaced 20 inches in row by 5ft between rows. There were 62 plants per plot with a density of 7,950 plants /A.

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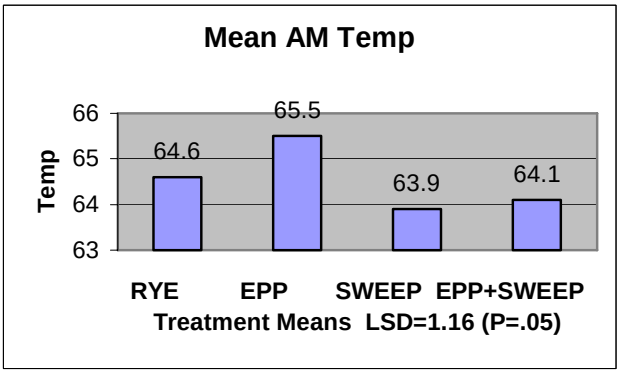
[2] Research Facility Manager, Upper Marlboro REC, University of Maryland
[3] Agricultural Research Technician, Upper Marlboro REC, University of Maryland
[4] Agricultural Program Assistant, Maryland Cooperative Extension, University of Maryland

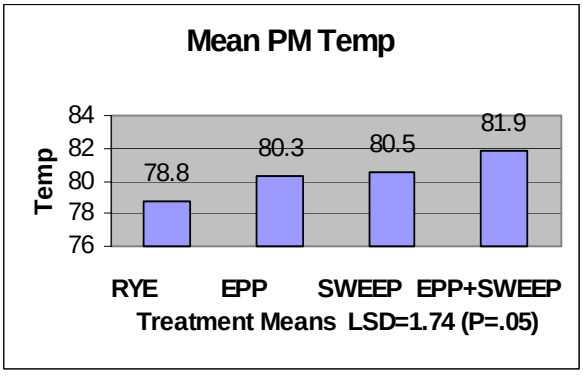
The research trial was conducted at the University of Maryland Research and Education Center in Upper Marlboro, Maryland, on a Monmouth Fine Sandy Loam Soil. No-till corn *Zea mays L.* was the proceeding crop, and cereal rye *Secale cereale var. Abruzzi* was planted following corn combining on November 5, 1997. On April 3, 1998, 10 gal/A of 30% UAN was broadcast applied to the rye-cover to encourage growth and enhance soil nitrogen. The soil test revealed optimum levels of phosphorus and potassium.

The first treatment utilized a full cereal rye-cover at tomato transplanting. This represents a no-tillage industry standard, and the experimental control. For the second treatment, an early pre-plant (EPP) application of paraquat 0.094 lb ai/A was applied on April 16,1998, three weeks prior to transplanting to effectively stop the rye at a canopy height of 30". The third treatment incorporated an at planting usage of row-cleaners, set aggressively, which further exposed the soil for warming, by sweeping a transplant zone 8" wide void of rye-cover and residues. The final treatment combined the EPP and row cleaner strategies prior to transplanting.

On May 6, 1998 all plots received a blanket herbicide application of metribuzin 0.25 lb ai/A plus napropamide 2.0 lb ai/A plus paraquat 0.38 lb ai/A, and the transplants were drenched with imidacloprid, Admire 1.3ml/72cell flat. The tomatoes *var. Sunbeam,* were transplanted on May 7, 1998, three weeks after the EPP herbicide treatment. A banded starter fertilizer application of 10-10-10 was made during transplanting at a165lb/A rate. Soil thermometers were installed for each plot, placed 2" deep and 3" off center of seedling trench. Soil and Ambient air temperatures were recorded between 7:00 – 9:00 a.m. and 3:00 – 5:00 p.m. daily. A broadcast fertilizer application of 0-0-60 @ 150lb/A was made on May 15, 1998. Two weeks after transplanting, on May 21, 1998, an application of metribuzin 0.25 lb ai/A was sprayed overtop to control lambsquarter and pigweed flushes. Fungicide applications were made biweekly, rotating the fungicides: chlorothalonil 1.5 lb ai/A, azoxystrobin 0.10 lb ai/A and mefenoxam 0.10 lb/A + copper hydroxide 1.2 lb ai/A. The tomatoes were also staked, pruned and twined on June 11,1998. Also, on the same day, 8 inch banded along both sides of tomato row, an 80lb Nitrogen/A UAN fertilizer was applied. On June 19, 1998, a nitrogen rapid stick test was conducted yielding a 500+ ppm nitrate-N concentration, which fell within the target range of 400-600 ppm nitrate-N. The second twine strand was weaved on June 25, 1998. Overhead pivot irrigation was applied on July 14 and July 17, 1998. Another nitrogen rapid stick test was conducted on July 22, 1998, yielding 400 ppm nitrate-N concentration, which fell within the target range of 300-400 ppm nitrate-N.

