Fertilizer and Water Management for Greenhouse Gas Emission Mitigation and Food Security

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Fertilizer and Water Management for Greenhouse Gas Emission Mitigation and Food Security

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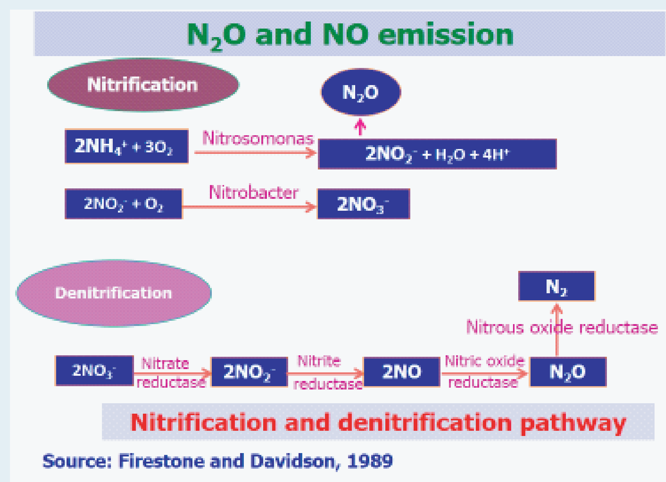
Significance of the study

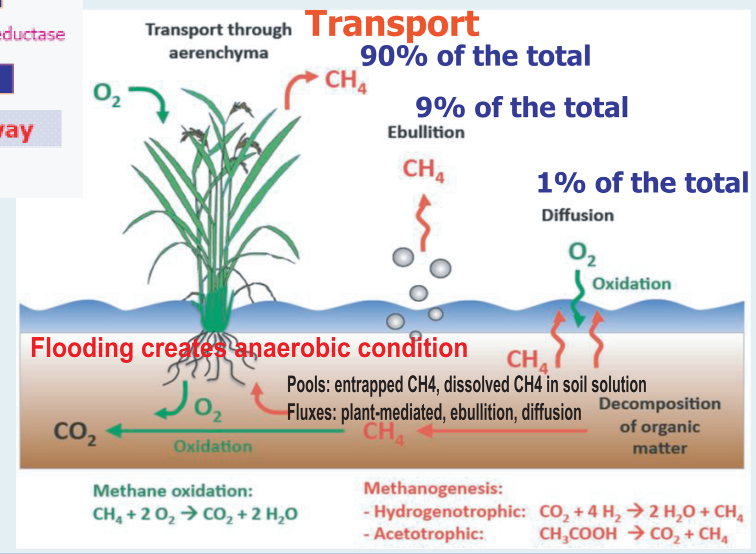
- Rice crop occupies 80% of the total cropped areain Bangladesh producing 38.13 million t rice annually.
- Efficiency of urea-N by broadcasting method is only 25-33 %, the rest is lost through volatilization, runoff, leaching and denitrification.
- Deep placement of urea briquettes has been shown to increase the N use efficiency up to 30 percent and increase rice production up to 20 percent.
- Agricultural activities contribute significantly to global GHG emissions, namely carbon dioxide, methane, and nitrous oxide, which are major GHGs contributing to global warming (IPCC, 2001). Different GHGs like methane (CH_4), nitrous oxide (N_2O) and nitric oxide (NO) are being emitted from rice fields that cause global warming.



N_2O
Absorbs 298 times energy than CO_2
Destroys ozone layer
Long life time (120-150 years)
NO
Responsible for acid rain
Causes environmental pollution

CH_4 emission

CH_4
Absorbs 25 times energy than CO_2
Persist for 8 -10 years



Objectives

- To quantify GHGs emission from rice-based cropping systems under different water and fertilizer management practice
- To find out an efficient nitrogen and water management technologies that increase crop productivity and mitigate GHG emissions

Experimental fields Boro 2016

Materials and Methods

Location: BAU Farm, Mymensingh (AEZ 9)

Soil Properties: Texture silt loam, pH 5.34, OM 3.04%, total N 0.16%, available P 2.97 μg g^{-1}, exchan. K 0.09 meq%, avail. S 12 μg g^{-1}

