Our results indicate that the $\delta^{15}N_{Air}$ values detected in the organically fertilized tomato leaves, fruit skins and fruit juices provided higher values than synthetic or no added fertilizer. The average $\delta^{15}N_{Air}$ values of organic tomato leaves and fruits was between 6 to 11‰. In comparison, conventionally fertilized tomato plant leaves and fruits had $\delta^{15}N_{Air}$ values averaging around 0‰.

Overall, this project found that greater amounts of $\delta^{15}N_{Air}$ were found in tomato plants coming from organic fertilization applications. Thus, by using nitrogen stable isotope analysis, we can differentiate among conventionally and organically fertilized tomatoes based upon their nitrogen isotopic values.

Little differences were observed in carbon stable isotope data, although conventionally fertilized tomatoes had higher $\delta^{13}C_{VPDB}$ values, indicating that lower amounts of water were available for plant uptake (e.g., the plants had to work harder to uptake their water source). However, more research is needed to better predict water use efficiency when studying carbon stable isotopic ratios due to a naturally high variability in tomato plants.

HOW DOES OUR PROJECT BENEFIT THE HORTICULTURE INDUSTRY?

This project has the potential to assure consumers that their tomato products are of organic or inorganic origins based upon the nitrogen stable isotopic values. Higher δ15NAir values indicate that the plants have been fertilized with organic nutrient materials. This is crucial as the organic vegetable and fruit industry is growing each year, and there are several rules that organically certified growers must follow regarding fertility and pesticide usage. This project also focused on sustainable methods to build soil organic matter content and retain important nutrients for crop growth, which can decrease nitrogen leaching and pollution, which is a global issue.

NITROGEN STABLE ISOTOPES DETECT ORGANIC OR CONVENTIONAL GROWN TOMATOES

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OVERVIEW

Many aspects of vegetable production are similar among organic or conventional systems, yet there are several important differences mostly related to fertility and pesticide management that consumers are becoming more aware of each year. Conventional agricultural production systems rely on short-term solutions and synthetic chemicals, while organic methods for crop production rely more on natural fertilizers and longer-term solutions that are more "preventative than reactive". The tomato is an important horticulture crop sold by many small Illinois farmers at local markets. However, tomatoes are high nutrient feeders and require large amounts of nitrogen to maximize production and fruit yields. Thus, the nitrogen source (whether organic and conventional) and timing of fertilizer applications are crucial to maximize production and reduce nitrogen losses and resulting pollution. Therefore, we evaluated the influence of conventional and organic fertility applications on the nitrogen and carbon stable isotopes ($\delta^{15}N_{Air}$ and $\delta^{13}C_{VPDB}$) that developed in soils and tomato plant parts at immature and mature stages of growth.

WHAT ARE STABLE ISOTOPES?

Although they are the same element, stable isotopes differ by the number of neutrons within the center of the atom (their nucleus).

WHAT STABLE ISOTOPES DID WE EVALUATE?

There are two naturally occurring stable isotopes for nitrogen and carbon. For nitrogen: ^{15}N-stronger bonds/ heavier element and ^{14}N-weaker bonds/lighter element. For carbon, ^{13}C-stronger bonds/heavier element and ^{12}C-weaker bonds/lighter element. The fractionation or relative amount of the isotope that develops in soil or plant tissue have the possibility to detect differences between production systems.

WHY USE STABLE ISOTOPES?

Stable isotopes have the potential to detect whether a tomato plant has been grown in a conventional or organic manner based upon their isotopic signatures. This is especially true for nitrogen, because plants prefer to uptake the lighter stable isotopes, and the heavier ^{15}N can be used as a fingerprint system.

WHAT DID WE FIND IN OUR PROJECT?

We can distinguish differences between conventionally and organically fertilized tomatoes based upon the plants $\delta^{15}N_{Air}$ isotopic values that were found in the mature leaves and fruits. For carbon stable isotope ($\delta^{13}C_{VPDB}$), we observed possible methods to better explain tomato plant water use efficiency using this isotope and how conventional versus organic vegetable production systems differ from one another regarding water use.

Our expected values for nitrogen:
Organically fertilized plants averaged 8 to 11‰ for the heavier nitrogen isotope ($\delta^{15}N_{Air}$)

Conventionally fertilized plants averaged -3 to 0‰

Our expected values for carbon:
Tomato plant parts averaged at -27 to -29‰ for the heavier carbon isotope ($\delta^{13}C_{VPDB}$) regardless of fertilization method.