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Movement and Retention of NH_4-N in Wetland Rice Soils as Affected by Urea Application Methods

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Significance of the study

- Rice crop occupies 80% of the total cropped area in Bangladesh producing 38.13 million t rice annually & production of 1 ton rice, rice plants needs to uptake of 18-20 kg N.

- Urea deep placement (UDP) in lowland rice soils at 7-10 cm depth concentrate ammonium nitrogen (NH_4-N) in the anaerobic soil layer reducing its movement to the soil surface or in floodwater.

- Deep placement ensures retention of NH_4-N in the soils for longer period of time, thus a single application is sufficient for whole rice-growing season compared to 2-3 split application in broadcast methods.

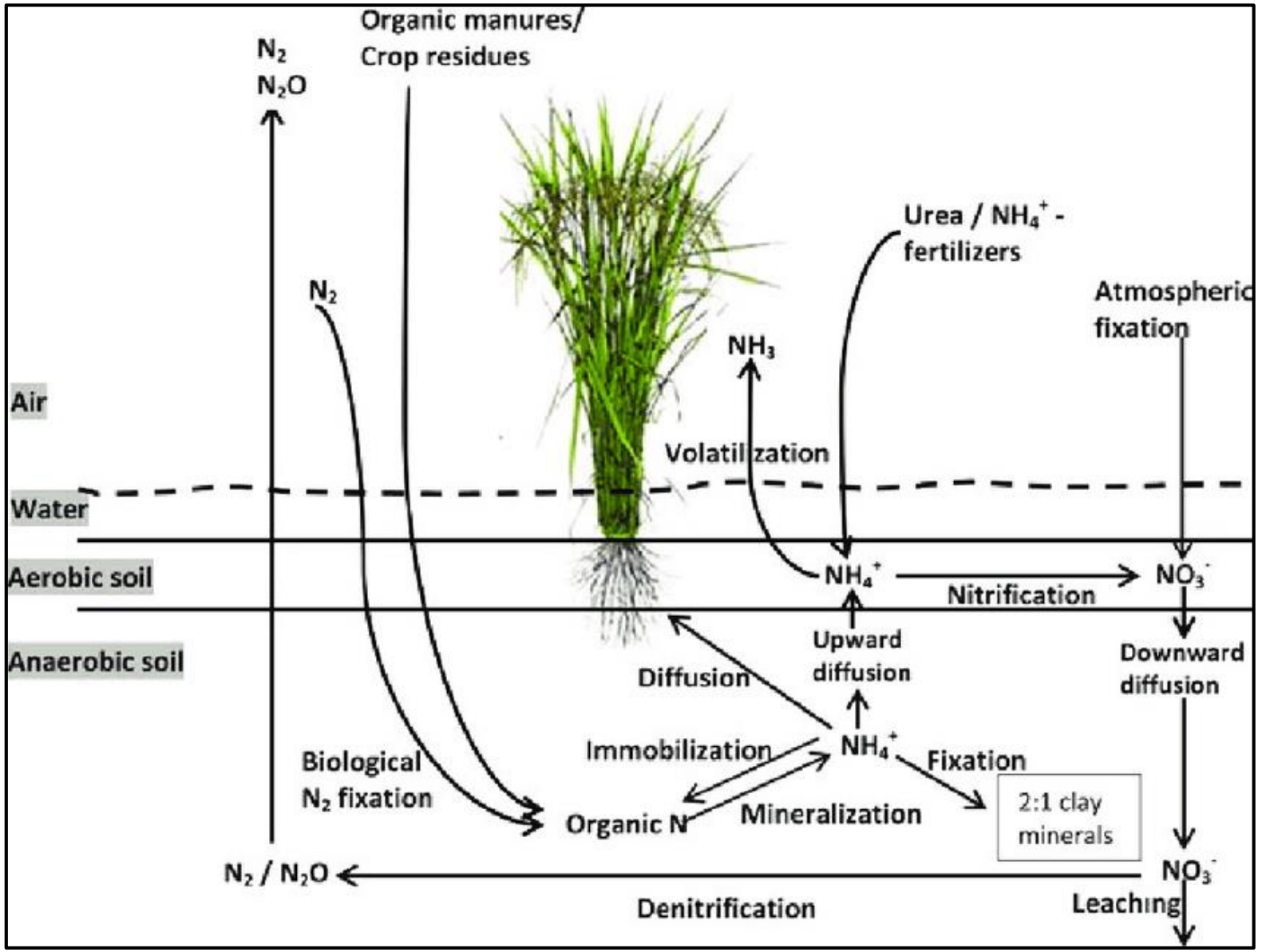
- Deep placement of USG have been shown to increase the N use efficiency by up to 30% and increase rice production up to 20%.