Cropping System: *Boro*-T. *Aus*-T. *Aman*; *Boro-Mustard*-T. *Aman*

Variety: BRRI dhan28 (*Boro* Season), BRRI dhan48 (*Aus* season), BR22 (*Aman* season), Binadhan-7 (*Aman* season), BARI sarisha14

Factors of Experiment:

A: Nitrogen forms: Prilled urea, urea briquettes and manures

B: Water Management practices : Continuous standing water (CSW) and alternate wetting and drying (AWD) (Boro season)

Design : RCBD
Plot size : 5.6 m x 3.6 m
Treatment : 8
Replication : 3

Treatment combinations with N rates applied in the experiment

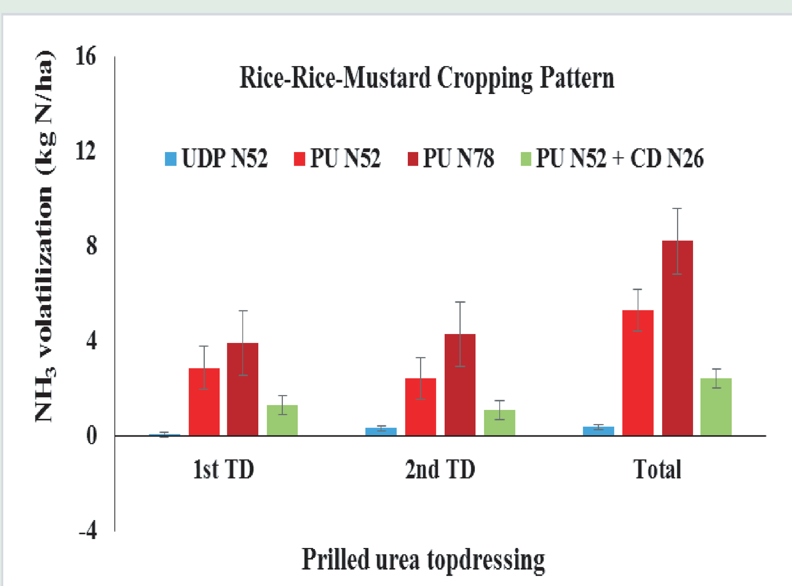
Treatment	Description	N Rate	N Rate
		Boro [a]	Aus & T. Aman [b]
T1	Control	0	0
T2	Urea briquette	78	52
T3	PU broadcast	78	52
T4	PU deep placement (BRRI Applicator)	78	52
T5	PU broadcast	156	78
T6	PU+ PM (IPNS basis)	156 (130 kg from PU and 26 kg from PM)	78 (52 kg from PU and 26 kg from PM)
T7	PU+VC (IPNS basis)	156 (130 kg from PU and 26 kg from VC)	78 (52 kg from PU and 26 kg from VC)
T8	PU+CD (IPNS basis)	156 (130 kg from PU and 26 kg from CD)	78 (52 kg from PU and 26 kg from CD)

