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Effect of neem (*Azadirachta indica* Juss.L) products on nitrification in rice growing soil

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ABSTRACT

A pot experiment was conducted, during wet season using three types soils, namely typic haplusters-clay loam, aridic haplustepts-sandy loam and typic haplustalfs-sandy loam with rice as test crop. Four neem (Azadirechta indica) products as neem cake (NC) @ 20% of urea, neem oil (NO) @ 1% volume by weight of urea, Nimco (NI) @ 2% and Neemagold (NG) @ 1% by weight, blended with prilled urea alone were tested in a factorial randomized block design with 3 replication. The nitrifying capacity of soil was significantly decreased due to the application of neem products coated urea than prilled (control) in typic haplusterts, aridic haplustepts and typic haplustalfs at tillering, booting and harvesting stages of paddy. Among the neem products, neem oil coated urea treatment significantly proved superior to reduce the activity followed by neemgold nimco and neem cake also. All soils were found to have significantly reduced the nitrification among the neem products. Irrespective soil types the mineralizable N in soils was higher in control at tillering stage than the later stages. The coating of urea with neem oil @ 1.0 per cent would be promising to reduces the nitrifying capacity of soil and control the mineralization of N in typic haplusterts, aridic haplustepts and typic haplustalfs as compared to neemgold, nimco and neem cake, respectively.

Key words: *nitrifying capacity, rice soil, neem products, and available nitrogen*

Neem (*Azadirachta indica* A. Juss) products and their derivatives have broad spectrum of antimicrobial action due to azadirachtin (Devakumar and Riar, 1993), which is an active in gradient of neem. It mainly acts as antibacterial and as nitrification inhibitor when used in combination with urea in soil (Prasad, *et al*. 1997). It also maintained the lower levels of nitrate for longer period due to its effect on nitrifying organisms (Chhonkar, 1984). The findings regarding the effect of neem products on nitrification in soil are, however, highly inconsistent. Thus, the action of neem products in different soils on nitrifying capacity in paddy grown soil was investigated.

A pot experiment was conducted, using three soils types of namely typic haplusters-clay loam (Black soil), aridic haplustepts-sandy loam (Alluvial soil) and typic haplustalfs-sandy loam (Red soil) with rice as test crop. Four neem (*Azadirechta indica* A. Juss) products *viz*. neem cake (NC) @ 20% of urea, neem oil (NO) @ 1% volume by weight of urea, Nimco (NI) @ 2% and Neemagold (NG) @ 1% by weight of urea 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/kg soil) as per treatment was added and the contents were thoroughly mixed. Phosphorus and Potassium were applied @ 80mg kg^{-1} soil as single super phosphate and murate of potash, respectively.

The nitrifying capacity of soil was determined by the method of Harrison and McCance (1966) by introducing known concentration of NH_4CI. The NO_2 formed after incubation was estimated by GriessIillosvary colorimetric method of Snell and Snell (1949) by the diazotization of an aromatic amine compound by nitrate in acid solution. The soil samples were collected for the analysis of mineralizable N and nitrifying capacity at tillering (35 DAS), Booting (65 DAS), and harvesting (120 days after sowing) stage for paddy under anaerobic as well as aerobic condition.

The nitrifying capacity of soil was significantly decreased due to the application of neem products coated urea than prilled (control) in anaerobic and aerobic condition of typic haplusterts, aridic haplustepts and typic haplustalfs at tillering, booting and harvesting

stages paddy (Table 2) grown soil due to reduced the growth of total and non symbiotic nitrifying bacteria (Blaise and Prasad, 1997; Vimale and Subramaniam, 1994) and other nitrifying organisms. Among the neem products, neem oil coated urea treatment significantly proved the superiority to reduction the activity followed by neemagold nimco and neem cake also. All soils were found to have significant reduction in the nitrification as oil had longer lesion on prilled urea and prolong the solubility in soil (Singh and Takkar, 1997) and might be more inhibitory products comparably to cake based products, among the neem products. Irrespective soil types, the nitrifying capacity was relatively higher typic heplustept than aridic heplustert at all the stages viz. tillering, booting and harvesting of crop which could be attributed to the fact in the reduced condition are unfavorable to the growth and activity of nitrifying organisms.

