

ORGANIC versus CONVENTIONAL - CAN $\delta^{15}\text{N}$ BE USED AS AN INDICATING PARAMETER IN GARLIC, SWEET PEPPER AND CARROT?

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OBJECTIVES:

- rapidly grown organic farming and industry- mislabelling and adulteration have become serious problems
- **the aim of our work-** to investigate whether the N isotopic composition ($\delta^{15}\text{N}$ values) of produce can reveal the use of synthetic nitrogen fertilizer in organic production using different N fertilizer types and combinations of them in order to leave a specific $\delta^{15}\text{N}$ fingerprint in garlic (*Allium sativum* L.), sweet pepper (*Capsicum annuum* L.) and carrot (*Daucus carota* subsp. *Sativus* L.)

MATERIALS AND METHODS:

Experimental design

A pot/field experiment:

- a completely randomised design- six treatments with four replications for garlic, three replications for sweet pepper and five replications for carrot, as follows:
 - an unfertilized control (C),
 - two single organic fertilizations with different organic fertilizers (Org 1 with $\delta^{15}\text{N} = 9.85\text{‰}$, Org 2 with $\delta^{15}\text{N} = 3.9\text{‰}$),
 - a single synthetic fertilization (S with $\delta^{15}\text{N} = 0.4\text{‰}$)
 - combinations of organic and synthetic fertilizations (Org 1 + S, Org 2 + S).

Within every treatment- three biological replications for garlic, two for sweet pepper and three for carrot.

Analysis

- Europa Scientific (U.K.) Europa 20-20 continuous flow isotope ratio mass spectrometer with ANCA S-L unit



Figure 1: EA-IRMS

RESULTS:

In garlic- statistically significant differences were found in mean $\delta^{15}\text{N}$ values between:

- Org 1 and all the other treatments,
- both organic (Org 1, Org 2) and S treatment,
- combined treatment Org 1 + S and S treatment,
- Org 1, Org 2, Org 1 + S regimes and control.

Similar to $\delta^{15}\text{N}$ values, the highest N content was determined in garlic treated with Org 1 (2.4 ± 0.2 g/ 100 g) and Org 1 + S (2.3 ± 0.0 g/ 100 g), showing statistically significant difference in comparison with other treatments.

In sweet pepper and carrots- no statistically significant differences were found nor in $\delta^{15}\text{N}$ values, neither in N content irrespective of the fertilization regime.

No statistically significant difference was found between $\delta^{15}\text{N}$ values and N content of soil, fertilized with organic or synthetic fertilizers or combination of them.

Table 1: N content (g/ 100 g) in garlic, sweet pepper and carrot grown under different production regimes

	C	Org 1	Org 2	S	Org 1 + S	Org 2 + S
	N content (g/ 100 g) \pm SD (g/ 100 g)					
garlic	1.78 ^b \pm 0.04	2.42 ^a \pm 0.23	1.93 ^b \pm 0.12	1.90 ^b \pm 0.10	2.30 ^a \pm 0.04	1.82 ^b \pm 0.12
sweet pepper	3.35 ^a \pm 1.41	3.09 ^a \pm 1.28	2.80 ^a \pm 0.92	3.75 ^a \pm 0.68	2.90 ^a \pm 0.80	1.93 ^a \pm 0.99
carrot	0.84 ^a \pm 0.10	1.00 ^a \pm 0.25	1.01 ^a \pm 0.06	1.13 ^a \pm 0.23	1.02 ^a \pm 0.17	1.08 ^a \pm 0.20

*Different letters (a,b) in the same row denote statistically significant difference ($P < 0.05$) according to Duncan's test.

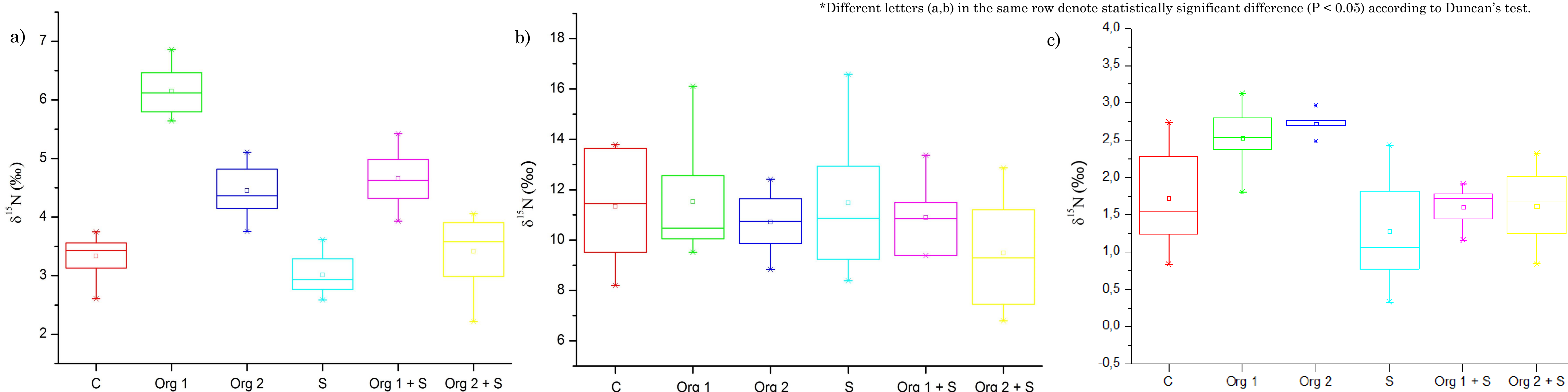


Figure 2: Boxplots of the nitrogen isotope ratio ($\delta^{15}\text{N}$ ‰) in a) garlic, b) sweet pepper and c) carrot, treated with different types of fertilizers. The boxes comprise the range between the first and the third quartile of the distribution, called interquartile range. Minimum and maximum values are represented by the vertical lines at the lower and upper end of the axis. Median value is depicted by the vertical line within the box, meanwhile the arithmetic mean is depicted by "o". "*" are extreme values- data points even lower or higher than outliers, which are positioned between 1,5 and 3 times interquartile range lower than the first or higher than the third quartile.

CONCLUSIONS:

- $\delta^{15}\text{N}$ in garlic showed a statistically significant difference, reflecting the higher $\delta^{15}\text{N}$ values of organic production compared to that of conventional production,
- $\delta^{15}\text{N}$ of sweet pepper and carrot alone could not be used even as a rough marker to discriminate between organic and conventional production,
- the method was found insufficiently sensitive to detect the addition of synthetic fertilizer to basal organic fertilization and low or moderate rates of synthetic N fertilizer, which could be illegally applied to organically grown garlic, sweet pepper and carrot,
- $\delta^{15}\text{N}$ could not be used as indicator of organic way of production by itself, but only as an additional indicator in combination with other parameters (e.g. elemental composition, chemical-physical parameters...).