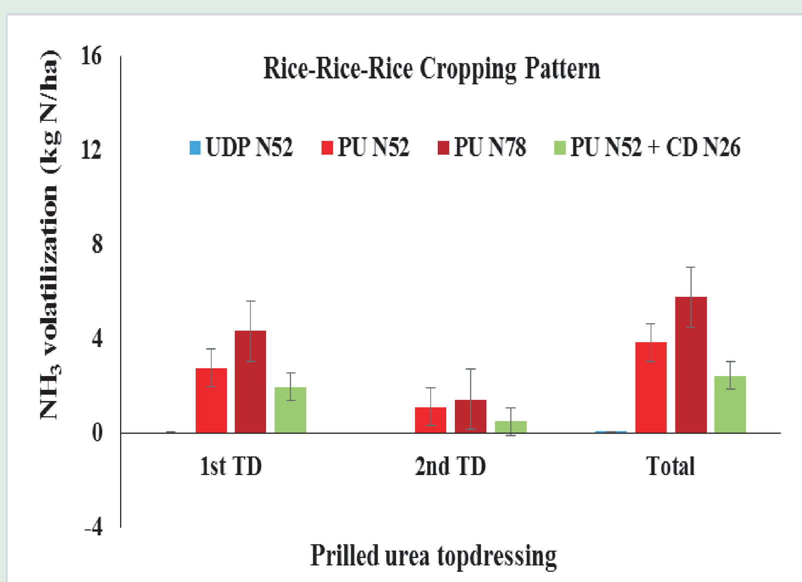
Data recorded

- Irrigation data
- Dates of heading, flowering, maturity, and harvest
- NH_4-N in rice field water after each N application for consecutive 7 days
- NO, N_2O & CH_4 emission measurement in rice growing seasons
- Yield & yield contributing characters

