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

Anja Mahne Opatič1, Marijan Nečemer2, Nina Kačjan Maršić3, Nataša Šink4, Tina Perko5, Sonja Lojen1

1Department of Environmental Sciences O-2, Institute “Jožef Stefan”, Jamova cesta 39, Ljubljana, Slovenia
2Department of Low and Medium Energy Physics F-2, Institute “Jožef Stefan”, Jamova cesta 39, Ljubljana, Slovenia
3Department of Agronomy, University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, Ljubljana, Slovenia
4Biotechnical center Naklo, Strahinj 99, Naklo, Slovenia

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 ($\delta^{15}$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 $\delta^{15}$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 $\delta^{15}$N = 9.85 %, Org 2 with $\delta^{15}$N = 3.9 %),
  - a single synthetic fertilization (S with $\delta^{15}$N = 0.4 %)
  - 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

RESULTS:
In garlic- statistically significant differences were found in mean $\delta^{15}$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 $\delta^{15}$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 $\delta^{15}$N values, neither in N content irrespective of the fertilization regime.

No statistically significant difference was found between $\delta^{15}$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

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>Org 1</th>
<th>Org 2</th>
<th>S</th>
<th>Org 1 + S</th>
<th>Org 2 + S</th>
</tr>
</thead>
<tbody>
<tr>
<td>garlic</td>
<td>1.78±0.04</td>
<td>2.42±0.23</td>
<td>1.59±0.12</td>
<td>1.90±0.10</td>
<td>2.30±0.04</td>
<td>1.82±0.12</td>
</tr>
<tr>
<td>sweet pepper</td>
<td>3.35±1.14</td>
<td>3.09±1.28</td>
<td>2.80±0.92</td>
<td>3.75±0.68</td>
<td>2.90±0.80</td>
<td>1.90±0.99</td>
</tr>
<tr>
<td>carrot</td>
<td>0.84±0.10</td>
<td>1.09±0.25</td>
<td>1.01±0.06</td>
<td>1.13±0.23</td>
<td>1.02±0.17</td>
<td>1.08±0.20</td>
</tr>
</tbody>
</table>

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

CONCLUSIONS:
- $\delta^{15}$N in garlic showed a statistically significant difference, reflecting the higher $\delta^{15}$N values of organic production compared to that of conventional production,
- $\delta^{15}$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,
- $\delta^{15}$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...).


ACKNOWLEDGEMENTS: This study was financially supported by European Commission- Community Research and Development Information Service in the scope of project 621329 ISO-FOOD ERA Chair for isotope techniques in food quality, safety and traceability, and research programme P1-0143 financed by the Slovenian Research Agency.