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STUDIES ON THE INFLUENCE OF DRAINAGE AS A CULTURAL PRACTICE IN INCREASING RICE YIELDS

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ABSTRACT

Field experiments were conducted to find out the effect of drainage on the growth and yield of rice, grown continuously under a standing water of 5 inches. Plots having drainage provision indicated 28 per cent and 49 per cent increase in rice yield for the varieties CHANDINA and IRATOM-24, respectively, over the rice yield in plots without drainage provision. Analysis of standing water in the field and drain water after an application of 23 kg of nitrogen per hectare on standing water indicated that the applied N is mostly absorbed and retained by soil possibly by diffusion.

INTRODUCTION

It is well known that highest yields of rice (5–6 tons per hectare) are obtained in Japan and Taiwan and this is usually attributed to the heavy fertilisation and improved cultural practices[1]. These practices when applied, however, did not increase the yields significantly in the developing countries, and the highest yield recorded with high yielding varieties was of the order of three tons per hectare. Both Japan and Taiwan have an additional cultural practice, *viz.*, provision of separate drainage channel parallel to irrigation channel in the rice fields[2,7]. Drinage through the root zone has its own significance in a crop grown with standing water and may contribute significantly to grain yield[3-6].

Experiments both on the field and in the laboratory are, therefore, conducted at the Institute of Nuclear Agriculture with a view to understanding the role of drainage in increasing the rice yield and the effectiveness of broadcasting of fertilizer N on standing water surface in rice fields.

EXPERIMENTAL

A statistically laidout field experiment with and without provision of drainage was initiated on a newly cultivated INA experimental field (Brahmaputra alluvial soils). Treatment A (irrigation with no drainage) and Treatment B (irrigation with drainage) were laid in pair of plots, there being 4 pairs for each treatment. For the purpose of performance study, 2 pairs of each treatment were randomly chosen. Irrigation was provided as to keep a level of 5" standing water in all the plots. Four weeks old rice seedlings were transplanted uniformly in all the fields. Fertilizer N, P and K @ 90 kg of N, 90 kg of P_2O_5 and 70 kg of K_2O per hectare were applied. Nitrogen, however, was given in three splits. The drainage channels were two feet deep and were good enough to drainwater through the rice root zone in the fields.

Results and Discussion

The mean grain yields obtained in the experimental plots are recorded in Table I.

water though increases rapidly in the first 24 hours, yet it decreases exponentially with time and reaches the original level of concentration in 72 hours possibly by the diffusion of the nutrient into the soil. The nitrogen concentration of drain water, however, increases upto 48 hours (curve C). The nitrogen concentration of the drain water was too low in comparison with that of the standing water of field plots. The delayed increase in nitrogen concentration may arise from the time lag in the process of infiltration due to tortuosity likely to be encountered in the rice field.

Table I

Effect of drainage on rice yields (Mean of two pair plots in Kg/ha)

Treatments	CHANDINA (Aman season 1975)		IRATOM-24 (Boro season, 1976)	
	Mean yields	Percentage increase in yields	Mean yields	Percentage increase in yield
Field with no drainage	2935	28*	1849	49*
Field with drainage	3752		2790	

* Significant at 5% level.

All other conditions remaining constant, field with provision of drainage increased the Chandina yield by 28% significant at 5% level. A second crop of IRATON grown on the same layout showed 49% increase in grain yields in the field provided with drainage (significant at 5% level). This increase in grain yield conforms to the finding of the experiment conducted in Taiwan, Philippine, Thailand and Japan[1,2] where two fold increase in the yield has been recorded from fields provided with drainage. This increase is spectacular in contrast to poor yields commonly obtained by farmers after providing all the inputs thought to give the maximum yields.

Twenty-three kg. of nitrogen was applied as a second dose on the standing water surface.

Nitrogen content of water collected from field plots and drains every 24 hours after the application of second dose of urea is shown in Fig. 1. Concentration of nitrogen in standing water from the field plots without drainage provision was found to be slightly higher than the nitrogen content of water in the field plots with drainage provision. Nitrogen concentration of standing water in both drained and non-drained plots was found to be maximum at 24 hours after the application of urea but the nitrogen content of water collected at 48 and 72 hours after application was found to decrease considerably (curves A and B). Concentration of nitrogen in standing

