J Res Punjab Agric Univ **40** (2) : 230-35, *June 2003*

Research Note

NITROGEN LEACHING LOSS IN IRRIGATED RICE FIELDS

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(Received : 15 April, 2002)

LEACHING of nitrogen from the applied fertilizers is the main cause of reduced nitrogen efficiency. In upland crop ecosystem, surface applied urea is subjected to volatilization losses (Singh and Singh 1993), where as in wetland crop ecosystem urea may be lost due to excessive leaching (Mahajan and Tripathi 1991) as well as denitrification (Katyal, et, al.1985). The efficiency of nitrogen from urea under wetland rice was 30-40% (De Datta 1981) as compared to 50-70% (Hauck 1971) under upland crops.

A field study was conducted (Fig.1) to quantify leaching losses of nitrogen from the applied urea in the Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana (Latitude 30^0-56'N, and Longitude 75^0-52'E) during the *Kharif* season of 2000. The average texture (up to 100 cm) of the experimental site was clay loam with sand, silt and clay of 25.40, 39.40 and 35.20 percent respectively. The other characteristics like organic carbon and bulk density were 0.44 and 1.45g cm^{-3}. The Rice crop (PR-106) was transplanted on June 23, 2000 in the four plots of size as shown in Fig.1. Tubewell water was used as a source of irrigation. Standard recommended practices were followed regarding land preparation, irrigation and other cultural practices as recommended by PAU in Packages and Practices for Kharif crops. Urea as per recommendation @ 275 kg ha^{-1} was applied in three equal split doses. The initial dose of urea along with ZnSO4 and DAP (di-ammonium phosphate) was applied 7 days after transplanting and second and third dose of urea was applied 15 and 35 days after transplanting respectively. The actual amount of urea per plot was 1.145g for each split dose. The crop was harvested on Oct.12,2000 with an average yield of 64.63 qha^{-1}

The leachate samples were collected from each plot after each irrigation and rainfall. The leachate samples (soil solutions) were collected through leachate collector (PVC tubes of 165 cm and 135 cm in length and each of 8 cm in diameter, fitted with a PVC end cap at the bottom). These leachate collectors had 30 cm blind pipe from the bottom with another 30 cm long perforated pipe and were installed vertically in the each plot (Fig. 2). Four leachate collector tubes were installed in each plot, two of them at 60 cm depth and the other two were at 90 cm depth below the ground surface as shown in Fig. 2. The samples were collected from the leachate collector tubes using a vacuum pump.

These samples were analyzed for NO_3^--N and NH_4^+-N and the measured values are given in Table 1. Perusal of table shows no definite trend, however, a total of NO_3^--N and NH_4^+-N was 10 mg/l and 8.67 mg/l respectively at 60 cm soil depth and 13.82 mg/l and 3.24