The mineralizable N in soils was higher in control at tillering stage than in neem products teatred treatments due to easy solubility of urea. Later, at the booting stage and harvesting, N content was greater than in control due to prolonged solubility of urea subsequent nitrification (Table 3). In contrast, neem products resulted in low mineralizable-N under anaerobic and aerobic condition due to controlled mineralization. However, at last stages mineralizable-N was relatively high with the application of neem

Table 1. Physico-chemical properties of experimental soil

Properties	Typic haplusterts	Aredic haplustepts	Typic haplustalfs
pH (1:2.5) (Jackson 1973)	7.92	7.80	7.51
EC (dSm^{-1}) (Jackson 1973	0.30	0.32	0.32
Organic C (%) (Walkely and Black 1934)	0.72	0.49	0.54
CEC (cmol (+) kg^{-1}) (Bowre *et al*., 1952)	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 clayloam	Sandy loam	Sandy loam
$KmnO_4$ extractable-N ($kgha^{-1}$)(Subbiah and Asija, 1956)	279.5	228.5	222.5
Olson-P ($kgha^{-1}$) (Olson *et al*., 1954)	17.5	19.7	11.5
NH_4OAc-K ($kgha^{-1}$) (Muhr, *et al.,* 1974)	205.8	275.0	230.2
Nitrifying capacity (ig NO_2 $g^{-0.05}$ $(NH_4)_2$ SO_4 g^{-1} soil) (Harrison and McCance 1966)	143.50	128.20	121.50

Table 2. Effect of neem products on nitrifying capacity of different soil paddy growing

Soils Neem	Typic haplustert			Aredic haplustept			Typic haplustalf		
products	Tillering stage	Booting stage	Harvesting stage	Tillering stage	Booting stage	Harvesting stage	Tillering stage	Booting stage	Harvesting stage
Control	594	500	298	495	425	295	496	452	280
Neem cake	400	350	275	393	350	195	493	410	190
Neem oil	397	325	175	299	225	178	390	295	140
Nimco	591	400	185	397	245	182	399	350	192
Neem gold	593	450	180	400	250	186	442	300	182
	S-7.53			S-3.53			S-3.702		
	P-16.9			P-7.90			P-8.30		
	SxP-21.75			SxP-10.20			SxP-10.70		

S= Soils, P= Products

Table 3. Effect of neem products on available N (kg ha^{-1}) different soils

Soils Neem products	Typic haplustert	Aredic haplustept	Typic haplustalf
Tillering stage			
Control	382	334	330
Neem cake	338	307	319
Neem oil	319	298	310
Nimco	360	306	318
Neem gold	360	307	310
CD(P=0.05)	Soil - 2.23, Product - 5.24,	Soil x Product - 17.7	
Booting stage			
Control	300	260	266
Neem cake	307	268	275
Neem oil	316	294	278
Nimco	304	267	273
Neem gold	307	268	275
CD(P=0.05)	Soil - 1.98, Product - NS,	Soil x Product - 11.90	
Harvesting stage			
Control	235	216	219
Neem cake	245	219	226
Neem oil	271	228	229
Nimco	246	223	227
Neem gold	251	221	226
CD(P=0.05)	Soil - 1.234, Product - 2.29,	Soil x Product - 6.48	

products than with prilled urea control due to regulatory action of neem product. Among the neem products, neem oil was found to be most effective in releasing N over a longer period.

The coating of urea with neem oil @ 1.0 per cent would be promising to reduce the nitrifying capacity of soil by 30-50 per cent over the control and it also reduced the mineralization of N in typic haplusterts, aridic haplustepts and typic haplustalfs as compared to neemagold, nimco and neem cake, respectively.

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