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# Nitrate reductase activity of soil influenced by neem (*Azadirachta indica* L. Juss.) products

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## Abstract

*A pot culture experiments were studied to evaluate the effect of different neem products and their formulation on change in nitrate reductase activity (NRA) in different submerged and aerobic soil under paddy wheat grown of oxygen unstressed and stressed condition of vertisols, inceptisols and alfisols. The inhibitors used were all the neem-based products viz. neem cake (@20 % w/w of urea, neem oil (@ 1.0 % w/v of urea), Nimco® (@ 2 % w/w of urea) and Neemagold® (@ 1.0 % w/w of urea) respectively to the applied urea. NRA significantly decreased in inhibitors coated treatment samples than the control, but the activity was high in submerged soil than aerobic and decreased in both conditions from tillering to harvesting stage of crop. Neem oil coating of 1 % applied urea to curtail the loss of N due to limits the NRA in all the soil at every stage among the neem products. NR activity was considerably low in Inceptisols than Vertisols and alfisols also.*

**Key words**- Nitrate reductase activity, Types of soil, neem products, paddy and wheat

## Introduction

Nitrate reductase catalysed the reduction of $NO_3$ to $NO_2$ under oxygen stress condition (Abdelmagid and Tabatabai, 1987). This enzyme is important in the process of denitrification leading to appreciable loss of fertilizer N under waterlogged soil especially in wetland paddy cultivation. The high N fertilization especially urea is associated with ecological problems such as $NO_3$ contamination of the ground water and $N_2O$ emission to the atmosphere (Jarvis, 1996). Use of organic matter to improve the soil properties and its increase nitrate reductase activity in both flooded and non-flooding soil but the nitrification inhibitors *viz*. PMA, HQ and neem cake directly decrease NR activity (Reddy and Chhonkar, 1990) also. There is divergence of finding regarding the aerobic condition and neem oil effect. However, the urea coated with

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neem cake and neem oil based products on nitrate reductase activity in different types of soils in semiarid climate is little known. Thus the effect of neem products in different submerged and aerable soil condition of paddy and wheat grown was studied.

## Materials and Methods

A pot experiment was conducted, during kharif and rabi season 1998-1999 using three soils, Vertisols-Typic haplustert-clay loam,Inceptisols-Aridic haplustepts-sandy loam and Alfisols-Typic haplustalfs-sandy loam with paddy and wheat crop. Four neem (*Azadirechta indica*) products-neem cake (NC) @ 20% of urea,( Reddy and Prasad, 1975) neem oil (NO) @ 1% v/ w of urea, Nimco (NI)® @ 2% and Neemagold (NG)® @ 1% w/w along with prilled urea alone were tested in a factorial randomized block design with 3 replication. The required quantity of urea prilled (PU) (120 mg urea/kg soil) as per treatment was added and thoroughly mixed. Phosphorus and Potassium were applied @ 80mg $kg^{-1}$ soil as single super phosphate and murate of potash, respectively.

**Table 1 Phyco-chemical properties of experimental soil**

| Properties | Typic haplusterts | Aredic haplustepts | Typic haplustalfs |
|---|---|---|---|
| pH (1:2.5) | 7.92 | 7.80 | 7.51 |
| EC ($dSm^{-1}$) | 0.30 | 0.32 | 0.32 |
| Organic C (%) | 0.72 | 0.49 | 0.54 |
| CEC (cmol (+) $kg^{-1}$) | 38.52 | 21.25 | 28.70 |
| Sand % | 28.50 | 59.5 | 58.6 |
| Silt % | 26.50 | 20.8 | 17.5 |
| Clay % | 44.50 | 18.5 | 22.8 |
| Texture | Silty clay loam | Sandy loam | Sandy loam |
| $KmnO_4$ extractable-N ($kgha^{-1}$) | 279.5 | 228.5 | 222.5 |
| Olson-P ($kgha^{-1}$) | 17.5 | 19.7 | 11.5 |
| $NH_4OAc$-K ($kgha^{-1}$) | 205.8 | 275.0 | 230.2 |
| Nitrate reductase activity ($\eta$ mol.$NO_2$ $g^{-1}$ soil $hr^{-1}$) | 143.50 | 128.20 | 121.50 |

Nitrate reductase activity was analysed by the method of Roberge (1978) and described by Aslam (1981) which is to monitor the rate of formation of $NO_2$-N in the reaction mixture incubated at 28 ± 0.5 $^0$C using 0.1M $KNO_3$ solution in black coloured glass vial 2 hr. The nitrite formed was estimated by the method described by Nicholas *et al.* (1976) by measuring absorbance of the pink colour of solution at 540 ηm wavelength using Spectrophotometer. Nitrate reductase activity was calculated as η mol $NO_2$ –N $g^{-1}$ $hr^{-1}$ by calibration curve of standard series prepared with $NaNO_2$ standard solution. The experiment data was statistically analyzed under the Randomized Block Design of factorial experiment in order to judge the significance of treatmental difference at 5 % level of significance as described by Gomez and Gomez (1984).

