https://doi.org/10.29321/MAJ.10.A02865

Madras agric. J. 67 (8) : 502—505, August, 1980

Effect of water Management Practices and Nitrogen Application on Losses of Nitrogen in Lowland Rice*

M. R. IRUTHAYARAJ[1] and Y. B. MORACHAN[2]

An experiment was conducted in pot culture at the Tamil Nadu Agricultural Univerity.s Coimbatore, from 1972 to 1973 with Kannagi and Bala varieties of rice in monsoon (wet) and summer (dry) seasons to find out the amount of N lost and to minimise the losses under five water management treatments and five N levels. The total N loss by leaching and volatilisation was heavy in monsoon and summer seasons. The total N loss was heavy in I_4 and I_5 treatments at higher N levels.

Nitrogen use efficiency in lowland rice has been reported to vary from 30 to 60 per cent (Becking, 1971). The rest is lost through leaching, denitrification (Abichandani and Patnaik, 1958) or volatilisation (Terman and Hunt, 1964). The water management and method and quantity of fertiliser application have great influence on the loss of N. The objective of the present study was to investigate the N losses and to minimise the losses under different water management practices N levels with two high yielding short duration rice varieties under pot culture.

MATERIAL AND METHODS

The experiment was conducted in pots in the open at the wetlands of Tamil Nadu Agricultural University, Coimbatore, in the years 1972 and 1973. The treatments were : (I) Water management treatments : I_1-maintaining 5 cm water depth daily throughout the crop growth, I_2-maintaining 5 cm water depth daily throughout the crop growth with stoppage of water for five days only at the end of tillering stage, I_3-maintaining saturation daily through out the crop period, I_4-maintaining 5 cm water depth daily for four days and afterwards stoppage of water for four days and I_5-maintaining 5 cm water depth daily for eight days and afterwards stoppage of water for eight days, (II) Varieties : V_1-Kannagi (IR8 x TKM 6) and V_2-Bala (N. 22 x T. (N)$_1$). (III) N levels : N_0-O kg, N_1-60 kg, N_2-120 kg, N_3-180 kg and N_4-240 kg/ha. A uniform dose of 60 kg each of P_2O_5 and K_2O/ha was applied to all the treatments.

The experimental unit consisted of earthern pots of 45 cm diameter and 45 cm height. The experiment was conducted in factorial design with single replication using 50 pots. Each

* Part of the Ph. D. Thesis submitted by the first author to the Tamil Nadu Agricultural University, Coimbatore.

1 and 2 Department of Agronomy, Tamil Nadu Agricultural University, Coimbotore-641 003.

pot was filled with 50 kg of the adjacent field soil. The soil was put in the pots about 3 months x in advance in order to settle it properly in the pots.

Twenty day old seedlings were planted in the pots with 8 hills pot and 2 seedlings/hill. One monsoon (wet) and two summer (dry) crops were taken.

Pots were coated inside and outside with wax and black japan to make them leak proof. The leachate was collected daily in bottle through a single delivery tube connected at the bottom of each pot. The bottles were covered to prevent sun drying. The leachate collected daily was measured and 10 ml was stored in a refregirator for analysis. Ammoniacal and nitrate N contents were estimated in the leachate collected. during the first 10 days and thereafter at 16 days interval, with the method of Bromner and Keeney (1965).

The total quantity of N lost per pot under different treatments were worked out from the amount of NH4 and No 3-N recovered. The available N in the soil was estimated by the method of Iruthayaraj *et al.* (1974). The amount of N losses under different treatments has been presented as percentage of total nitrogen. The difference between total N (N applied plus native available N) and the sum of N uptake, N loss due to leaching and the available N at harvest in the soil was considered as N lost by volatilisation.

RESULTS AND DISCUSSION

Leaching loss the total N loss in the leacheate in monsoon was higher than in summer due to heavy rainfall leaching N from the soil in Bartholomew (1971).