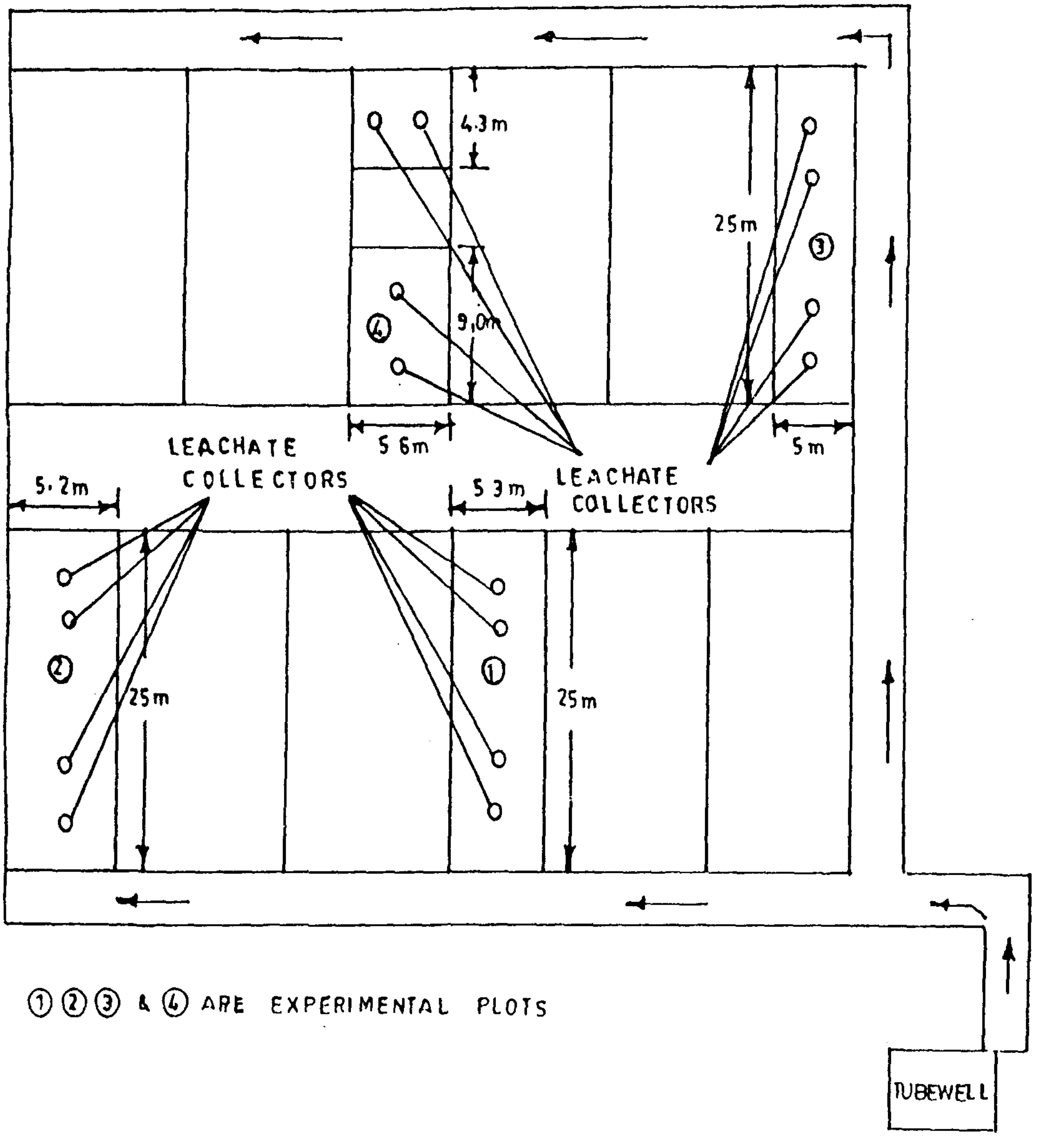

Fig. 1. : Layout of Experimental Plots

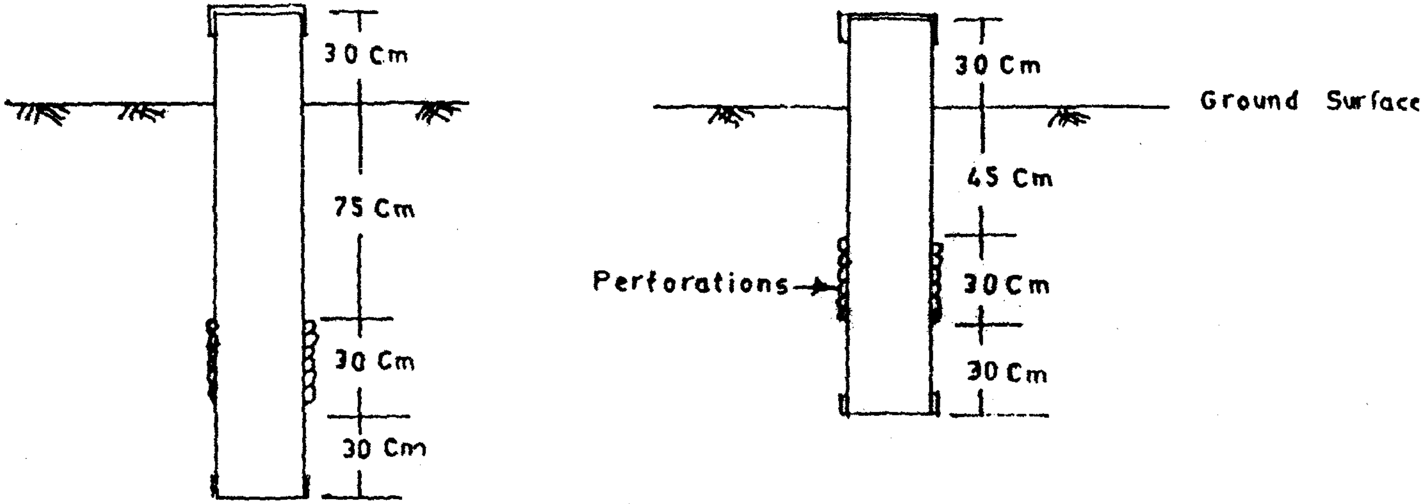

Fig. 2. : Schematic Section of leachate Collectors

Table 1. Observed Nitrate and Ammonium Concentration the Leachate Samples at different Time Intervals in the Rice Field from the date of transplanting.

Time (Days)		*17*	*25*	*35*	*41*	*48*	*56*	*62*	*69*	*77*	*90*	*95*	*Total*
NO_3–N Concentration (mg/l)	60 cm	3.164	1.959	1.251	0.295	0.754	0.576	0.366	0.913	0.184	0.355	0.173	10.000