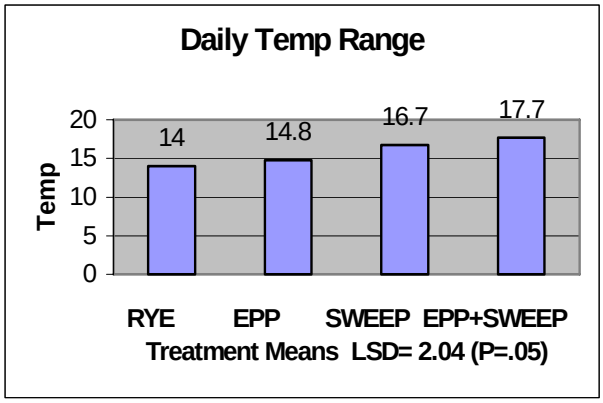
Results

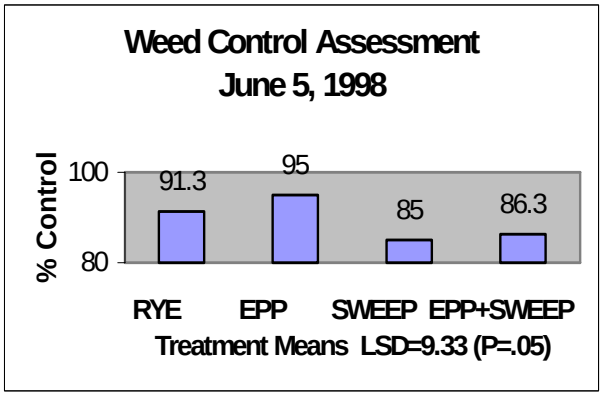




The mean 1998 a.m. Fahrenheit temperatures for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 64.6, 65.5, 63.9, and 64.1 degrees, respectively, where the least significant difference (LSD) was 1.16 at the 0.05 probability level.

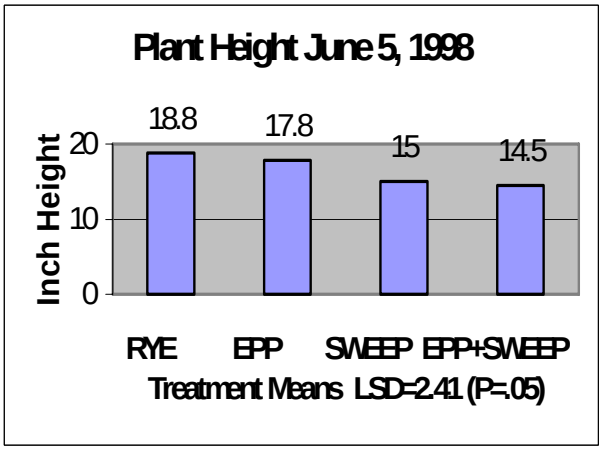
The mean 1998 p.m. Fahrenheit temperatures for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 78.8, 80.3, 80.5, and 81.9 degrees, respectively, where the least significant difference (LSD) was 1.74 at the 0.05 probability level.

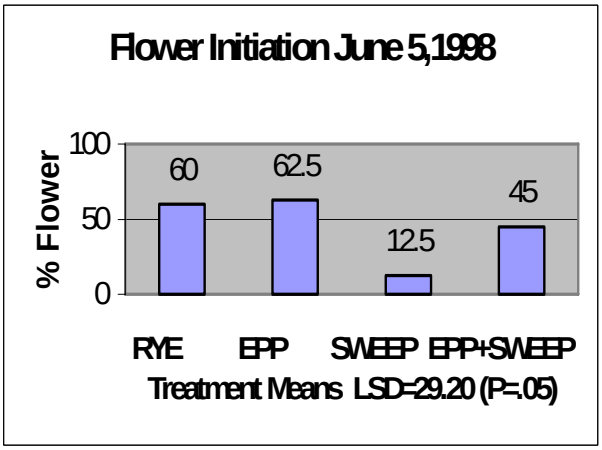




The mean 1998 daily temperature ranges for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 14.0, 14.8, 16.7, and 17.7 degrees, respectively, where the least significant difference (LSD) was 2.04 at the 0.05 probability level.

