AMMONIA FLUX FROM A COTTON CANOPY DURING DEFOLIATION

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Abstract

This study was conducted to evaluate a method being used in California to monitor N loss from field scale fertilizer applications for estimates of canopy N loss during defoliation. The methodology employs citric acid traps to measure NH_3 concentrations at various heights above the canopy for field estimates. A micro-site was established using the same active denuder samplers at heights within and above the canopy. These sites were monitored prior to and through the post treatment period following a Def and Prep application. Standard mass balance micrometeorological techniques were used to estimate the integrated NH_3 flux by combining measurements of wind speed and NH_3 air sample concentrations from the height-dependent sampling locations. The experiment was timed to span a short (2-week) period pre- to post-defoliation application based on the hypothesis that the enhanced senescence induced by a chemical defoliant would increase plant emissions of NH_3. Information obtained on NH_3 emissions will be used to help develop a complete N budget for California cotton.

Prior measurements of NH_3 emissions from cotton fields fertilized with anhydrous NH_3 injected on a silty clay with pH of 8.5 and a similar site with pH of 7.8 produced emission factors of 5.6 and 3.9 % of applied fertilizer, respectively (Potter et al). The defoliation site was on a Lethent silty clay with pH of 7.9. The methodology and sampling procedure produced data that showed differences in diurnal NH_3 emission values and distinct differences related to the canopy defoliation. At this site, the canopy sampling showed a 76% reduction of NH_3 emissions from the pre-treatment canopy to 5 days post treatment. By this time the field had reached 65 % defoliation (visual rating) and was well desiccated (75%). NH_3 volatilization peaked at 2 days post-defoliation. This value was 11% higher that the pre-treatment value. There was at this time, a distinct shift in the diurnal emissions. Prior to defoliation the day/night emission were nearly equal (51/49% respectively). After defoliation, the nighttime emissions were reduced to only 6% of the total diurnal value. This trend in reduced night emissions was extended to the 5th day of the sampling period. At 65 % defoliation (5 days post treatment) the total diurnal emissions were reduced 70% from the pretreatment values.

This field study showed that canopy level NH_3 emission can be monitored to provide estimates of NH_3 volatilization loss from a cotton field. The sampling procedure was sensitive enough to show differences in diurnal NH_3 flux values and changes associated with plant defoliation and desiccation. Additional monitoring could provide estimates of seasonal N losses and specific losses from various fertilizer application methods and soil types. This information could help explain discrepancies in unaccounted N for a complete cotton N budget.

Reference

Potter, C., C. Krauter and S. Klooster. 2001. Statewide Inventory Estimates of Ammonia Emissions from Native Soils and Chemical Fertilizers in California. CA Air Resources Board Emissions Inventory Branch, June 30,2001 (ARB ID 98-716).