Non-CO_2 Greenhouse Gases: Nitrous Oxide

Source/Sectors: Agriculture/Agricultural Soil Management

Technology: Inhibition of nitrous oxide formation (B.1.1.2)

Description of the Technology:
Several agricultural activities increase mineral nitrogen availability in soils for nitrification and denitrification and ultimately increase the amount of N_2O emissions (USEPA, 2006a). Although most of the N_2O emissions from agricultural activities are from soils, the emission flux of N_2O per unit surface area of soil is small and varies greatly across time and space. The flux rate depends significantly on soil type, climate conditions, and soil management practices (IEA, 2000). Basically, there are two types of strategies and related technological options that are applicable to emission reduction of N_2O from agricultural soils. The first type uses measures that improve efficiencies in nitrogen utilization, and the second type inhibits the formation of nitrous oxide (Kowalenko, 1999). It should be noted that there are overlaps in these two types. For example, the use of the nitrification inhibitor and change in irrigation practices are also measures for improving nitrogen fertilizer efficiencies in the field.

With regards to inhibition of N_2O formation to reduce its emission from agricultural soil, there are many technological options and practices mentioned in the literature; but most of them were mentioned without detailed discussion and information. Below are a list and a brief description of the technological options and practices found from the literature search:

- Nitrification inhibitors – Nitrogen applied must be nitrified to nitrate before it is available for denitrification. Nitrification inhibitors delay the transformation of ammonium to nitrate (Cole *et al.*, 1997; Kroeze and Mosier, 2000). They can reduce the loss of nitrogen and permit crop production at constant or improved yields at given fertilizer application rates. The abatement cost for the nitrification inhibitor option is approximately \$70/$MT_{CO2\text{-}Eq.}$ (Gale and Freund, 2002).
- Urease inhibitors – Urease inhibitors delay the transformation of urea to ammonium to help matching the timing of nitrogen supply with crop demand (Cole *et al.*, 1997; Kroeze and Mosier, 2000).
- Alternative tillage systems – Some studies suggested that N_2O emissions could decline as a result of reduced nitrogen application rates following a shift to no till agriculture (Lemke *et al.*, 1999). Conversion from conventional tillage to no till will cause less disturbance to soils and more crop residual is retained (USEPA, 2006b)
- Changes in irrigation practices – Because soil-water content is an important factor in volatilization as well as nitrification/denitrification, irrigation practices can have an important impact on N_2O emissions from agriculture (Lemke *et al.*, 1999). However, the appropriate use of irrigation water is site-, crop-, soil-, and temperature-specific, therefore this option may not be easy for practical application.
- Improving drainage and avoiding soil compaction – Improving drainage and preventing soil compaction can reduce N_2O emission by 3% (Branosky & Greenhalgh, 2007; O'Hara *et al.*, 2003).

Effectiveness: Low

Implementability: Low

Reliability: Low

Maturity: Low

Environmental Benefits: It reduces nitrous oxide emission.

Cost Effectiveness: Low

Industry Acceptance Level: Low

Limitations: May affect the yield of crops.

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