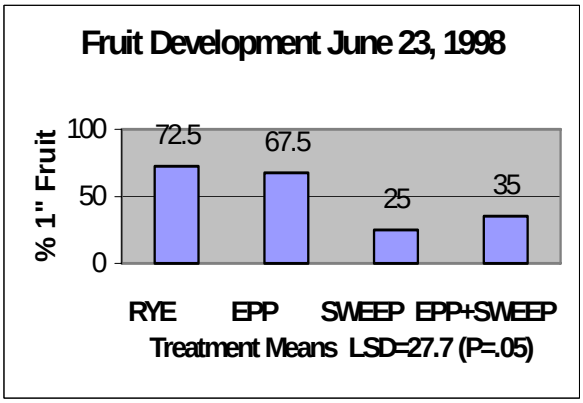
Weed control assessment on June 5, 1998 for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 91.3, 95.0, 85.0, and 86.3 % control, respectively, where the least significant difference (LSD) was 9.33 at the 0.05 probability level.

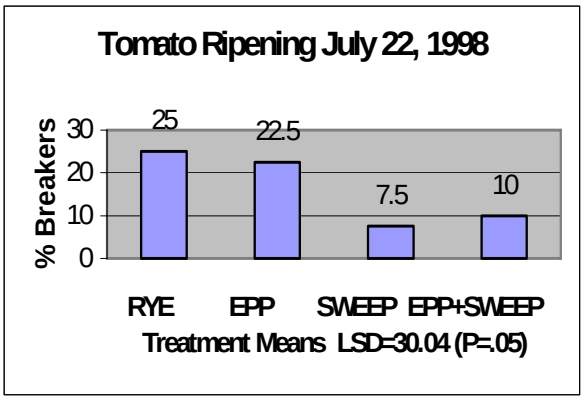




Plant height measurements on June 5, 1998 for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 18.8, 17.8, 15.0, and 14.5 inches, respectively, where the least significant difference (LSD) was 2.41 at the 0.05 probability level.

Flower initiation measurements on June 5, 1998 for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 60.0, 62.5, 12.5, and 45.0 % flower, respectively, where the least significant difference (LSD) was 29.20 at the 0.05 probability level.





Fruit development measurements on June 23, 1998 for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 72.5, 67.5, 25.0, and 35.0 inches, respectively, where the least significant difference (LSD) was 27.70 at the 0.05 probability level.

Tomato ripening measurements on July 22, 1998 for the treatments Rye, Rye EPP, Rye + Sweep, and Rye EPP + Sweep were 25.0, 22.5, 7.5, and 10.0 % breakers, respectively, where the least significant difference (LSD) was 30.04 at the 0.05 probability level.

At harvest, no significant differences occurred with maturity or yield among treatments. The tomato harvest period was from July 24,1998 to September 3, 1998. The tomatoes were picked weekly, yielding 137 boxes of graded and marketed tomatoes. The total plot size was 0.124 Acre, and the total plot yield was 3425 lbs. of graded/marketed tomatoes. This yield equates to 27,620 lbs./A marketable tomatoes. The tomatoes graded as follows: 13 boxes of large, 77 boxes of mediums, and 47 boxes of small. After July 17, 1998, no irrigation was applied, and drought conditions prevailed. The tomatoes graded small; however, quality remained high and the water conservation effects of no-till were apparent.

Conclusions

Mean morning soil temperatures were significantly lowered when row-cleaners were utilized, whereas, EPP burndown increased morning soil temperatures. Mean afternoon soil temperatures were increased significantly by both utilizing row-cleaners and applying an EPP burndown. Both EPP burndown and row-cleaner utilization significantly increased daily soil temperature range. Weed control was significantly enhanced by EPP burndown, and significantly decreased by row-cleaner sweeping. The utilization of row-cleaners as an aggressive soil sweep reduced plant height, delayed flower initiation, delayed fruit development, and hindered tomato maturity. There was an inducement of drought conditions and soil compaction in a year of heavy early May rains followed by intense high temperatures; however, no treatment significantly differed in tomato maturity or yield at harvest. In 1999, the study will include a tilled plasticulture treatment for comparison, and all plots will have trickle-irrigation to negate water effects.