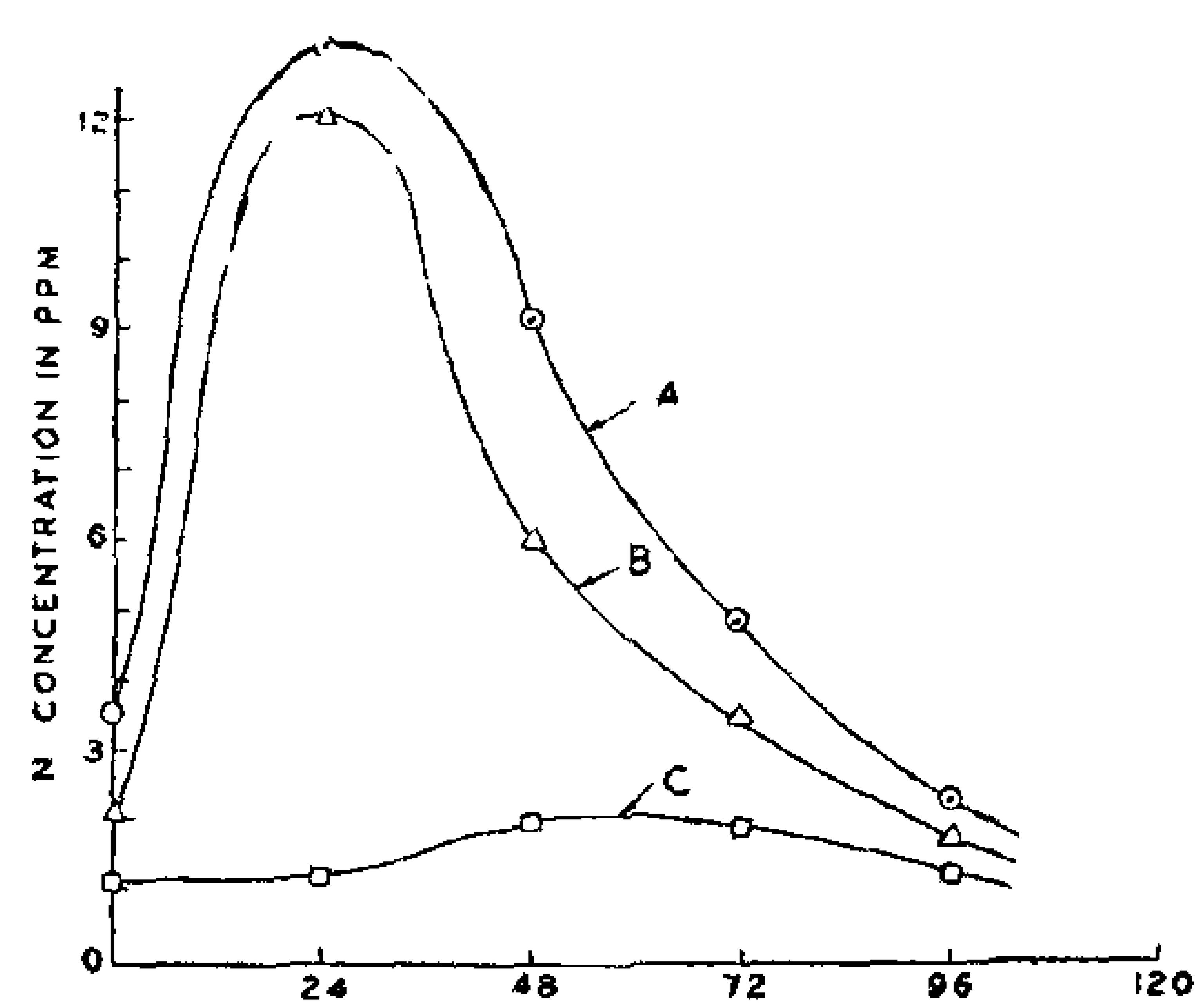

Fig. 1. Concentration of Nitrogen in standing water and drain water of rice fields.

A, Standing water of field plots without drainage; B, Standing water of field plots with drainage; C, Drain water.

With a view to understanding the mode of disposal of nitrogen within the first 72 hours after application on the water surface, a laboratory experiment simulating the field conditions was conducted in pots in duplicate keeping the infiltration rate same as in normal rice soils, *viz.*, at 2 mm level per day. The results are given in Fig. 2. The rapid fall in the nitrogen concentration of the standing water in pots between 24 and 72 hours

(2A) after application of urea in solution is in conformity with the field observations. The drainage water did not show any cognisable change in concentration as indicated in Fig. 2 (curve C). The nitrogen content of soil, however, rapidly increased as indicated by curve B of Fig. 2.