Characteristics of submerged soil

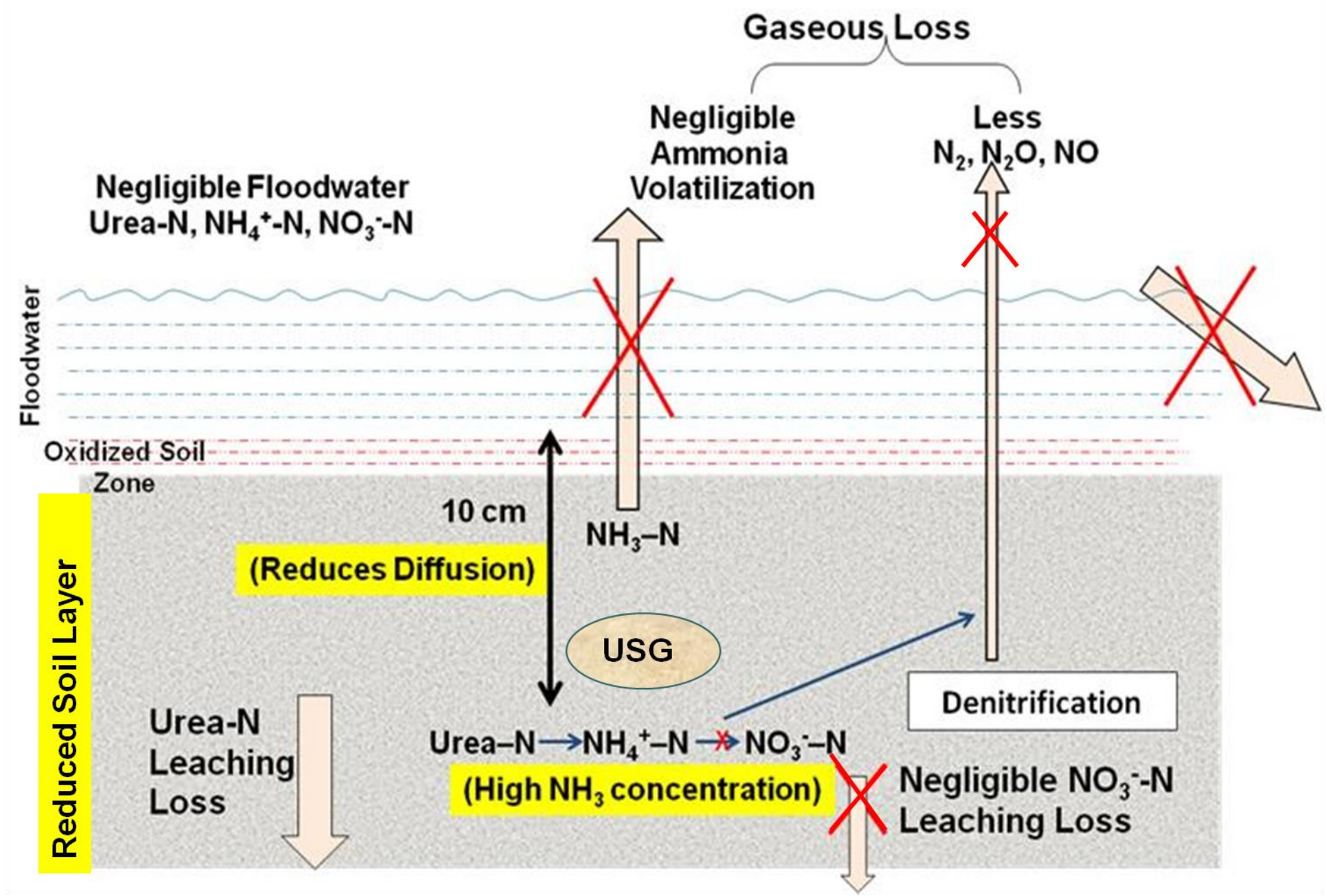
- The submergence leads to gradual depletion of oxygen and causes reduction of a number of ions such as NO_3^-, (NO_2^-, N_2O, N_2) Mn_4^+, Fe_3^+, SO_4^{2-}, CO_2 in the soil.
- Exchange of gases between soil air and atmosphere is curtailed.
- The soil undergoes reduction and the oxidized constituents of soil are reduced.
- Soil pH changes and approaches to neutrality. This is a result of the change in chemical compounds when soil is reduced.

