

COMMENTS AND LETTERS TO THE EDITOR

Ammonia Volatilization from Flooded Rice Soils

The recent publication by Mikkelsen et al. (1978) leaves the reader with some serious questions. The most important point to be raised concerns the methodology. Ammonia losses were estimated by two methods: (i) by scrubbing air before and after passing it through a jar placed over a soil, or, (ii) by collecting NH_3 in a static acid trap placed under a plastic canopy suspended over the water surface.

The authors rightfully list wind velocity as one factor influencing ammonia volatilization, yet fail to recognize that the same is true in method (i) (2, 3, 7). The rate of airflow imposed in these experiments appears one order of magnitude below reportedly required air velocities (3, 6, 7, 8) and thus becomes the limiting factor reducing soil, N source, or N management effects on NH_3 loss.

The method (ii) employed in these experiments is a novel approach. The question of what the collected NH_3 represents (e.g., does air move freely under the canopy or is it stagnant, what surface area contributes to the acid trap) has not been addressed by the authors.

Interpretation, in terms of absolute magnitude of NH_3 loss, of data collected by the two methodologies employed will require extreme caution. Reported agreement with other data that the authors reviewed is mainly due to similarities in measurement techniques. Alternative methods of measurement appear to lead to much higher estimates of NH_3 volatilization (1, 6).

A second point to bring to the attention of the readers deals with the floodwater chemistry. Firstly, the authors inaccurately quote Stumm and Morgan (1970, p. 127) by using equations that hold only for pure $\text{H}_2\text{O}-\text{CO}_2$ systems in equilibrium with atmospheric CO_2 ($p\text{CO}_2 = 3.5$), and applying them to natural waters. This leaves the reader with the impression that all natural waters maintain a pH of 5.65. The relevance of the electroneutrality equation for pure water in a study with water fertilized with urea or ammonium sulfate is doubtful in the first place.

Along this line, it remains unclear how the authors arrived at their bicarbonate and carbonate concentrations in Fig. 3 and 4. Assuming that 3 days after fertilization with N some of this N is still present in the floodwater to be volatilized, one must assume that the alkalinity titration includes the titration of NH_3 to NH_4^+ . At a pH of 8.5 (Fig. 3) the contribution from NH_3 to this alkalinity may be predominant, yet the authors do not seem to take this into account. Besides, the authors do not reveal the source of N used (Fig. 3, 4), leaving the impression that there is no difference between the carbonate equilibrium of urea [$(\text{NH}_4)_2\text{CO}_3$] fertilized water and ammonium fertilized water. At least for Louisiana clay this seems at odds with results given in Fig. 2, as well as with my own findings (6, 7).

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deficiencies similar to others that have been reported and do not agree with the main body of data in the literature.

A question raised by Vlek relates to an apparent typographical error wherein the air exchange rate required for the train-acid trapping device was printed at 6 per minute rather than the correct value of 6 per minute. This error has been requested of the Managing Editor who suggests that a "required" air exchange should be used, as there can be no "required" air exchange since air exchange is a function of wind velocity under the canopy and is subject to at least four additional major factors: wind velocity as well as environmental and biological factors. The authors choose the frequently used air-trapping collection method for this research fashioned after Kissel (2), wherein an air exchange of 3.5 times per minute was adequate for maximum removal of NH_3 collected over soil. We did not use a 2- to 3-fold increase in air volume (14 to 16 volumes per minute as did these authors) and effects were created on evaporation rates, wind velocity, and air density. Unfortunately little is known about the role of wind velocity in ammonia transfer from aquatic rice systems. The important variables have been integrated into the model.

Vlek indicates that the authors inaccurately used Stumm and Morgan (5) by using equations appropriate for CO_2 systems in equilibrium with atmospheric CO_2 in our paper that the natural aqueous system is in equilibrium with atmospheric CO_2 . The reactions cited were "simplified". We were unaware, however, that 91.5% of the total CO_2 occurs in Asia where an estimated 47% is dissolved in much of the balance irrigated by rainfed systems and pure water. It was not the intent of the authors to use the carbonate systems occurring in all natural waters (4) but to characterize an important biological process in the aquatic system affecting ammonia volatilization. Data reported in Fig. 3 and 4 of our paper show that CO_3^{2-} and HCO_3^- values obtained by titration are not the standard methods for the examination of carbonate systems are made in these methods to correct for the effect of ammonia due to undissociated ammonia.

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Literature Cited

1. Bouldin, D. R., and B. V. Alimagno. 1973. Ammonia volatilization losses from IRRRI paddies following various applications of fertilizer nitrogen. Int. Report, Los Banos, Philippines.
2. Fenn, L. B., and D. F. Kissel. 1973. Ammonia volatilization from surface applications of ammonium sulfate to rice. Int. Report, Los Banos, Philippines.