Is it organic or not? Scientists use isotopic discrimination to detect synthetic fertilizers

As organic farming becomes more common, methods to identify fraud in the industry are increasingly important. In a recent study in *Journal of Environmental Quality*, scientists successfully use nitrogen isotopic discrimination to determine if non-organic, synthetic fertilizers were used on sweet pepper plants.

Scientists at the Instituto Murciano de Investigación y Desarrollo Agrario y Agrario y Alimentario (IMIDA) jointly with the Instituto de Agrobiotecnología (UPNA-CSIC), in Spain, investigated the use of isotopic discrimination in organic crops to detect if chemical N fertilizers were added, in a study funded by the Fundación Séneca de la Región de Murcia. Specifically, they measured 15N-abundance variations in sweet pepper plants with three common manures, with or without the addition of chemical fertilizers during the crop cycle.

Results from the study were published in the January-February issue of the Journal of Environmental Quality. The research was also presented in Naples, Italy, at the GreenSys2007 Symposium of the International Society for Horticultural Science in October 2007.

Francisco del Amor, who conducted the study, said that “isotopic discrimination has demonstrated that we can successfully identify fraud if synthetic N fertilizers are used in the organic production of sweet peppers; however, further studies including the effects of different soil characteristics, climate, and biotic or abiotic stress could be useful in determining the proper interval of 15N-values to exclude non-organic fertilization practices for certification policies.”

15N abundance in the atmosphere, the largest N reserve in the world, remains constant around the planet. However, several physical, chemical, and biological processes and reactions implicated in the synthesis and transformation of organic compounds present different affinities for 15N or 14N isotopes. Due to this discrimination, products resulting from these reactions are usually enriched or impoverished in 15N in comparison with the original. The N in synthetic N fertilizers is derived from atmospheric N2, and this process results in little change in the original atmospheric N isotope ratio but, by contrast, nitrate derived from animal manures (typically used in organic farming) can have greater values signifying a 15N enrichment above the original 15N/14N ratio in starting N2. This is significantly different from the fertilizer N isotopic value, and plants grown with different fertilizer sources of N can be identified.

15N-values (stable isotope abundances expressed as the relative difference of the isotope ratio from that of an international standard in parts per thousand), were determined in sweet pepper plants under controlled ambient and soil conditions in a greenhouse. Leaves (young and old), stems, roots and fruits were analyzed in plants cultivated organically or with synthetic fertilizer amendments. Therefore, three types of animal manures (sheep, hen or horse) were applied at preplanting, and during the crop cycle half of the plants in each manure zone received only water, and the other plants received chemical fertilizers as commonly used in conventional cultivation. The results of this study showed that (i) use of synthetic fertilizers significantly reduced 15/14N2vsN2atmosphere compared with treatments that only received water; (ii) with respect to the plant organs, old leaves and fruits were more sensitive to the synthetic fertilizer additions with reductions in 15/14N2vsN2atm of 24.1 and 27.8%, respectively; and (iii) independently of the organic manure used, no additional fertilization (synthetic or organic) was required before 106 days after transplanting with the common dosage of manure, as plant fresh weight was not reduced.

Source: American Society of Agronomy