Alternative Manure Management Strategies: Impacts on Water Quality

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Manure management on dairy farms has come under scrutiny due to concerns that manure may be a potential nonpoint source of nitrate and phosphate contamination of ground and surface water. Corn and grass hay are the preferred crops for manure application by dairy farmers. Cropland planted to legumes may be a less desirable location for animal manure application because they do not require additional nitrogen, and because nitrogen may stimulate unwanted weed and grass growth. However, manure applications to perennial forages on dairy farms, with large herds relative to cropped land, could increase greatly the total land area available for spreading. This will decrease the amount spread on any one field, lessening the nitrate leaching potential. Considering the fact that many dairy farms in New England have a surplus of manure, and the nutrient value of manure often exceeds crop N requirements, alternative ways to reduce the N surplus are needed. Alfalfa, being the preferred perennial forage legume by dairy farmers in the northeastern USA, was chosen for experimentation as an alternative crop for spreading manure.

Application of low rates of dairy manure (approximately 5,000 gal/ac/yr) did not significantly effect either herbage yield or weed incidence compared to alfalfa receiving no nitrogen (Figure 1). However, application of high manure rates were noticed to increase weed incidence when manure applications were followed by a dry period. Manure application to alfalfa at the low rates appeared to have negligible economic risk compared to the conventional production strategy.

Table 1. Total herbage yield as affected by application of manure or NH_4NO_3 at the Deerfield site

	Year							
	1990-91				1991-92			
	Cutting Month				Cutting Month			
Treatments	July	Aug.	May	Total	July	Aug.	May	Total
	tons/ac							
No nitrogen	1.8	1.3	3.1	6.3	2.0	1.5	2.4	5.9
Low manure	1.9	1.4	3.2	6.4	1.9	1.6	2.3	5.9
High manure	1.9	1.5	3.1	6.6	1.6	1.5	2.0	5.1
Low NH_4NO_3	2.0	1.4	3.3	6.6	2.1	1.5	2.4	6.0
High NH_4NO_3	2.0	1.4	3.2	6.6	2.0	1.6	2.3	5.9
LSD (0.05)	NS	NS	NS	NS	0.2	NS	NS	0.4

Dairy manure applications to alfalfa at the low rate of 100lb N/ac/yr did not increase nitrate-N concentrations in the soil water as compared to the zero N treatment. Mean nitrate-N

concentrations in soil water under alfalfa at the low manure rate over the two years were low at 2.5 mg L^{-1} nitrate-N at the South Deerfield site. In the second year an increase in nitrate-N with the higher manure application rate was detected. Presumably, this is due to mineralization of a larger pool of organic N during year 2. Increased nutrient uptake by regenerating alfalfa after each cutting, low soil moisture contents, and low precipitation during the summer reduce the potential for nitrate-N leaching. Rainfall during the period from August to December accounted for 46% and 56% of the annual precipitation in the years of 1990 and 1991. During the fall season, when plant growth and water uptake is lower, there appears to be a greater potential for nitrate leaching (Figure 1). At the end of the fall season, it was observed that nitrate-N concentrations at 120-cm depth decrease indicating a lesser possibility for nitrate leaching during winter months in New England.

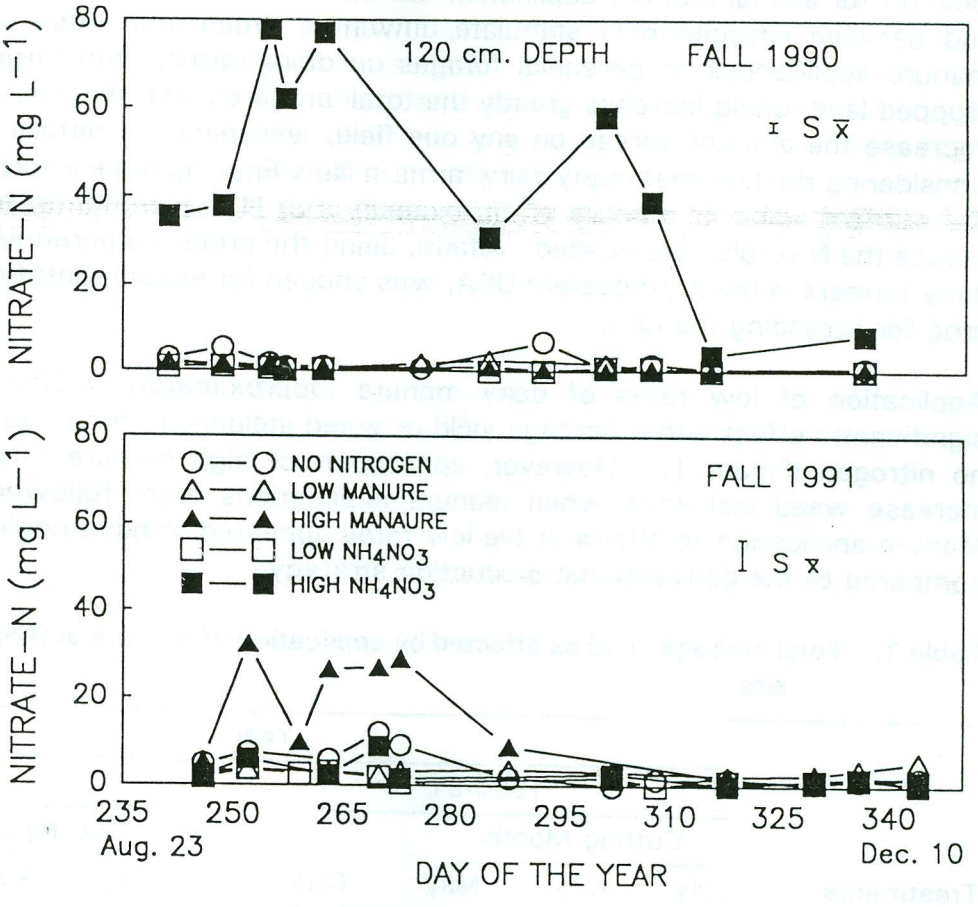

Fig. 1. Mean nitrate-N concentrations at 120-cm depth for the fall season.

We conclude that dairy manure can be applied to alfalfa at low rates of approximately 5,000 gal/ac/yr)20 ton semi-solid/ac/yr) without any adverse effects on soil water nitrate-N concentrations or forage production. Application of manure to alfalfa will increase the total land area available for manure spreading on dairy farms thereby reducing over-application of manure on corn fields.