	90 cm	2.993	2.565	1.966	0.842	1.045	0.811	0.598	1.247	0.508	0.899	0.347	13.820
NH_4-N Concentration (mg/l)	60 cm	0.782	1.167	1.104	0.327	0.832	0.656	0.628	1.484	0.471	0.909	0.313	8.670
	90 cm	0.215	0.302	0.243	0.320	0.286	0.282	0.279	0.443	0.272	0.410	0.191	3.240

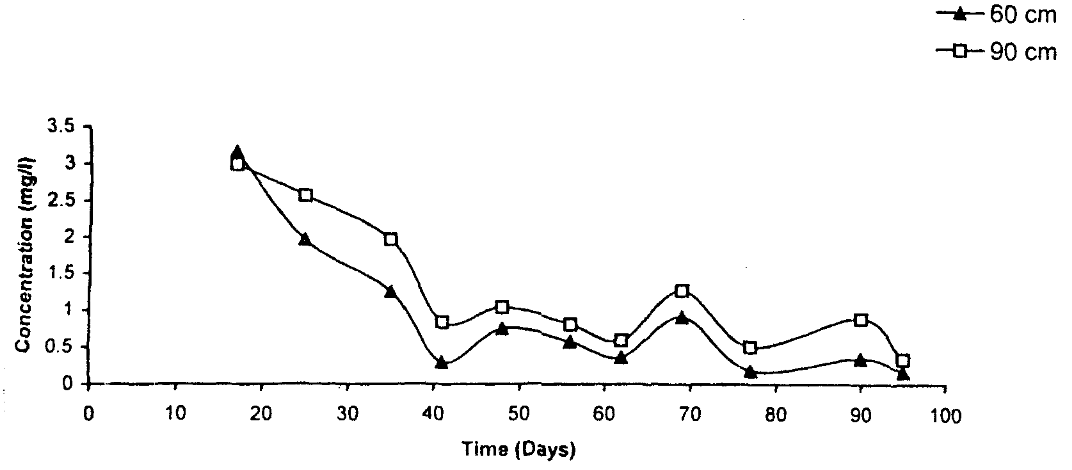

Fig. 3. : Observed NO_3^--N concentration in the Leachate samples at different time intervals in the rice field from the date of transplanting