Inorganic N: very soluble, move rapidly through soils into groundwater & can be toxic at high concentrations, which depends on pH and temperature.

Nitrogen transformation in flooded soils



Why N deep placement ?



Objectives

- To investigate the movement and retention of NH_4-N in the soils during rice-growing season with two application methods, viz. Urea deep placement (UDP) and broadcast, with different N rates

N fertilizer sources

N Sources	N rate (Kg/ha)
Urea briquette (one 1.8-g)	52
Urea briquette (one 2.7-g)	78
Urea briquette (two 1.8-g)	104
Prilled urea	52 & 78

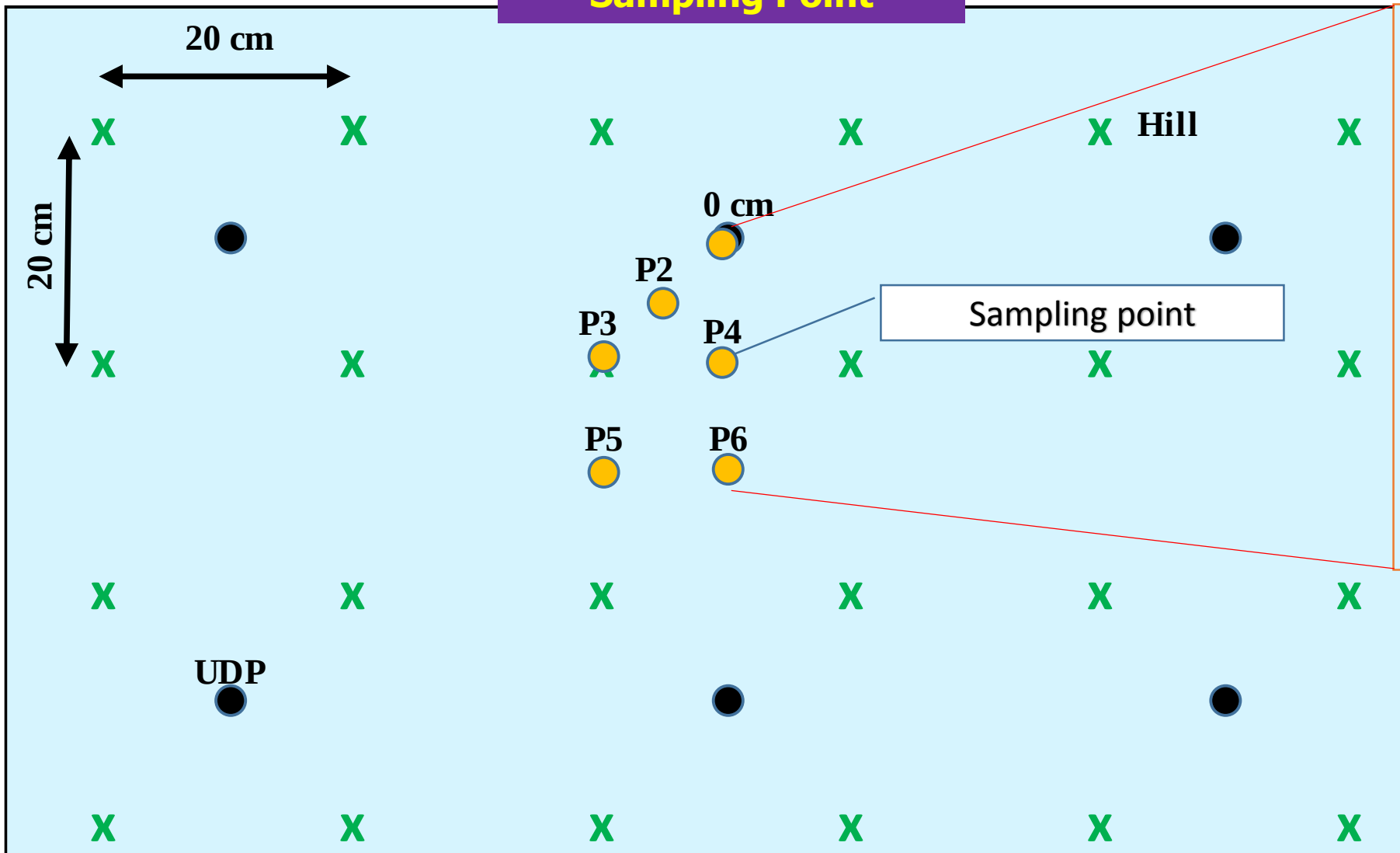
Application methods : Urea briquette deep placement and prilled urea broadcast.

