

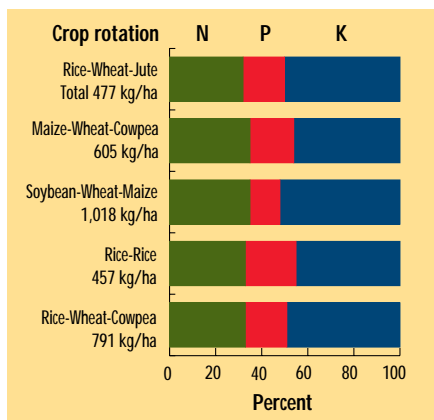
## Experiences with Balanced Fertilization in India

By H.L.S. Tandon

*Intensive crop rotations and imbalanced fertilizer use have resulted in multiple nitrogen (N), phosphorus (P), potassium (K) and other nutrient deficiencies. For intensive, high yielding cropping systems, current recommended NPK rates are inadequate and need revision upwards. Privatization of the fertilizer industry already in process will provide farmers with a wider choice of fertilizers and better prices and services. It appears that education of policy makers is of equal importance to the education of scientists, extension personnel and farmers with regards to proper fertilization practices.*

In India, fertilizers have contributed 60 percent of recent increases in food production. Balanced fertilizer use was the major strategy used, with an ideal N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ratio of 1:0.5:0.25 for grain-based production systems. India was approaching this ideal ratio until policy changes which removed subsidies from P and K but retained them for N were introduced in 1992. While P and K consumption immediately slumped, farmers gradually are increasing consumption of these plant nutrients again because of improved crop prices and farmer awareness of the benefits of balanced N, P and K use.

Figure 1. Mean annual nutrient uptake by some intensive irrigated rotations. Data for each rotation is mean total uptake of N+P<sub>2</sub>O<sub>5</sub>+K<sub>2</sub>O, kg/ha.



Intensive crop rotations take up and remove large quantities of N, P and K annually (Figure 1). When N, P and K applications are imbalanced, large quantities of the nutrients not applied in adequate amounts are mined from the soil until they become critically deficient. India is already in the era of multiple nutrient deficiencies with N, P, K, S and Zn being the most widespread. Average wheat field trial yield responses to these plant nutrients are 1,092, 488, 371, 813, and 360 kg/ha, respectively (Table 1). Such findings underscore the

fact that balanced fertilizer use for high yields goes beyond N, P and K application.

Balanced fertilizer use is a profit maximizing approach not only in intensive irrigated farming, but also in rainfed-dryland farming where both high productivity and yield stability are required. Balanced fertilizer use produced millet grain yields of 3 t/ha or more 14 out of 17 years. In contrast, average millet yields in India are less than one t/ha.

Long-term experimental results in India show that continuous use of only N, P and K fertilizers is not sustainable. With the addition of 12 to 15 t/ha manure each year, the system

is sustainable. This is possibly due to additional K, S and specific micronutrients being provided in the manure as well as improvements to soil physical properties. Continuous applications of P and K generally result in a positive P balance, but a negative K balance indicating more K needs to be added.

For intensive high yield cropping systems, recommended "optimal" N, P and K rates are inadequate and hence, need revision upwards. This is amply demonstrated by large numbers of on-farm trials where soils testing "high" had sizable responses to additional P and K, Table 2.

Soil testing in India has not been a successful program. Less than 10 percent of the farmers adopt recommended fertilizer rates. And, only a few samples are sent to the 518 operational soil testing laboratories.

Fertilizer recommendations in India are not made on a flexible basis. Thus, if a farmer cannot afford the total recommendation or cannot obtain a particular nutrient, he does not know how to adjust the recommendation.

India has an elaborate fertilizer distribution and marketing system where private traders play an important role. Of the 253,000 establishments engaged in selling fertilizers to farmers, 69 percent are private dealerships and 31 percent are cooperatives or similar organizations. There is an increasing shift towards further privatization of the fertilizer sector, with the exception of urea. This is expected to provide a more competitive environment resulting in wider product choice with better prices and improved farmer services.

In August 1992, all P and K fertilizer prices...but not N...were decontrolled. This created an immediate imbalance in fertilizer consumption favoring N. Even though crop prices were improved to compensate farmers, the excessive use of N in relation to P and K was exaggerated by this policy change. If continued, this could lead to yield decline due to P and later K deficiencies. However, India's farmers did not reduce P and K use in proportion to their increase in prices. This was a good sign. Arrangements for financial credit for farmers are helping them purchase more P and K fertilizers, thereby practicing a more balanced fertilization strategy.

Presently, it appears that education of policy makers on the importance of balanced fertilization needs as much attention as educating farmers, extensionists and scientists. BCI

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**Table 1. Average yield responses of wheat to various plant nutrients in India.**

Nutrient	Trials	Average response,		Nutrient	Trials	Average response,	
		kg/ha				kg/ha	
N	3,768	1,092		Zn	2,358	360	
P	3,768	488		Fe	60	190	
K	3,768	371		Mn	59	590	
S	32	813		Cu	35	380	
				B	34	380	

**Table 2. Soils testing high in P and K still respond to applications of these nutrients.**

Nutrient rate, kg/ha	Soil test rating	Number of trials	Average response,	
			kg/ha	Rs/ha
P <sub>2</sub> O <sub>5</sub> , 60 kg/ha	Low	2,140	680	2,448
	Medium	2,446	669	2,408
	High	147	486	1,350
K <sub>2</sub> O, 60 kg/ha	Low	749	245	882
	Medium	2,167	250	900
	High	1,834	192	691



*There are over 174,570 private fertilizer dealers in India.*