The total N loss in the leachate was the highest in I_4 treatment followed by I_5 treatment and was the lowest in I_3 treatment. In I_4 treatment the water was allowed to drain naturally through the soil column. The soil came to saturation level on the 3rd day and to field capacity on the 4th day. This brought the soil surface to the aerobic condition for two days in a cycle of four days wetting and four days drying. Within these two days the magnitude of aerobic mineralisation would have been higher. Nitrate produced in the surface oxidised layer could be easily moved downward by diffusion and percolation into the underlying reduced layer where it would have been denitrified. In the I_5 treatment the soil came to saturation on the 3rd day, to field capacity on the 4th day and then reduced to around 60 per cent available moisture level which caused severe water stress to the crop. Further the shrinkage of soil colloids resulted in deep cracks and subsequently when irrigation was given the water movement was very fast in the beginning carrying N to lower layers. The leaching loss was lower than in I_4 treatment due to transformation of N to unavailable forms (Parr, 1967). Due

TABLE Effect of irrigation and N levels on leaching and volatilisation losses of N in lowland rice (%)

Treatments	Leaching loss	Volatilisation loss
1972 Monsoon	14.89	7.12
1972 Summer	12.10	7.36
1973 Summer	13.10	7.27
S.E.	0.02	0.05
C.D. (5%)	0.07	0.14
V_1	13.36	7.23
V_2	16.35	7.27
S.E.	0.02	0.04
C.D. (5%)	N.S.	N.S.
I_1	13.92	5.51
I_2	12.52	5.44
I_3	9.44	7.87
I_4	15.60	6.66
I_5	15.34	10.78
S.E.	0.03	0.06
C.D. (5%)	0.09	0.19
N_0	8.71	2.80
N_1	8.15	3.76
N_2	11.23	8.33
N_3	16.97	9.75
N_4	21.75	11.61
S.E.	0.03	0.06
C.D. (5%)	0.09	0.15

N.S. Not significant.

to frequent alternate flooding and drying in I_4 treatment more amount of N was lost.

At higher level of N application, ammonification, nitrification and denitrification occurred at a relatively faster rate leading to heavy loss in I_4 and I_5 treatments with 240 kg N/ha.

Volatilisation loss :

The volatilisation loss was low during monsoon. In summer there was high evaporative demand due to greater amount of solar energy received and high temperature. This could have led to higher loss by volatilisation (Willis and Sturgis 1945).

Under all water management treatments, as the N level increased the loss increased. The loss was the highest in I_5 treatment in all the seasons. During the drying period, aerobic conditions set in leading to nitrification. When the soil was reflooded again anaerobic conditions followed and denitrification set in causing the evolution of NH_3, NO_2, N_2O and N_2 (Broeshart, 1971).

Under continuous submergence (I_1 and I_2), leaching and volatilisation losses were minimum. Where there is dearth of water to maintain continous submergence, I_3 treatment could be recommended in spite of the fact that the loss by volatilisation was fairly high in this treatment which was compensated to some extent by lower leaching loss.

REFERENCES

ABICHANDANI, T.C. and S. PATNAIK. 1958. Nitrogen changes and fertilizer losses in low land water logged soils. *J. Indian Soc. Soil Sci.* 6 : 87–93.

BECKING, J.H. 1971. Biological nitrogen fixation and its economic significance. In "Nitrogen 15 in Soil – Plant Studies" Vienna IAEA/STI/PUB/278. p. 189 – 222.

BREMNER, J.M. and D.R. KEENEY. 1965. Steam distillation methods for determination of ammonium, nitrate and nitrite. *Anal. Chim Acta.* **32** : 485 – 495.

BROESHART, H. 1971. The face of nitrogen fertilizer in flooded rice soils. In "Nitrogen 15 in Soil. Plant Studies". Vienna. IAEA/STI/PUB/278. pp. 477 – 82.

IRUTHAYARAJ, M.R., T. R. SRINIVASAN and Y.B. MORACHAN. 1974. A rapid steam distillation method for estimation of available nitrogen in soils. *Madras agric. J.* **61** : 615 – 18.

PARR, J.F. 1967. Biochemical considerations for increasing the efficiency of nitrogen fertilizers. *Soil Fert* **17** : 329 – 36.

TERMAN, G.L. and C.M. HUNT. 1964. Volatilization losses of nitrogen from surface applied fertilizers as measured by crop responses. *Soil Sci. Soc. Amer. Proc.* **28** : 667 – 72.

WILLIS, W.H. and M.B. STURGIS. 1945. Loss of nitrogen from flooded soil as affected by changes in temperature and reduction. *Soil Sci. Soc. Amer. Proc.* **9** : 106 – 13.