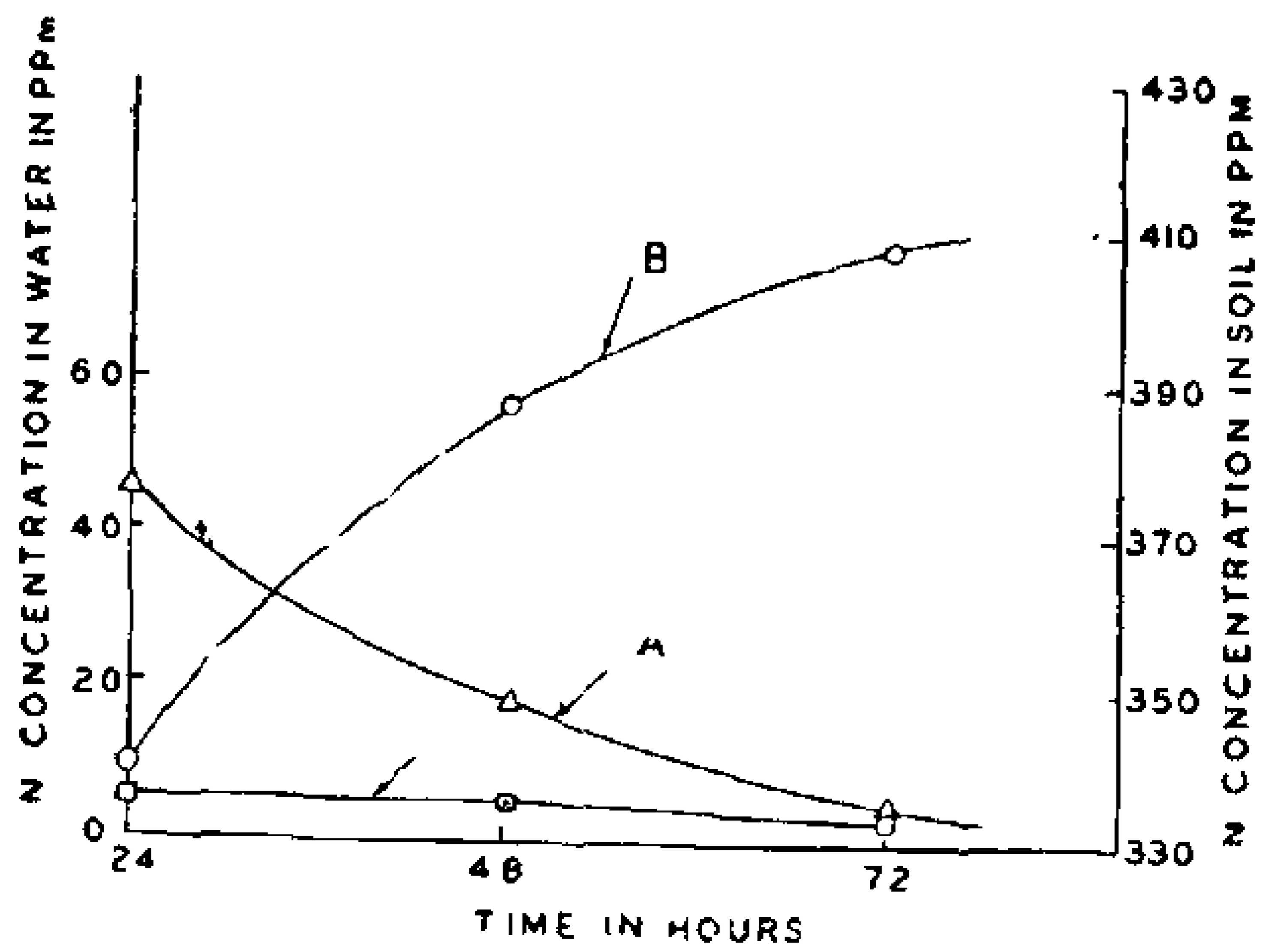

Fig. 2. Concentration of Nitrogen in standing water. Soil and leachate of pot experiment.
A, Standing water; B, Soil; C, Leachate.

The results recorded in these experiments clearly indicated the significant increase of grain yields in rice plots provided with drinage and also confirmed that the practice of applying nitrogen fertilizer on standing water is in no way inferior to broad-casting on the wet soil as the soil seems to have the capacity to absorb and retain most of the nitrogen applied.

Brahmaputra flood plain soils have infiltration rates much higher than the traditional rice growing heavy soils of Bangladesh (2 mm per day). The beneficial effects of drainage are likely to be more prominent on the traditional rice growing soils. The experiment is, therefore being repeated during 1976 at other research centres, *viz.*, Kashimpur and Ishurdi representing Brahmaputra grey flood plain soils and Ganges calcareous grey flood plain soils with impeded drainage.

Further investigations are in progress to determine deletion/removal of nutrient and toxins from the rizosphere soils under the stress of plant uptake and the slow seepage of irrigation water to drainage channel. The influence of additional oxygen supply with the water moving laterally through rootzone on the root and consequent nutrient uptake is also under study.

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