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Application note 002

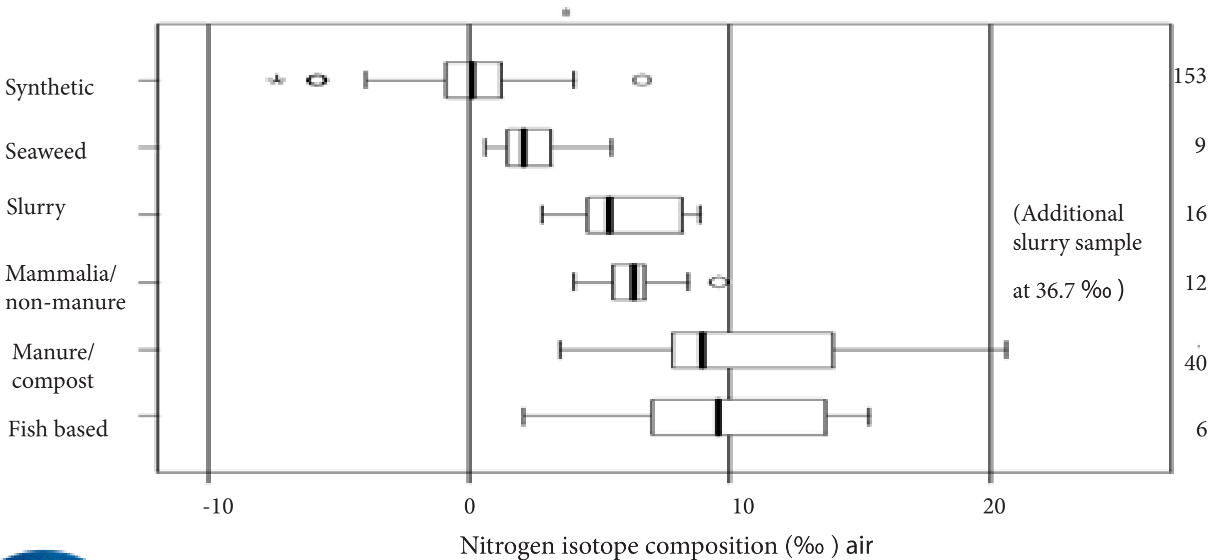
Detecting Substitution of Organic Tomatoes with Conventionally Grown Products Using δ^{15}N ‰ Analysis

Authentic samples of commercially produced organic and conventionally grown tomatoes were collected and analysed for their δ^{15}N composition in order to assemble datasets to establish if there were any systematic differences in nitrogen isotope composition due to the method of production. The tomato dataset show that the different types of fertiliser commonly used in organic and conventional systems result in differences in the nitrogen isotope composition of this crop.

A mean δ^{15}N value of +8.1‰ was found for the organically grown tomatoes compared with a mean value of -0.1‰ for those grown conventionally.

KEYWORDS: Nitrogen, isotope, organic, conventional, δ^{15} N.

Figure 1: Distribution of ^{15}N in accepted organic and conventional synthetic fertiliser



Nitrogen-15 distribution in fertiliser (Figure 1).

There has been considerable recent interest in the potential application of nitrogen isotope analysis in discriminating between organically and conventionally grown crops. A prerequisite of this approach is that there is a difference in the nitrogen isotope compositions of the fertilizers used in organic and conventional agriculture.

The $\delta^{15}N$ values of the synthetic fertilizers in the compiled dataset fall within a narrow range close to 0‰ with 80% of samples lying between -2 and 2‰ and 98.5% of the data having $\delta^{15}N$ values of less than 4‰ (mean =0.2‰ n = 153).

The fertilizers that may be permitted in organic systems have a higher mean $\delta^{15}N$ value of 8.5‰ and exhibit a broad er range in $\delta^{15}N$ values from 0.6 to 36.7‰ (n = 83).

Bulk nitrogen isotope analysis of freeze dried tomato

Samples for nitrogen isotope analysis were freeze-dried, homogenised and ground to fine powder using a ball mill. Dried samples were weighed into tin capsules, and standards and samples matched to give 0.1 mg (+/-20%) N per analysis. The total-N content of standards and samples were closely matched in order to minimise errors associated with source-linearity effects. Nitrogen isotope compositions were determined using a PDZ Europa ANCA-GSL elemental analyser connected to a 20:20 continuous flow isotope ratio mass spectrometer.

Samples were analysed in triplicate and values accepted when precision (sn-1, n=3) was <0.3‰. Long-term performance of the mass spectrometer was monitored by analysis of a secondary reference material, L-alanine with an accepted $\delta^{15}N$ value of +8.7‰, in every batch.

The long-term standard deviation of the values obtained from measurements of the secondary laboratory standard was 0.16‰.

Results and discussion

Modelled normal distribution curves for the organic and conventional tomato populations are shown in Figure 2. Ninety-five percent ($p=0.05$) of the modelled organic population would be expected to have stable nitrogen isotope values between +1.7‰ and +14.4‰. Of the remaining 5% of the population, 2.5% would be expected to fall in each of the distribution tails. This means that 5 organic samples out of 200 could be expected to have $\delta^{15}N$ values of less than +1.7‰.

A tomato with a $\delta^{15}N$ value of <+1.7‰ can be described as statistically "unlikely" to be drawn from a population with the same mean as the set of organic tomatoes analysed during the baseline survey. In the same way, it can be said that a tomato with a $\delta^{15}N$ value of <-0.5 is statistically "highly unlikely" to be drawn from a population with the same mean as the organic dataset analysed during the baseline survey.

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References

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Acknowledgement
This research was funded by the UK Food Standards Agency

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