Improving nitrogen-use efficiency in irrigated rice (*Oryza sativa* L.); use of Stabilized Urea

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Why is it so important to increase nitrogen use efficiency in Rice ?

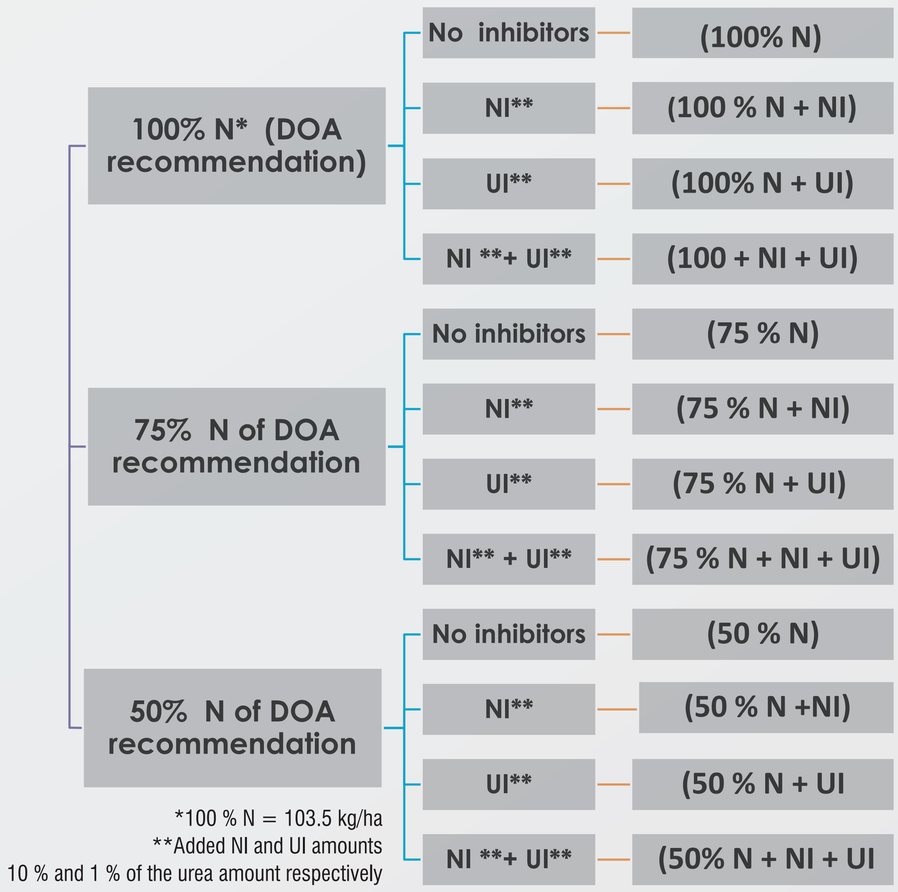
- Nitrogen affects all parameters contributing to yield (Dobermann et al., 2000)
- In Sri Lanka net extent harvested in 2013 was 1.07 million ha and production 4.62 million mt (Central Bank, 2014)
- Sri Lanka has imported 0.6 mn mt of solid fertilizer in 2012, urea ~50% (National Fertilizer Secretariat, 2013) and around 64% of the imported urea used in paddy cultivation (Sirisena et al., 2001)
- Recovery of applied N 15-30% (Sirisena et al., 2001) so that nitrogen can be loss through ammonia volatilization, nitrification, denitrification, and leaching leads to high economical and environmental cost
- Nitrogen affects all parameters contributing to yield (Dobermann et al., 2000)
- Therefore increasing N-use efficiency through minimizing losses is critical in enhancing yields

Use of Nitrification and Urease inhibitors

- Nitrification Inhibitors (NI) delay the bacterial oxidation of the NH_4^+
- Urease inhibitors (UI) delay the transformation of urea to NH_4^+
- NI - Nytrapyrin, ATC, TU, DCD*
- UI - NBPT*, PPDA, Hydroquinone

Materials and Methods

- Pot experiment conducted in a glass house in University Experimental Station, Dodangolla, Kundasale
- Treatment combinations



*100 % N = 103.5 kg/ha
**Added NI and UI amounts
10 % and 1 % of the urea amount respectively

Experimental Design

- Complete Randomized Design (CRD) with three replicates Establishment
- Conduct in 20L (d=30 cm) buckets

Data analysis

- Using analysis of variance ANOVA as a two factor factorial design (SAS 9.2)
- Mean comparisons through DMRT method

Measurements

Weather parameters
- Light intensity, Temperature, Relative humidity

Vegetative parameters
- Above ground bio mass (AGB)

Reproductive parameters

- End of the ripening stage
- Yield components
- Grain yield
- Harvest index (HI) = $\frac{\text{Dry grain weight}}{\text{Total dry weight}}$
- Agronomic efficiency (AEN) of applied Nitrogen

Overall objective

To assess the influence of nitrification inhibitors (NI) and urease inhibitors (UI) on increased agronomic efficiency of nitrogen (AEN) in rice

Specific objectives

To ascertain,
- Net urea reduction achieved by adding NI and UI with urea, without affecting yield and growth of rice
- Whether N-use efficiency can be improved by adding NI and UI with urea application in rice

