**Title:** Nitrogen rhizodeposited by faba bean and chickpea

**Topic area:** Rhizodeposition

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**Summary:**

*Purpose*: determining the N derived from rhizodeposition under field conditions using an *in situ* 15N-labelling technique.

*Key words*: Nitrogen rhizodeposition; 15N labeling; field experiment

*Brief description*: Plants were labelled by allowing individual plants to absorb 15N-enriched urea solution through their petioles in chickpea and injected into the stem in faba bean.

*Example of use*: N fertiliser saving because the contribution of N to the soil by legumes.

**Methodology**

1. Plant labelling and sampling

Steel frames were inserted into the soil demarcating an area for each crop row according to the methodology described by Rochester et al. (1998). Plants within these frames were thinned to an optimal plant density for faba bean and chickpea, respectively. At early flowering, the chickpea plants were labelled by allowing individual plants to absorb 1 ml of a 0.15 M 15N-enriched urea solution (99% atom. 15N) through their petioles once a week over 3 weeks. The urea solution was placed in a plastic vial, sealed and attached to a petiole from which a leaflet had been severed. The tip of the petiole located at the end of the leaf was positioned at the base of the vial, which was removed after 72 h when the urea solution had disappeared according to the methodology described by Rochester et al. (1998).

In faba bean, the same amount of 15N used in chickpea was introduced to each plant, but as a one-time feeding of 1 ml 0.45 M 15N-enriched urea solution injected into the hollow stem at mid flowering. To inject the urea into the stem, a 1-ml syringe and a needle, 9 cm in length, were used. The stems were sealed with plasticine (Teroson, Henkel, Dusseldorf, Germany) to prevent possible losses through the holes caused by the needle. During the labelling process, both the soil around the plant and the stems were covered with absorbent paper to collect any accidental spillage of the 15N solution.

The plants inside the steel frames were harvested at maturity, and shoots and roots were separated. Fallen leaves were collected regularly from a cloth laid over the soil surface and added to the harvested material. All of the material was dried at 70 °C for 48 h, weighed and milled. After harvest, cylindrical soil cores were sampled from the steel frame using a 5-cm diameter bi-partite root auger (Eijkelkamp plant root auger, Amsterdam, the Netherlands). Soon after sampling, the soils were frozen (−30 °C) to prevent any alteration of the biological status (--[Stenberg et al., 1998] and [Lee et al., 2007]). The cores were broken open and all visual roots were subsequently removed by hand from the soil and dried at 70ºC to constant weight. The soil adhering to the fresh roots was easily separated from the roots and mixed with the bulk soil. All recovered roots were subsequently dried at 70 °C to a constant weight. Subsamples of recoverable roots were muffled at 550 °C for 3 h to correct their N analyses for soil contamination. In this study, N rhizodeposition is defined as the release of all types of N-compounds lost from living plant roots after removal of recoverable roots. Above-ground plant samples, root material and soil were finely pulverised and analysed for 15N isotopic abundance and total N concentration using a Carlo Erba 1108 Elemental Analyzer coupled to a VG Isochrom isotope ratio mass spectrometer in continuous flow using the Dumas combustion method (EA 3000 Eurovector Sp A, Milan, Italy).

2. Calculations

The 15N recovery in the soil plant system was calculated as the sum of the 15N content in the stems and leaves (including any leaves collected from the ground), grain, macro roots and rhizodeposits. To perform these calculations, the following were assumed: (i) all excess 15N in the soil originated from 15N-enriched faba bean and chickpea below-ground biomass, and (ii) the recovered roots isolated from each soil layer were representative of the N concentration and 15N enrichment of all of the root tissue in that layer. Assuming that the N deposited had the same 15N enrichment as the sampled macro root N, the rhizodeposition relative to the total N in the bulk soil and in the rhizosphere soil was calculated using the following equation (Janzen and Bruinsma, 1989):

where the atom. % 15N excess of the roots was calculated as atom. % 15N in recovered roots − atom. % 15N in atmospheric air. The atom. % 15N excess of the soil was calculated as atom. % 15N in soil inside the steel frames − the average natural 15N enrichment of the soil N at harvest of the non 15N-fed faba bean and chickpea plots (0.3691 atom. % 15N) (Schmidtke, 2005).

The total amount of N rhizodeposited (kg N ha−1) was calculated as:

where Ns is the total N content in the soil or soil layer expressed in kg N ha−1.