Pore water samples were collected from 10 cm soil depth using rhizome sampler at 0.0, 7.07, 10.0, 14.14, 20.0 and 22.36 cm from the point of placement.

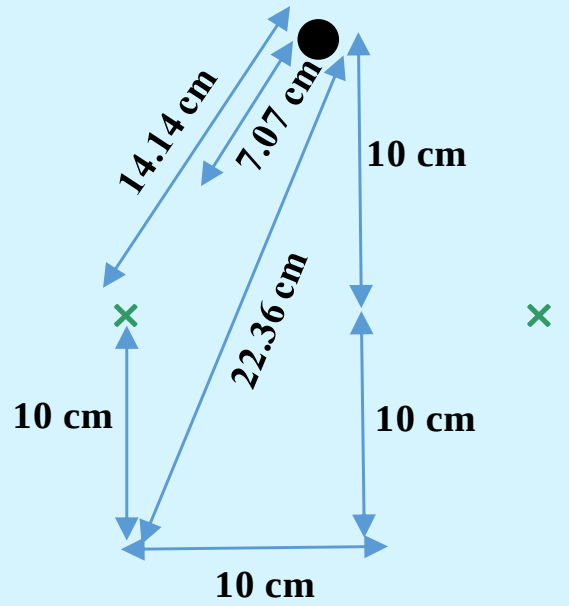
Pore water samples were collected at 7, 14, 21, 35, 64 and 83 days after transplanting.

Methodology

Sampling Point



Point distance (cm)



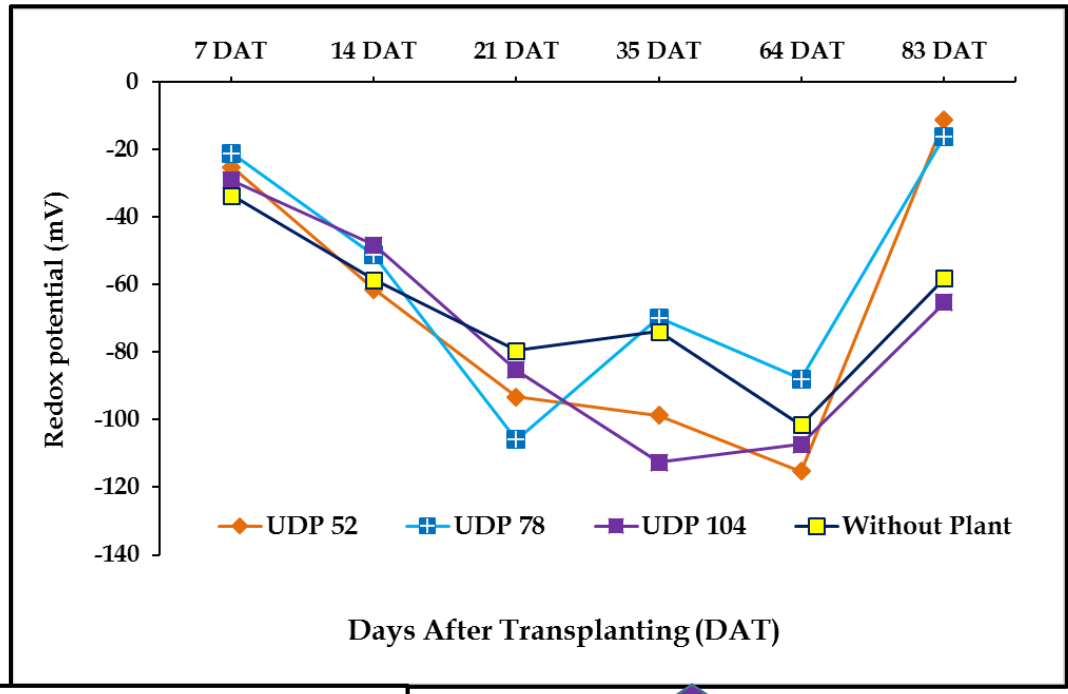
Microrhizon sampler, 10 cm long, 2.5 mm Diameter

