

## ESTIMATION OF LOSS OF MAJOR PLANT NUTRIENTS IN PERCOLATION IN RICE FIELDS

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Land submergence and field to field irrigation as practiced in rice culture, involves huge wastage of water through percolation. Drainage studies on heavily manured paddy fields at the Central Rice Research Institute, Cuttack, have revealed that during the kharif crop season 42 kg nitrogen, 29 kg phosphorus, 38 kg iron and 17 kg manganese were lost per hectare (Kanwar, 1972). The estimation of the extent of loss of major plant nutrients in percolating water formed the object of the present study.

### Materials and Methods

The investigation was conducted during the autumn (July—October) and winter (November—January) seasons of 1973-74 in the Rice Research Station, Pattambi. The soil of the experimental plot was a lateritic sandy clay loam containing 35.8% coarse sand, 23.6% fine sand, 9.3% silt and 29.3% clay.

The amounts of water lost in evapo-transpiration and percolation were estimated by the 'drum-culture technique' (Dastane *et al.*, 1970). Water percolating below the root zone of rice (25 cm below ground level) was collected in polythene tubes placed at random in the rice field. This technique was developed by Shinde and Va'madevan (1973) at the Central Rice Research Institute, Cuttack. Water from these tubes was syphoned out at intervals of 5 days for chemical analysis. Nitrogen ( $\text{NH}_4\text{-N}$  and  $\text{NO}_3\text{-N}$ ) was determined by modified Kjeldhal method. Phosphorus was estimated colorimetrically by Bray's No. 1 method while potassium was determined by flame emission spectrophotometric method. Percolating water was thus collected and analysed from 2 adjacent plots of (17 m X 17 m) the same fertility (organic carbon 0.84%, available  $\text{P}_2\text{O}_5$  32.5 kg/ha; available  $\text{K}_2\text{O}$  112.5 kg/ha; PH 5.7), one receiving 100 kg nitrogen, 50 kg  $\text{P}_2\text{O}_5$  and 50 kg  $\text{K}_2\text{O}$  per hectare in the form of ammonium sulphate, superphosphate and muriate of potash respectively, and the other receiving no fertilizer at all. Each plot had 4 polythene tubes for collecting water percolating below the root zone of rice plants. The lateral seepage of water was arrested by constructing levees lined with polythene film. The test variety planted was Jaya. The loss of plant nutrients was calculated based on the total amount of water lost in percolation per hectare and the mean percentages of nutrients contained in the percolating water.

Results and Discussion

The mean evapo-transpiration and percolation were estimated as 4.88 mm and 3.91 mm per day respectively, in the autumn season (97 days) and 7.32mm and 7.99 mm per day in the winter season (86 days) (Table 1). Total water lost in percolation alone was 379 mm' in autumn and 687 mm in winter. The magnitude of loss of water in the autumn was low, due to high water table position in that season, its fluctuation varying from 2 cm to 25 cm only. In the winter season, on the other hand, water table receded as low as 78 cm below the ground level.

Table 1

Evapo-transpiration and percolation during autumn and **winter** seasons of 1973-74

Season	Evapo-transpiration (mm)		Percolation (mm)	
	per day	total	per day	total
autumn	4.88	4734	3.91	379.3
winter	7.32	629.5	7.99	687.1

The extent of loss of all the major plant nutrients which moved out of the root zone of rice plant was high during the winter season because of high rate of percolation. While the quantum of nitrogen loss as ammonium was almost equal during both the seasons, loss of nitrogen as nitrate was far higher in the winter season compared to that of the autumn season.

The total loss of nitrogen from the manured plot in the autumn season was 31.49 kg/ha of which 19.35 kg/ha was in the form of  $\text{NH}_4\text{-N}$  and 12.14kg, in the form of  $\text{NO}_3\text{-N}$  (Table 2). During the winter season, 18.55 kg of  $\text{NH}_4\text{-N}$  and 19.24 kg of  $\text{NO}_3\text{-N}$  were lost per hectare in percolating water, the total loss being 37.79 kg/ha. P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O lost from this plot amounted, to 18.74 and 19.72 kg/ha respectively, in the autumn and 28.24 and 58.62 kg/ha in the winter. The extent of loss of plant nutrients from the unmanured plot was 21.0 kg N (11.13 kg  $\text{NH}_4\text{-N}$ ; 9.87 kg  $\text{NO}_3\text{-N}$ ), 14.4 kg P<sub>2</sub>O<sub>5</sub> and 13.65 kg K<sub>2</sub>O per hectare in the autumn season and 24.74 kg N, (10.31 kg  $\text{NH}_4\text{-N}$ ; 14.43  $\text{NO}_3\text{-N}$ ) 28.02 kg P<sub>2</sub>O<sub>5</sub> and 46.60 kg K<sub>2</sub>O per hectare in the winter season. It was interesting to note that even under unmanured conditions the soil released reasonable amounts of plant nutrients and supported plant life.

Table 2

Nutrients lost in percolating water and grain yield of Jaya rice.

Season	Nutrients lost in percolation (kg/ha)						Grain yield (kg/ha)	
	from the manured plot			from the control plot			manured plot	control plot
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O		
autumn	31.49	18.74	19.72	21.00	1440	13.65	4554	3120
winter	37.79	28.24	53.62	24.74	13.02	46.60	3515	2180

Grain and straw yields were considerably reduced during the winter season in spite of good crop management, the percentage of reduction being 22.8 and 30.1 in the manured and the unmanured plots, respectively. This might partly be due to the high rate of percolation. Yield decline in the winter season is a usual phenomenon in Pattambi and similar other places in Kerala, although climatic conditions are quite favourable for crop growth in this season.

It is anticipated that as consumption of fertilizers increases, loss of nutrients through drainage water will also increase (Konwar, 1972). Conditions which favour greater recovery of nutrients by the crop, therefore will be favourable for the least loss of nutrients through leaching. This study highlights, the need for formulating sound agronomic practices for bringing down the rate of leaching loss in rice fields.

Summary

In an investigation conducted at the Rice Research Station, Pattambi, it was found that appreciable amounts of nitrogen, phosphorus and potash moved out of the root zone of rice plants in percolating water. The magnitudes of loss of these nutrients through percolation during the autumn and winter seasons of 1973-74 are reported in this paper.

സംഗ്രഹം

നെൽപ്പാടുകളിൽ മണ്ണിലൂടെ ഉന്മൂലം പോകുന്ന ജലദത്താടൊപ്പം സസ്യപോഷക മൂലകങ്ങളും നഷ്ടപ്പെട്ടുപോകുന്നതായി പട്ടാമ്പിയിലെ നെല്ലുഗവേഷണകേന്ദ്രത്തിൽ 1973-74 ൽ നടത്തിയ ഒരു പഠനത്തിൽ തെളിഞ്ഞു. ഓരോ പുവിലും മൂല്യ പോഷക മൂലകങ്ങൾക്ക് ഇപ്രകാരം സംഭവിക്കുന്ന നഷ്ടം എത്രയെന്ന് ഈ ഗവേഷണ പ്രബന്ധത്തിൽ റിപ്പോർട്ട് ചെയ്തിരിക്കുന്നു.

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(M. S. received: 21-7-1975)