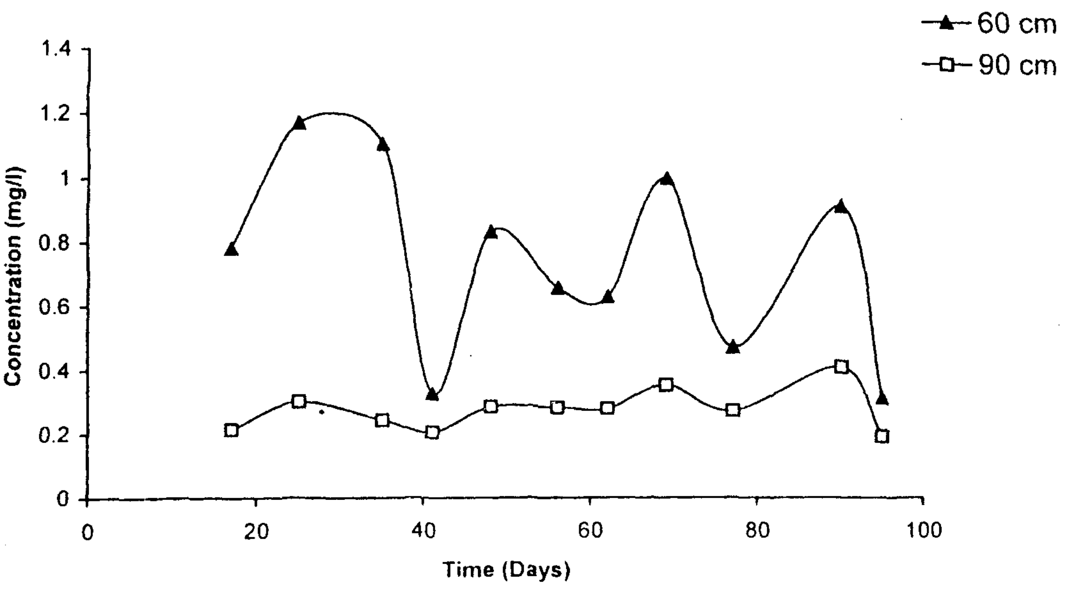

Fig. 4. : Observed NH4+-N concentration in the Leachate samples at different time intervals in the rice field from the date of transplanting

mg/l at 90 cm soil depth. The temporal variation of peak concentration with respect to time for 60 and 90 cm soil depth is depicted in Fig. 3 and 4. The NO_3^--N concentration decreased with time (Fig. 3). This establishes the movement of NO_3^--N in the lower layers. The NO_3^--N concentration was increased as the soil depth increased but the NH_4^+-N concentration decreased, as the soil depth increased. This is due to the conversion of NH_4^+-N to NO_3^--N as the soil depth increased, because the degree of saturation decreases as soil depth increases. The total leaching losses were calculated as:

Total concentration of NO_3^--N (mg/l)= (concentration of NO_3^--N at first sampling x leachate volume + . . . + concentration of NO_3^--N at last sampling x leachate volume)/Average leachate volume

Total concentration of NH_4^+-N (mg/l) = (concentration of NH_4^+-N at first sampling x leachate volume + . . . + concentration of NH_4^+-N at last sampling x leachate volume)/Average leachate volume

Total concentration of NO_3^--N (kg/ha) = Total concentration of NO_3^--N (mg/l) x 2.24

Total concentration of NH_4^+-N (kg/ha) =Total concentration of NH_4^+-N (mg/l) x 2.24

Total Leaching loss = (Total concentration of NO_3^--N + Total concentration of NH_4^+- N) x 100/ total nitrogen applied

The total cumulative nitrogen leaching loss after 95 days was 32.2 percent and 29.6 percent of the applied urea at 60 cm and 90 cm depth below the ground surface respectively.

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