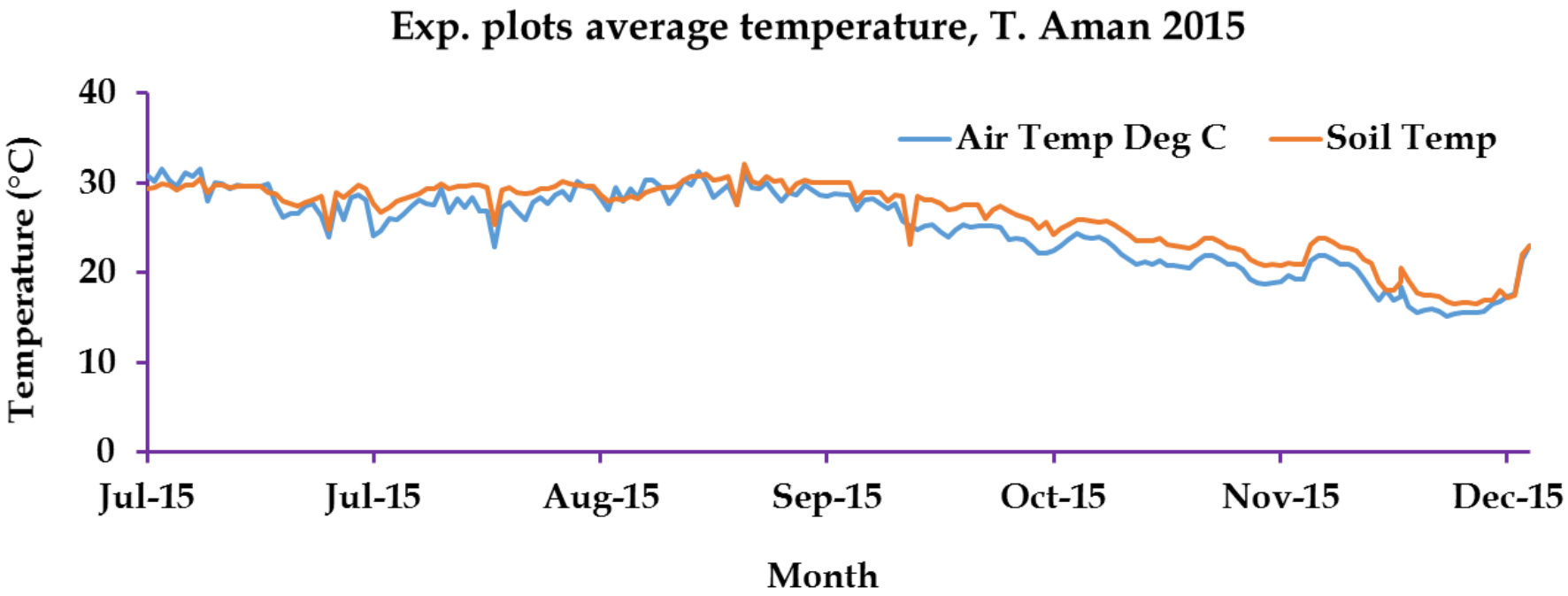
Data recorded: Porewater NH_4-N, air temperature, soil temperature & water potential

Auxiliary Measurement

➢Soil temp. & air temp. changed seasonally whereas soil temp. was 2-3°C higher than the air temp.

