Technology 8: Balanced Use of Nutrients: Key to Sustainable Productivity

Fertilizer is one of the key inputs of green revolution in India. Long-term fertilizer experiments provide an opportunity for precise monitoring the changes in soil fertility and productivity. Continuous use of chemical fertilizers with major plant nutrients and introduction of irrigation under intensive agriculture accelerated the mining of nutrients from soil. To monitor the crop yield and soil nutrient status under different soil and cropping systems, a long term fertilizer experiment was initiated in early seventies. The results of long-term fertilizer experiments revealed that in first few years there was no adverse effect on crop yields. But after few years a drastic reduction in yield was noticed at several places in the plots, which received nutrients in imbalanced form. Soil analysis revealed that inadequacy of some of the plant nutrients and hidden hunger of micronutrient were found to be yield limiting factors. Some classic examples are given below for substantiating the yield limiting facts.

- Continuous use of N alone and imbalance supply of nutrients (N, NP, NPK) in several long term experiments has resulted failure of crop specially in Alfisols. For instance at Bangalore, Ranchi and Palampur continuous application of N alone resulted in almost failure of crop (Plate 1) which was even poorer than absolute control.

Plate 1 **Continuous use of N alone (through Urea) led to complete crop failure**

- Due to continuous harvesting of high yield of rice and wheat at Pantnagar and Ludhiana, Zn became the limiting factor. The zinc availability has gone down from 2.7 mg kg^{-1} soil to 0.8 mg kg^{-1}. Inclusion of Zn in fertilizer schedule resulted in significant increase in yield of rice and wheat (Table 1, Plate 2 & 3). FYM met out the requirement of zinc of both the crops.

Table 1. Effect of addition of Zn and FYM along with NPK on rice and wheat yield at Pantnagar

Treatment	Rice (t ha^{-1})	Wheat (t ha^{-1})

	1998	1999	2000	Mean	1998-99	1999-2000	Mean
100% NPK	4.06	3.94	3.84	3.95	3.68	3.61	3.45
100% NPK+Zn	4.72	4.58	4.44	4.58	4.15	4.20	4.17
100% NPK+FYM	4.88	4.76	4.67	4.77	4.65	4.71	4.68

Zn was applied @ 50 kg Zn SO_4 ha^{-1} in soils in *kharif* of 1993 and 1997.
FYM @ 15 t ha^{-1} once in a year before transplanting of rice

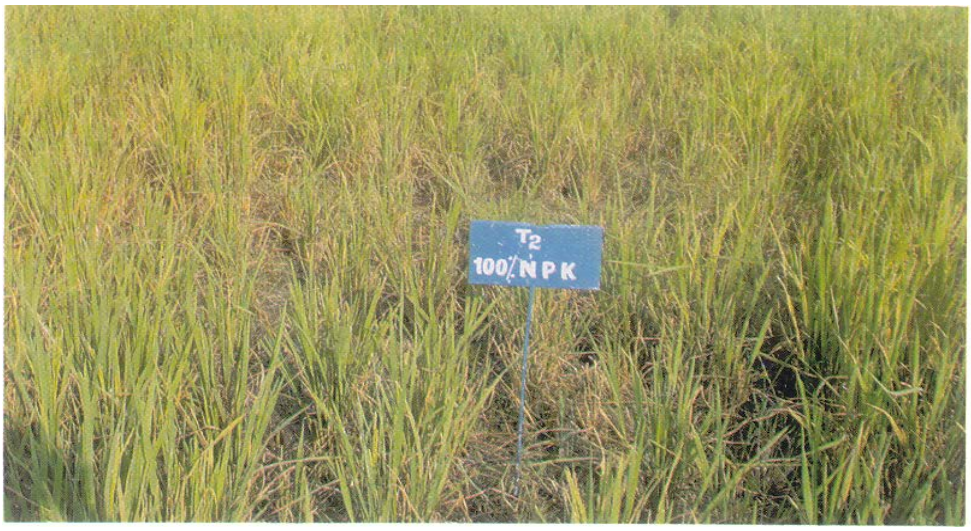

***Plate 2** Zn deficiency in rice under optimal NPK at Pantnagar*

***Plate 3** Response of rice to Zinc application in Mollisol of Pantnagar*

- Similarly, K was found to be a yield limiting factor in Alfisols (Plate 4). Because, the amount of K removed by the crop was much larger than the applied. Spectacular increase in yield of finger millet and maize was noted on application of K (Table 2). Further increase in yield on application of FYM indicates inadequacy of other nutrients.

Table 2. Potassium application and crop yield (t ha^{-1}) at different centre of LTFE (2002-03)

Treatments	Bangalore		Palampur		Udaipur	
	F. millet	Maize	Maize	Wheat	Maize	Wheat
NP	0.59	0.25	2.79	0.47	2.88	3.54
NPK	4.35	2.03	4.35	1.73	3.06	3.85
NPK+ FYM	4.74	2.40	5.80	2.48	3.45	4.33

Plate 4. Deficiency symptoms of K in maize in Alfisols (Bangalore) and Inceptisol (Udaipur)

At some of the sites of LTFE more than one nutrient were found as yield limiting factor. Thus, the results of LTFE clearly demonstrated that balanced supply of nutrients either through inorganic or organics or conjunctively is the only solution for sustainable productivity.