Results and Discussion

- Dodangolla
- Mean day time temperature (inside glass house)
  minimum- 22 °C
  maximum-34 °C
- Mean day time RH 80 %
- Light intensity 2253.4 μmoles/m^2/s at 12 noon (inside glass house)

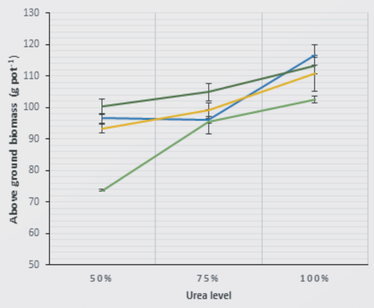


Figure 1. Response of different inhibitors to different rates of added urea with respect to above ground biomass in rice

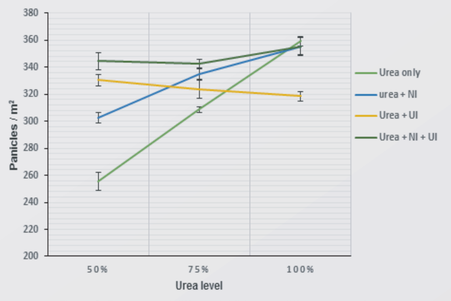


Figure 2. Response of different inhibitors to different rates of added urea with respect to panicles /m-2 in rice.

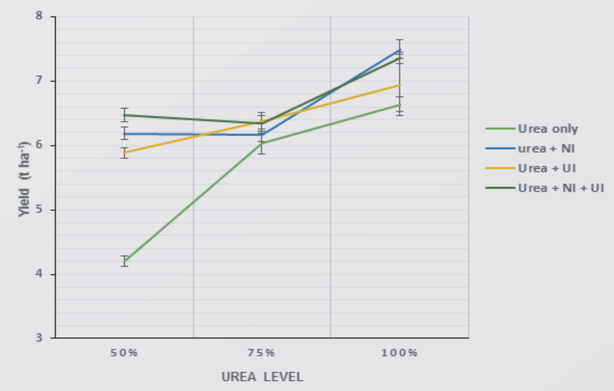


Figure 3 Responses of different inhibitors to different rates of added urea with respect to grain yield) in rice.

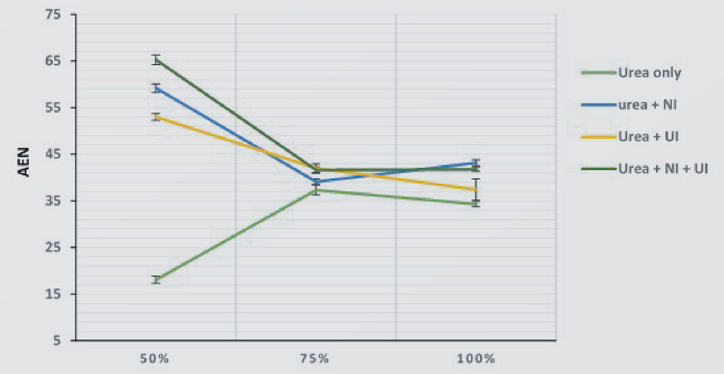


Figure 4.Responses of different inhibitors to different rates of added urea with respect to Agronomic Efficiency of in rice.

Conclusions

Application of 50% of the recommended rate of urea treated with inhibitors could attain a grain yield similar to that of at 100% of the recommended rate of urea so that 50% of the recommended rate of urea could be saved if urea is applied with DCD and NBPT. AEN in rice could be increased by reducing N losses through treating urea with inhibitor/s (DCD and/or NBPT) when 50% of the recommended rate of urea is applied.

Results

Yield components

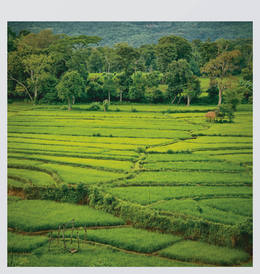
- Significant interaction effect of urea level and inhibitor compounds indicated that different inhibitors responded differently to different rates of urea with respect to number of panicles/m2 , number of spikelets/panicle and filled grain percentage.

Grain yield

- Without urea application yield was 3.32 t ha-1
- Grain yield responded significantly to urea addition and significant interaction effect of urea level and inhibitor compound indicated that different inhibitors responded differently to different levels of urea
- At 50% urea level, grain yield was considerably increased with added inhibitors over no inhibitor treatments recording the highest grain yield in the DCD + NBPT treatment.
- The grain yield of DCD + NBPT treatment at 50% urea rate was similar to that of 100% urea alone indicating that recommended rate of urea can be cut down by 50% without affecting grain yield if urea is amended with DCD + NBPT.
- However, adding both DCD + NBPT to 50% urea level performed greater than adding DCD and NBPT alone. Increasing availability of N to the plants through decreasing N losses by inhibitors may be the reason for the above observations.

AE_N (Agronomic efficiency of nitrogen)

- The highest AEN was recorded at 50% urea level amended with both DCD and NBPT while the lowest was recorded in urea alone at 50% urea level, indicating that there is a significant efficiency improvement at 50% urea level with inhibitors, further considerable amount of added N is made available by preventing from losing.
- At 75% and 100% urea levels rice plant is getting adequate amount of N even with N losses so that saving N by inhibitors has no use.



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