➢Warm temperatures increase the rate of urea hydrolysis subsequently increase soil concentrations of ammonium dissolved in soil water

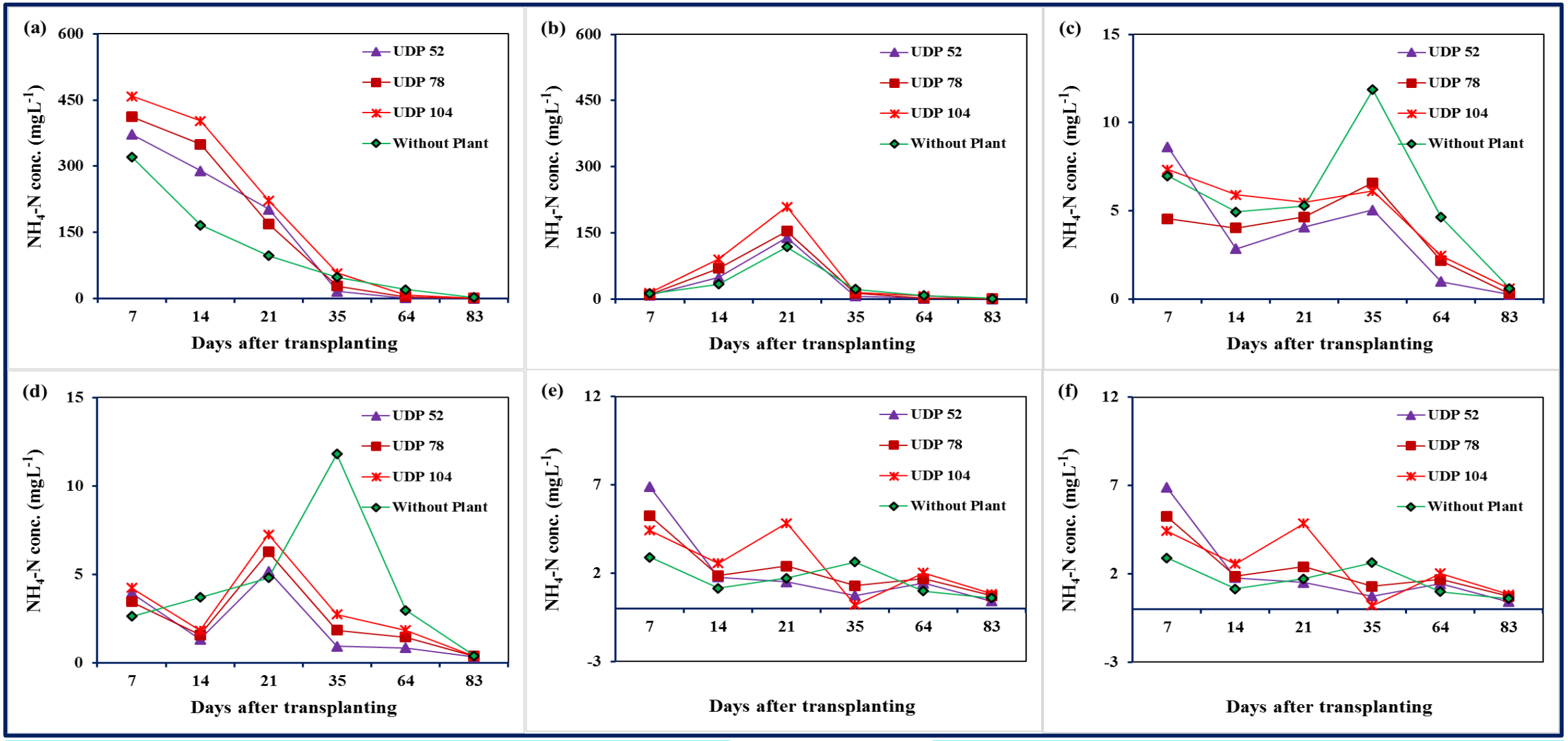




➢Initially there was a decrease in redox potential eventually increased at the end of season with drying period

Results

Comparison of NH_4-N concentration in the soil solution at different distances (a) 0 cm (b) 7.07 cm (c) 10.0 (d) 14.14 (e) 20.0 cm and (f) 22.36 cm from UDP placement point of application at day 7, 14, 21, 35, 64 and 83 in the experiment experimental plots.



UDP had the highest NH_4-N (371-458 mgL^{-1})

While in broadcast urea only 2-4 mgL^{-1}

Conclusion

- The NH_4-N concentration at all the sampling points decreased gradually with time and moved horizontally up to 10 cm from placement point and the movement was significant up to 21 DAT
- In diffusion area the highest NH_4-N concentration was found up to 7.07 cm (maximum rice root zone) and after that it decreased gradually
- Results also confirm that UDP retains higher NH_4-N in soil up to 64 DAT (panicle initiation stage) but broadcast urea plot was recorded very low suggesting its losses through different mechanisms

THANKS