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Application of dairy manure amended with mineral nitrogen fertilizer on stubble-covered soil: effects on ammonia emissions

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Introduction

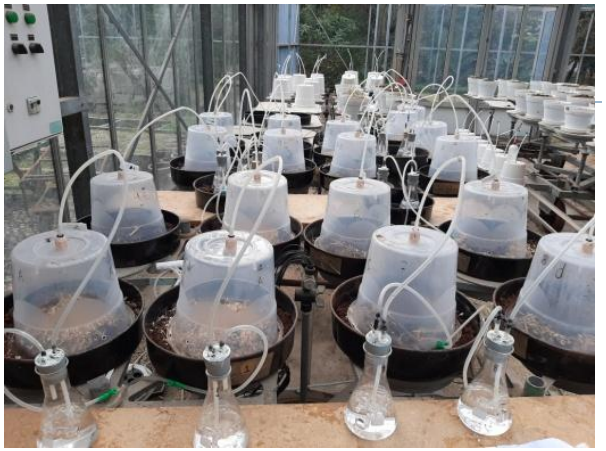
Joint application of animal manure with mineral fertilizer

reduction in the manure application rates and consequently:

- ✓ potential to reduce costs
- ✓ decrease environmental impact
- ✓ extend the manure benefits to greater acreage.

Aim of the present work: to evaluate the effects of mineral nitrogen fertilizer amendment to manure, right before application, on ammonia (NH_3) emissions.

Material and methods



- Five treatments (3 replicates):
  - Unfertilized treatment (Control),
  - Urea (U),
  - Calcium ammonium nitrate (AN),
  - Dairy manure (MAN),
  - Urea + Dairy manure (UMAN),
  - Calcium ammonium nitrate + Dairy manure (ANMAN).
- The manure, mineral fertilizers and their combinations were spread by hand on the stubbles, at a rate of 0.5 g of total-nitrogen per pot. For the organic-mineral combinations, the mixture was done right before the application and each component contributed 50% of total-N.
- The ammonia emissions were collected through a dynamic chamber system for seven days.

Results and discussion

Table 2. Cumulative ammonia emission expressed as mg NH_3-N pot^{-1} and as a percentage of total nitrogen applied (removed the Control emission). For each parameter, in the same column, values followed by different letters are significantly different based on the LSD test (mean of 3 replicates).

	Cumulative NH_3 emission mg NH_3-N pot^{-1}	% of Total-N applied
UMAN	117.5 [a]	23.4 [a]
ANMAN	96.8 [a]	19.3 [a]
MAN	62.7 [b]	12.5 [b]
U	25.7 [c]	5.0 [c]
AN	5.9 [cd]	1.1 [c]
Control	0.51 [d]	-

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The joint application of manure and urea or manure and calcium ammonium nitrate led to higher NH_3-N emission than the sum of emissions from each of the component separately.

Results and discussion

- the addition of mineral fertilizer to dairy manure affected ammonia daily emission rates and dynamics. UMAN emitted 1.87 and 4.47 times more NH_3-N than MAN and U, respectively. ANMAN emitted 1.54 and 16.4 times more than MAN and AN, respectively.
- The higher ammonia emission from manure amended with mineral nitrogen fertilizers might be motivated by the slightly alkaline pH of the manure.

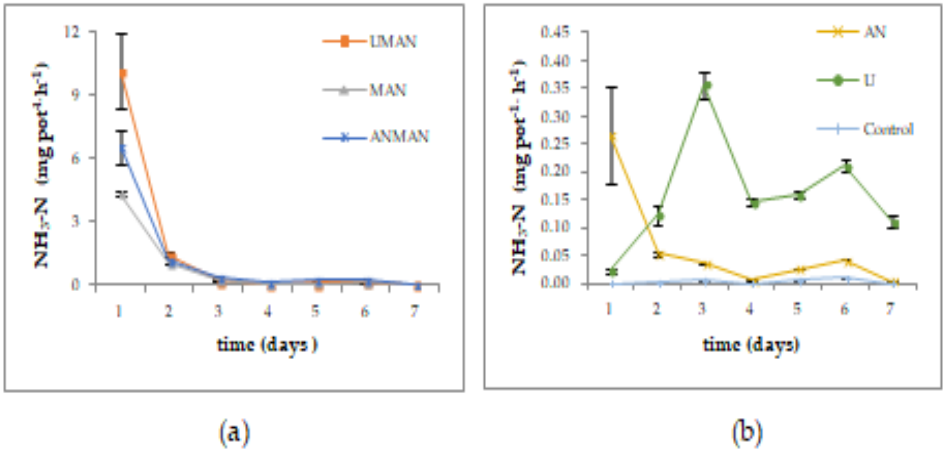

Figure 1: NH_3-N daily emission rates (mg pot^{-1} h^{-1}). Error bars represent the standard error values (mean of 3 replicates). (a) emissions from UMAN, MAN, ANMAN. (b) emissions from AN, U, Control.

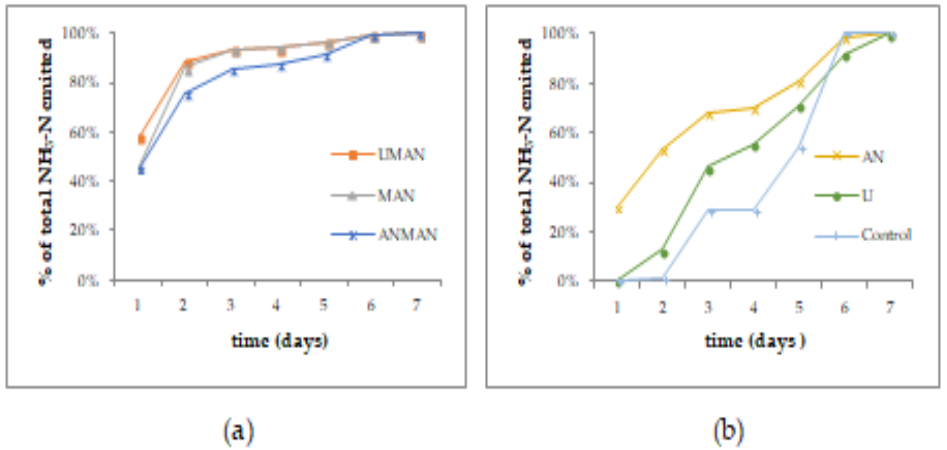

Figure 2: NH_3-N emission dynamics (percentage of the total NH_3-N emitted). (a) NH_3-N emissions dynamics from UMAN, MAN, ANMAN. (b) NH_3-N emissions dynamics from AN, U, Control.

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Conclusions

- ✓ Application of dairy manure mixed with urea or calcium ammonium nitrate on stubble-covered soil stimulates NH_3–N emissions relative to the isolated application of manure or mineral fertilizer.
- ✓ The enrichment of untreated dairy manure with U or AN for application on stubble-covered soil should not be recommended.
- ✓ This work contributes to better understand the losses of ammonia from manure and manure amended with mineral nitrogen fertilizers applied on the stubble.
- ✓ Some manure pre-treatments or the use of other mineral fertilizers should be investigated to improve such solution in no-tillage agriculture.

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