## Results and Discussion

Anaerobic condition as a submerged leads to increase the concentration of nitrate reeducates throughout the crops growth period of paddy (anaerobic) and wheat (aerobic) in all types of soil (Table 2)

**Table 2. Effect of neem products on nitrate reductase activity (η mol.$NO_2$ $g^{-1}$ soil $hr^{-1}$) of different soils under the paddy and wheat grown soil**

| Soils ⇨ Neem products⇩ | Wheat grown | | | Paddy grown | | |
|---|---|---|---|---|---|---|
| | Vertisols | Inceptisols | Alfisols | Vertisols | Inceptisols | Alfisols |
| **Tillering stage** | | | | | | |
| Control | 352 | 418 | 352 | 452 | 436 | 460 |
| NC | 318 | 353 | 332 | 360 | 416 | 365 |
| NO | 298 | 304 | 310 | 339 | 339 | 330 |
| Ni | 338 | 348 | 340 | 342 | 352 | 345 |
| NG | 339 | 350 | 343 | 348 | 345 | 360 |
| C.D.(p=0.05) | S-NS, P-13.96, SxP-40.31 | | | S-6.45, P-6.89, SxP-8.34 | | |
| **Booting stage** | | | | | | |
| Control | 308 | 298 | 226 | 292 | 300 | 282 |
| NC | 234 | 285 | 208 | 248 | 288 | 268 |
| NO | 190 | 193 | 191 | 210 | 245 | 204 |
| Ni | 226 | 270 | 210 | 260 | 276 | 270 |
| NG | 211 | 243 | 224 | 280 | 284 | 275 |
| C.D.(p=0.05) | S-7.83, P-17.51, SxP-22.61 | | | S-NS, P-13.76, SxP-17.76 | | |
| **Harvesting stage** | | | | | | |
| Control | 104 | 108 | 101 | 185 | 198 | 193 |
| NC | 100 | 102 | 95 | 110 | 163 | 129 |
| NO | 92 | 98 | 90 | 107 | 153 | 110 |
| Ni | 102 | 101 | 92 | 159 | 178 | 111 |
| NG | 94 | 104 | 94 | 166 | 171 | 122 |
| C.D.(p=0.05) | S-NS, P-3.74, SxP-4.83 | | | S-3.18, P-7.11, SxP-9.18 | | |

S= Soils, P= Products, S x P=Soil x Products

The NRA in vertisols, inceptisols and alfisols was decreased under the treatment of neem products than the control (PU) treatments. It is fact that moisture in excess of half of water holding capacity and very poor aeration leads to enhance nitrate reductase (Roberg, 1978). The reduced NRA by the application of neem oil in aerobic condition of wheat grown but in anaerobic condition of paddy grown was higher than the aerobic condition due to nitrate accumulation persist up to prolong duration (Gill *et al.*1991). In submerged condition of paddy grown soil NRA was significantly decreased by the application of neem products coated urea but the urea prilled was coated with neem oil resulted the greater decreased in NRA in both aerobic and anaerobic condition of Paddy and wheat than the other products might be persistent capacity of oil prolong the effectiveness to maximum decrease as well as control also. In both the situation on the NRA has left to decline from begning to harvesting stage of crops might be availability and moisture condition with time with the crop paddy and wheat can be attributed to reduction in nitrate nitrogen concentration due to uptake by crop plant or transformation in the other forms (Reddy and Chhonkar, 1991). In respect of different soils coated urea @ 1.0 % w/v neem oil represented the very low

NRA in vertisols and so high observed in inceptisols because of higher clay minerals may have inhibitory as well as stabilizing effect on enzymes activity including NRA also due to aquatic sediments associated with humic substances (Kiss, *et al*. 1986) at every stage of crop.

## Conclusion

The study showed that neem oil coating is beneficial than others formulation of neem and its restricts the NR activity and consequently ensure slow release of nitrogen (Hulagen and Shinde, 1984) will be promising for losses of N and their pollution in submerged and wetting drying condition of cultivation as well as plant growth and development. Nitrate reductase enzyme is important to the process of denitrification, leading to appreciable losses of N fertilizer under wet waterlogged soil, especially paddy cultivation in wetland but in aerobic condition of wheat cultivation could be attention for losses of N.

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