**A new approach for measuring ammonia volatilization in the field: First results of the French research project "VOLAT'NH3"**

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## 1. Background & Objectives

Atmospheric ammonia is becoming a great challenge for French agriculture, regarding its economic and environmental impacts. On the one hand, the increasing prices of mineral fertilizers enhance the need for improving the efficiency of mineral and organic fertilization while in the other hand, air quality regulations are becoming more strengthening. Although scientific studies were carried out in the past two decades in France (Génermont and Cellier 1997; Morvan, 1999; Le Cadre, 2004), there is still a lack of field experiments designed to assess the best ways to reduce ammonia emissions in different production systems. This situation is merely caused by the lack of a simpler method than those classically available to measure ammonia emissions in the field. Funded by French State CASDAR program, The "VOLAT'NH3" research project has been launched in 2009 with two main purposes: 1) elaborate a simple method to measure ammonia emissions based on the inverse modelling approach (Loubet et al., 2010) using batch diffusion $NH_3$ concentration sensors (alpha badges (Sutton et al. 2001), 2) use this method to test the sensitivity to ammonia emissions of various mineral and organic fertilizer and the effectiveness of some agricultural practices to reduce emissions following fertilization. This paper presents the first results of the project.

## 2. Materials & Methods

Eight field experiments (Table 1 for two examples) were carried out in spring 2011: 4 comparing mineral fertilizer applications on winter wheat or oilseed rape, and 4 studying pig or cattle slurries applications on bare soil surface or incorporated after application. Plots were statically randomized with 2 repetitions per treatment (field of at least 400 m²). Alpha badges were placed at two heights (30 and 100 cm from crop or soil) in each field and exposed sequentially during 6 periods (6 hours after application, application + 1 day, + 2 days, + 3 days, + 6 days, + 20 days). Some alpha badges were placed on background measurements masts located away from the field and at a height of 3 m. In this abstract we present only a comparison of the $NH_3$ concentrations measured in each fields.

Table 1. Main characteristics of two experiments

| Experiment/ crop[@] | Soil characteristics (0-25 cm) | | | | Treatment | Total N rate* ($kgN.ha^{-1}$) | $N\text{-}NH_4^+$ rate** ($kgN.ha^{-1}$) | $N\text{-}NO_3^-$ rate*** ($kgN.ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | Clay ($g.kg^{-1}$) | Silt ($g.kg^{-1}$) | Total C ($g.kg^{-1}$) | pH | | | | |
| Bernienville 2011 / ww gs Z30 | 132 | 770 | 7.6 | 6.9 | 0 N | 0 | 0 | 0 |
| | | | | | AN | 100 | 50 | 50 |
| | | | | | UAN | 100 | 25 | 25 |
| Derval 2011 / bs | 184 | 507 | 19.9 | 6.4 | 0 N | 0 | 0 | 0 |
| | | | | | Cattle slurry on surface | 135 | 60 | 0 |
| | | | | | Cattle slurry incorporated | 135 | 60 | 0 |

0N = without N application; AN=Ammonium nitrate; UAN=Urea Ammonium Nitrate; [@]ww gs Z30 = winter wheat at growth stage zadoks 30, bs = bare soil; *Organic and mineral nitrogen; **$NH_4^+$ form nitrogen; ***$NO_3^-$ form nitrogen

## 3. Results & Discussion

The variability of the $NH_3$ concentrations between repetitions is small, indicating a rather good accuracy of the method. The climatic context of spring 2011 in France was in favour of large ammonia emissions (almost no rainfall and warm temperatures during experiments). Concerning mineral fertilizers, we measured larger $NH_3$ concentrations for UAN compared to AN in non-calcareous soil (Figure 1a). The same experiment carried out in calcareous soil (soil pH = 8.3, data none showed) suggests the same emission rate for both fertilizers. The ammonia concentrations were larger than the background during almost one week following application. For the slurry application (Figure 1b), we can see the strong effect of fertilizer incorporation. Moreover, the emission kinetic is quite different from mineral fertilizer. Almost all ammonia is volatilized during the first two days after applications. These results are consistent with those already published in France and elsewhere. There is still work to be done to get from ammonia concentrations to nitrogen fluxes, using the method developed and presented in Loubet et al. (2010 and 2011).

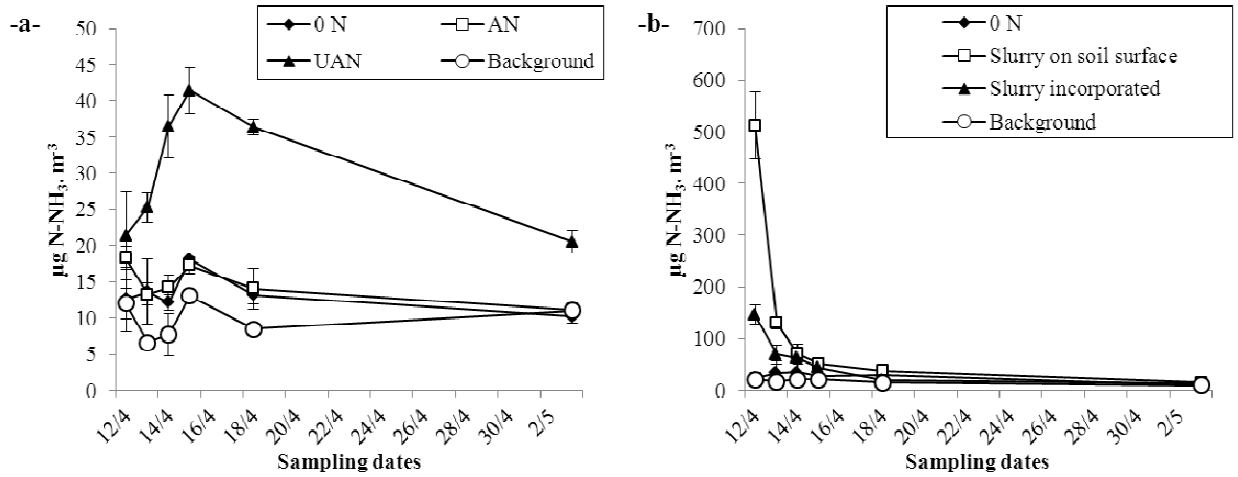


Figure 1. Ammonia concentrations at 30 cm height following mineral fertilizer applications in Bernienville 2011 experiment (-a-) and cattle slurry application in Derval 2011 experiment (-b-). Vertical bars are standard deviations.

## 4. Conclusion

These first results using a new method of ammonia volatilisation measurements easy to use in the field are promising. The method should help elaborating strategies of ammonia emission reduction in various French agricultural contexts.

## References

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