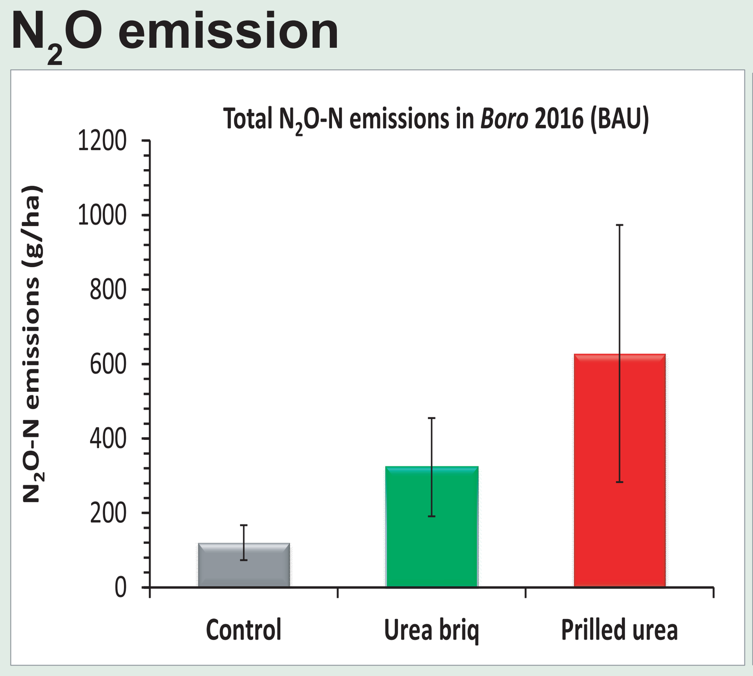
Results

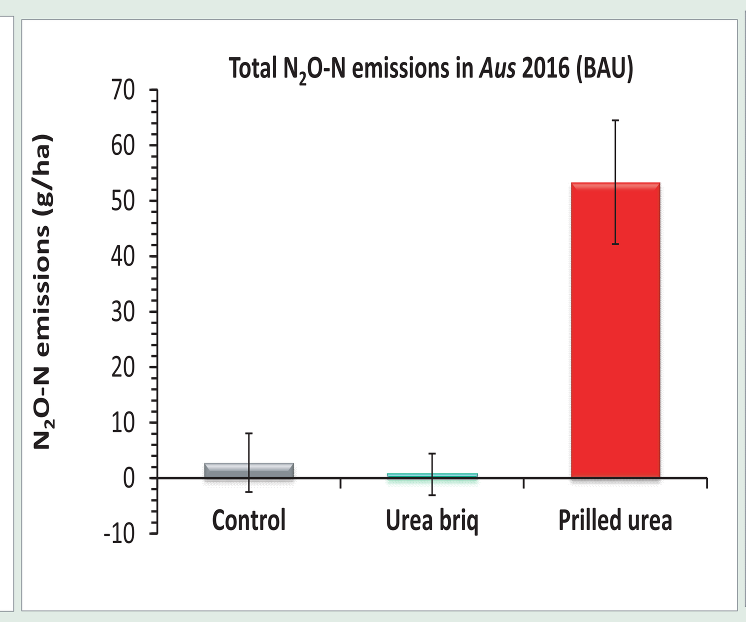
Ammonia volatilization

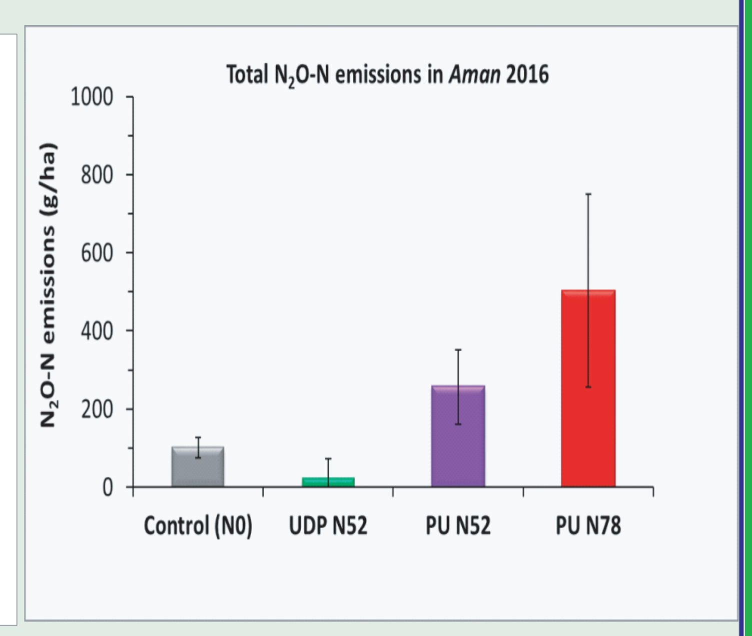




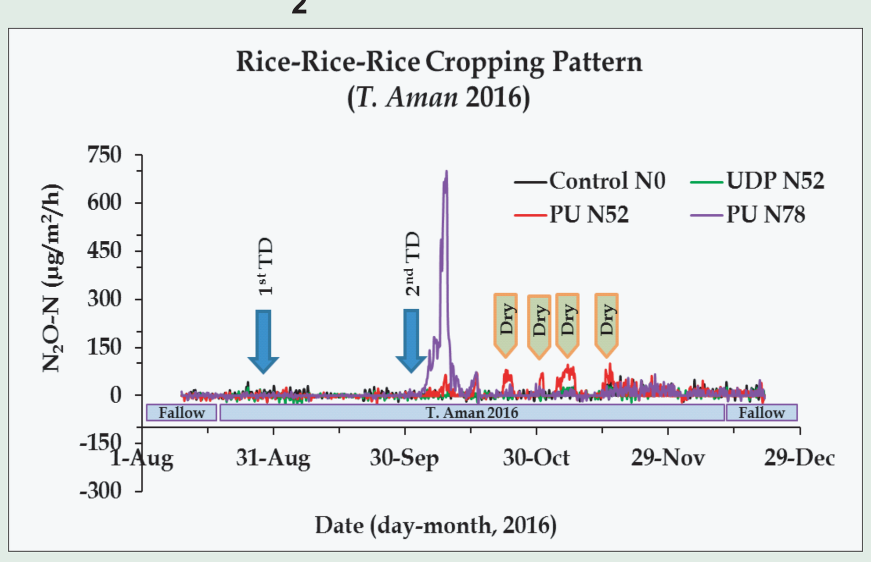
N_2O emission



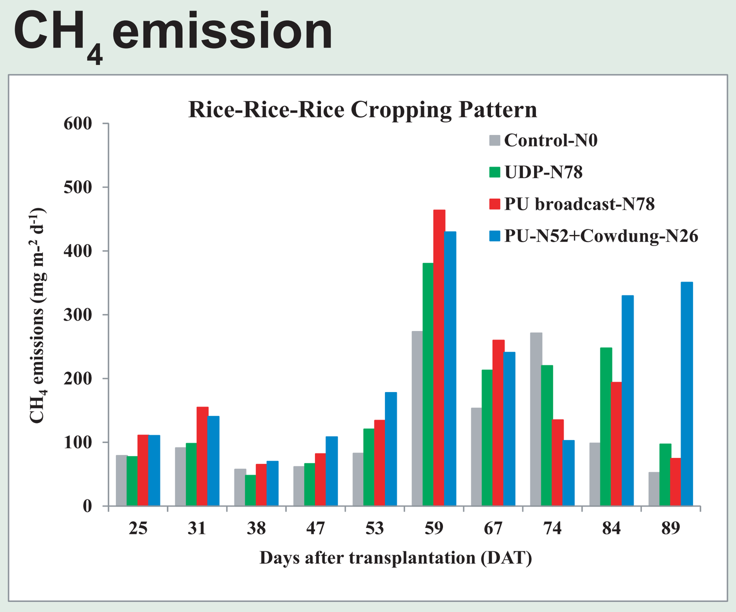


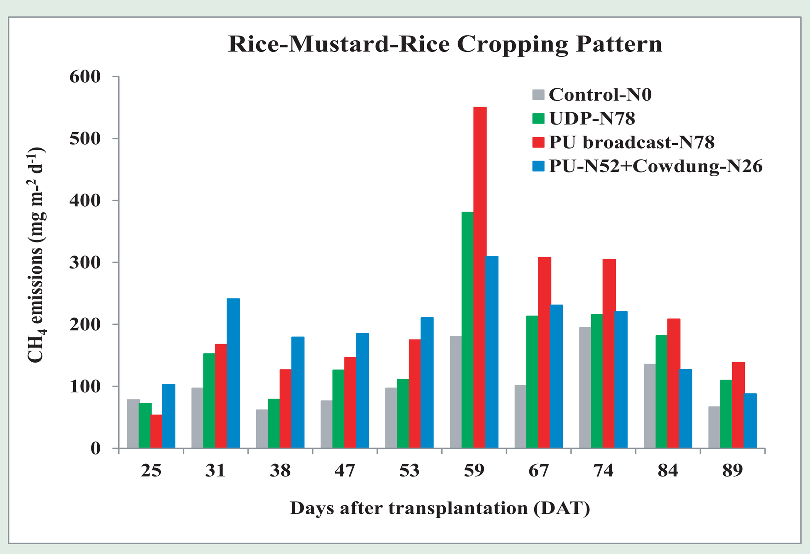


Seasonal N_2O emission trends

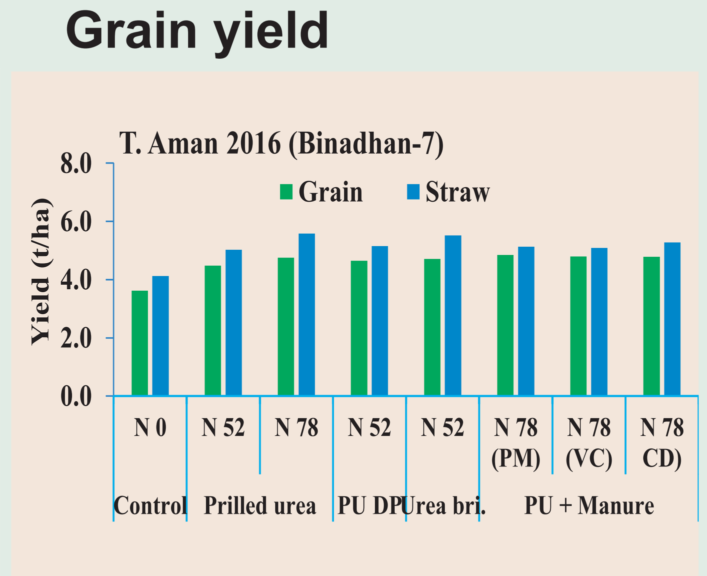


