

Background

Organic growers have the technology to match the timing and amount of nitrogen (N) applied with the needs of their crop but lack reliable data on temporal N uptake by plants and release from organic amendments.

Our project's goal was to measure the seasonal N uptake pattern of a popular heirloom tomato variety (Brandywine) and assess temporal availability of N from 19 composted, granular and liquid amendments used by local organic growers.



Questions and Approach

Crop nitrogen uptake

- How much N do Brandywine tomatoes take up?
- When in the season is demand the highest?
- How much N is taken up and removed for each ton of fresh yield?



Replicated field trials at UC Davis in 2017 and 2018 (UCD)

- Harvest whole plant samples 6-7 x per season; measure dry weight and N concentration
- Monitor fresh weight, dry matter and N concentration of yields
- Regular soil sampling; analysis for available N

Grower fields in Capay Valley (Esparto in 2017 only, Guinda 2017-8)

- Monitor fresh weight and N concentration of yields
- Harvest whole plants at the end of the season; measure biomass and N concentration (2018 only)
- Regular soil sampling; analysis for available N

Amendment nitrogen release

- How much N becomes available from different amendment types?
- How quickly does N become available?
- Does soil management history affect N release?



Lab incubations with different amendment types in different soil types

- Mix amendments with soil from organic or conventional fields at a rate of 300 lbs N/acre
- Incubate amendments for 12 weeks at 73 °F and 60% water holding capacity
- Harvest after 0, 7, 21, 42 and 84 days, analyze for available N
- Compare with unamended controls

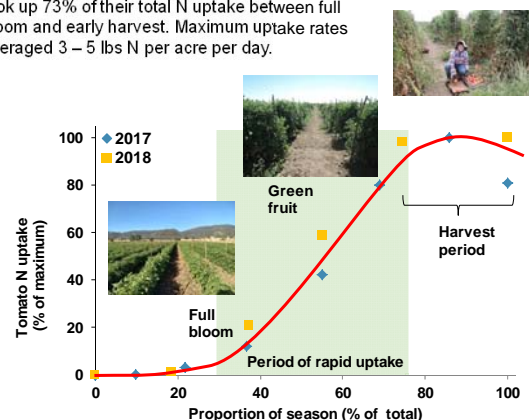


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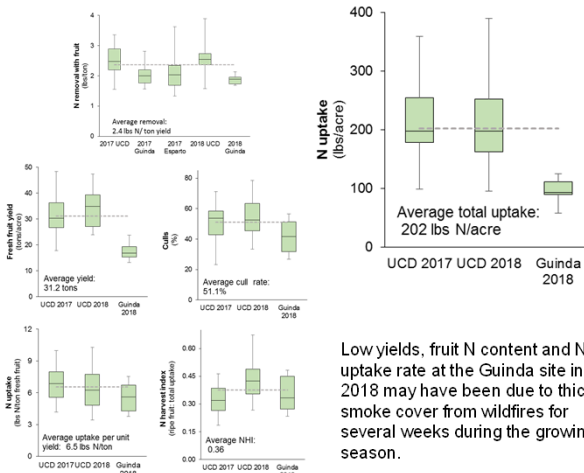
Results: Crop Nitrogen Uptake & Partitioning

Averaged over 2017-2018, Brandywine tomatoes took up 73% of their total N uptake between full bloom and early harvest. Maximum uptake rates averaged 3 – 5 lbs N per acre per day.



- Total N uptake averaged 202 lbs N/acre across all site-years.
- Total N uptake varied with the site, amount of available N in the soil and plant vigor.
- On average tomatoes took up 6.5 lbs N/ ton of fresh fruit, and 2.4 lbs was located in the fruit
- Only 18% of N on average was allocated to the marketable fruit.

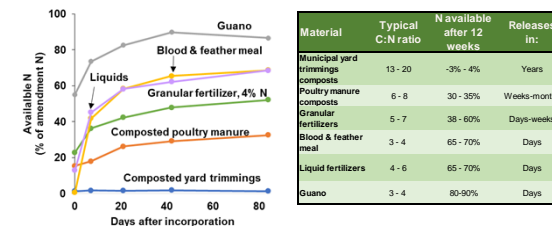
Average and interquartile range of the yield and N uptake parameters across the study. Differences for most parameters were stronger between sites than between years.



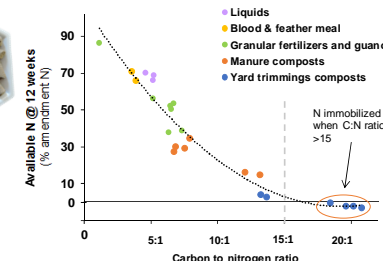
Low yields, fruit N content and N uptake rate at the Guinda site in 2018 may have been due to thick smoke cover from wildfires for several weeks during the growing season.

Results: Amendment Nitrogen Release

Potential N release from different amendment types is shown below. Amendment N release did not differ between conventional and organic soils



- Composted yard trimmings released little to no N
- Manure-based composts and granular fertilizers had significant amounts of N available at application
- Blood and feather meal contained no available N at application, but released N very quickly when mixed with soil.
- Liquid fertilizers contained some available N at application and mineralized N quickly.



The potential N release was negatively correlated with the carbon to nitrogen ratio (C:N). Amendments with C:N ratios >15 immobilized N.

Summary

- Brandywine tomatoes took up 73% of their N between the full bloom and the first harvest
- Little N was taken up before flowering or during harvest
- Total N uptake varied with the site, amount of available N in the soil and overall plant vigor. Overall average uptake was 202 lbs N per acre
- Nitrogen removal with the harvested fruit averaged 2.4 lbs N per ton
- Amendment N release varied widely, from slight immobilization of soil N to almost 100% availability, but was predictable based on the amendment carbon to nitrogen ratio
- Amendment N release was similar in organic and conventional soils

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This poster is dedicated to the memory of Mina Tissoudal

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