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The Fate of Nitrogen from Crop Residues

F.J. de Ruijter & H.F.M. ten Berge

Wageningen UR, Plant Research International
P.O.Box 16, 6700 AA Wageningen, the Netherlands
Email: Frank.deruijter@wur.nl

Background and Objectives

To protect groundwater and reduce or prevent eutrophication of surface waters, the EU has adopted the Nitrates Directive and the Water Framework Directive. To reduce nutrient emissions and deliver 'good water quality for all purposes, the Netherlands have defined crop-specific limits to N inputs. At present, the crop-specific N standards are based on the current N recommendations. The high nitrate concentrations on sandy soils, especially those with low groundwater tables, indicate that further action is required. N standards can be cut to levels below the N recommendations, especially for crops that have a high N surplus. However, some crops (eg. Broccoli) have a high N surplus because of a high N content of the crop residues. Cutting back N standards may then have little effect on N leaching and management of crop residues may contribute more to reducing nitrate emissions to groundwater and surface waters.

Little is known about what part of the N content of crop residues is lost to groundwater. To predict effects on N leaching of different options of management of crop residues, knowledge of the fate of N from crop residues is required. The objective of this study was to monitor all emission routes of N from crop residues.

Material and Methods

A field experiment was setup at the end of October 2006 on a sandy soil with crop residues of Broccoli and Leek. Six treatments were studied: Broccoli - no tillage and rototillage; Leek - no tillage and rototillage; fertilizer (150 kg N ha^{-1}); blanc. Residues of Broccoli were collected from a farmers field, residues of Leek were derived after harvest and cleaning on the farm. About 150 kg N ha^{-1} in crop residues was applied.

Mineral N in the soil profile was studied by soil sampling (0-30, 30-60 and 60-90 cm) and by sampling of soil moisture using macro rhizons at depths of 30, 60, 90, 120, 150, 180 and 210 cm. Breakdown of crop residues was studied using nylon litter bags of 50x50 cm that were either placed on the soil surface or covered by 10 cm of soil. Denitrification was studied by taking soil cores and further analysis in the lab. Ammonia emission was studied in a separate experiment.

Results and Conclusions

Ammonia emission started one (Leek) or 2.5 weeks (Broccoli) after start of the experiment. Losses through emission of ammonia were substantial when residues are not incorporated into the soil (Table 1). These losses do not contribute directly to nitrate in groundwater of the field, but may leach after deposition on other fields or may deposite directly on surface waters. Incorporation of the residues reduced ammonia emission, but increased denitrification. Incorporation of the residues

increased Nmin at 70 days after start of the experiment. At that time, some N is leached below 90 cm, as can be seen from the fertilizer object. A complete overview of the fate of N from crop residues will be made in spring after analysis of residues in litter bags and N in extracted soil moisture.

Table 1. Preliminary results: losses through ammonia emission during the first 70 days, losses through denitrification during the first 40 days and Nmin at 70 days after start of the experiment (all in kg N ha^{-1}).

Object	NH_3-N emission	Denitrification-N	Nmin (0-90)
Blanc	0	0	48
Fertilizer	-	-	142
Broccoli – no tillage	29	3	87
Broccoli – rototillage	0	10	101
Leek– no tillage	11	4	70
Leek – rototillage	0	10	89