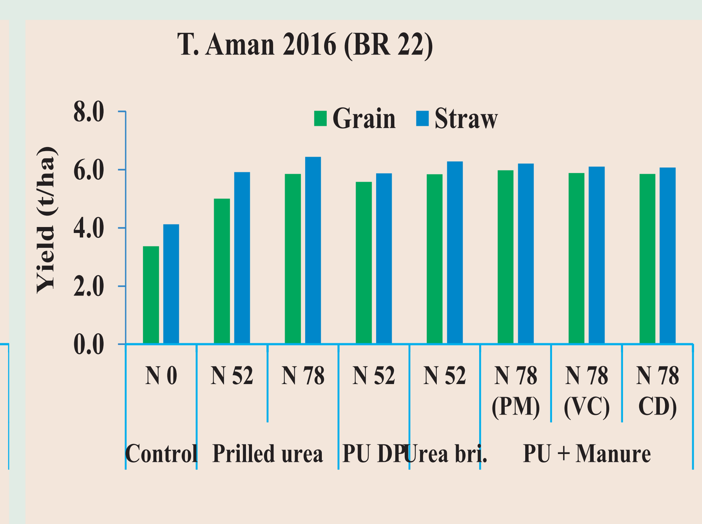
CH_4 emission



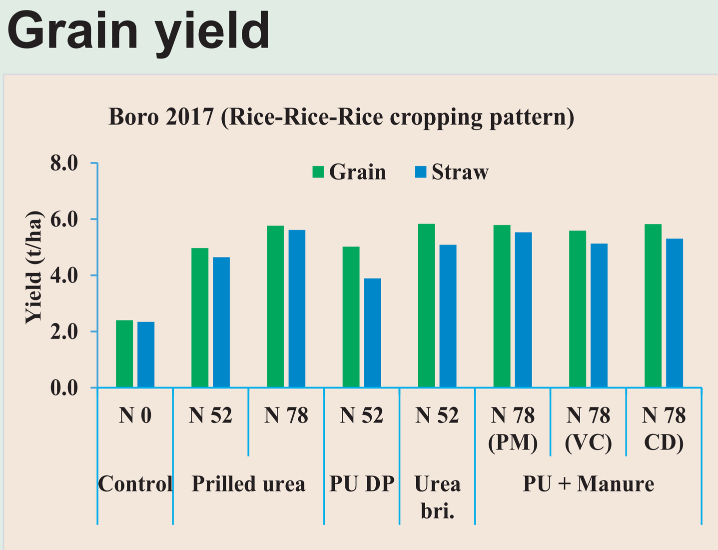


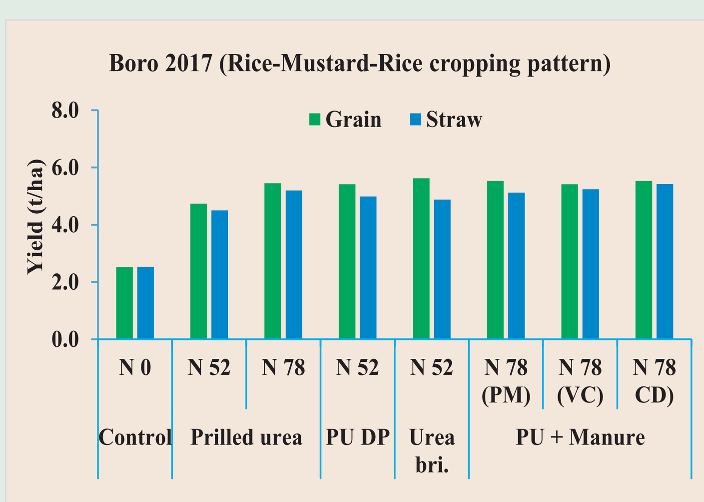
Grain yield



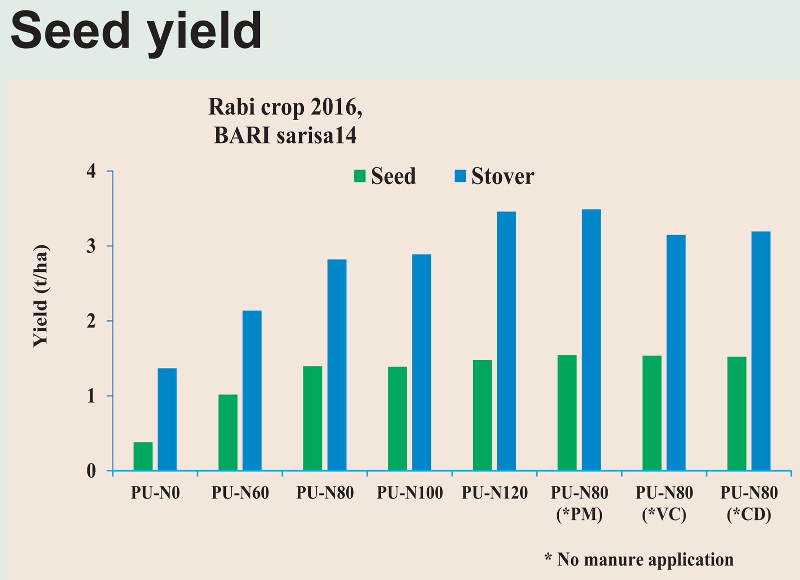


Grain yield

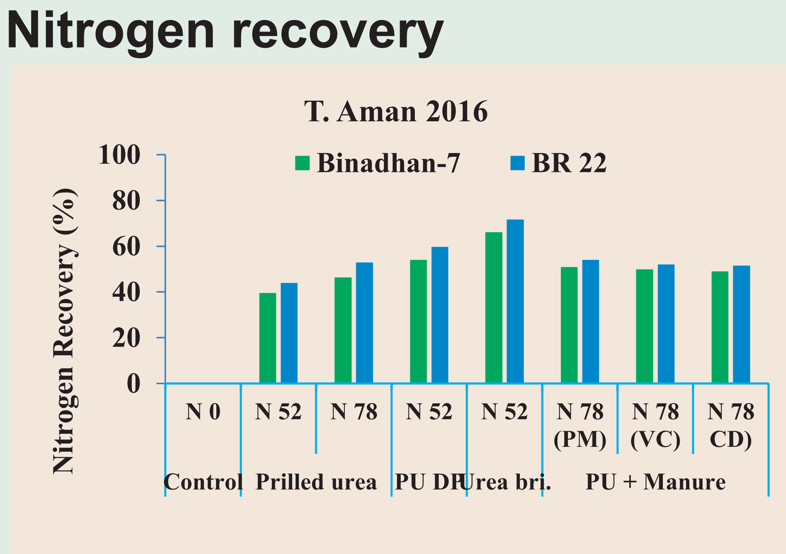


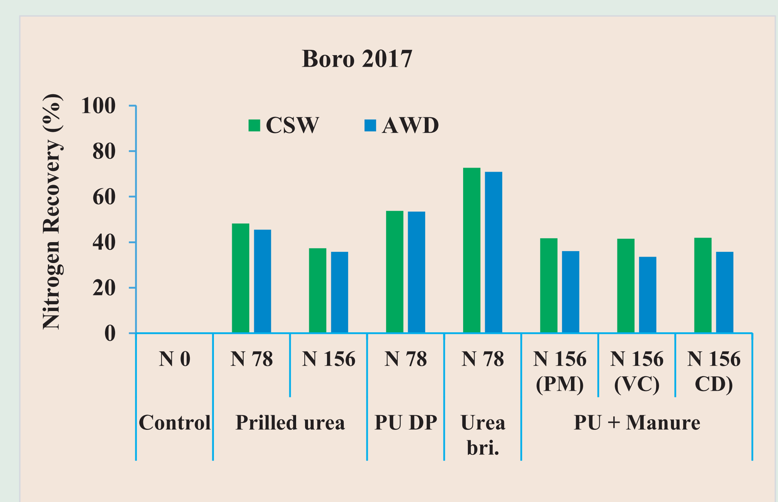


Seed yield



Nitrogen recovery





Conclusions

- UDP significantly reduced NH_3 volatilization & N_2O emissions compared to broadcast PU.
- Emissions of N_2O from broadcast PU were two times higher than that of emissions from UDP and they increased with increasing N rates.
- Methane emissions were higher at maximum tillering and panicle initiation stages than that during flowering and maturity stages.
- Integrated application of manure with broadcast N fertilizer significantly increased both grain and straw yields of rice compared to without organic manure.
- Deep placement of either urea or urea briquettes irrespective of N rates increased grain yields significantly compared to broadcast PU ensuring food security.

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