Balanced Fertiliser Use Increases Crop Yield and Profit

By G. Dev

Balanced fertilisation refers to the application of essential plant nutrients in optimum quantities and proportions. Balanced nutrient supply is a best management practice (BMP) that should also include proper application methods and timing for the specific soil-crop-climate situation. This BMP ensures efficient use of all nutrients, maintenance of soil productivity, and conservation of precious resources.

The importance of balanced fertilisation is clearly visible from the large number of long-term experiments conducted on cropping sequences throughout different agro-climatic zones in India (**Tables 1** and **2**). Balanced fertilisation's positive effect on farm income is self evident both before and after the governmental price restructuring process that took place in 1992 (**Figure 1**).

Research is showing the advantages of improved crop production with balanced fertilisation.

Ratio as an Indicator of Balanced Fertiliser Use

The nitrogen (N), phosphorus (P), and potassium (K) use ratio is valuable as an index of balanced fertilisation if comparing large regions of diversified crops and soils such as a states or countries. As an example, grain based sys-

Table 1. Effect of balanced nutrition on yield of different crops, India.

Crop	Season and condition	Number of trials	Nutrients $N\text{-}P_2O_5\text{-}K_2O$, kg/ha	No fertiliser, t/ha	Yield increase over control, % N	NP	NPK
Rice	Kharif, unirrigated	380	120-60-40	2.42	49	74	99
Rice	Kharif, irrigated	9,634	120-60-60	2.96	27	51	56
Rice	Rabi, irrigated	5,686	120-60-60	3.20	28	51	53
Wheat	Rabi, irrigated	10,133	120-60-60	1.55	59	95	114
Sorghum	Kharif, unirrigated	367	90-60-60	1.10	51	80	97
Sorghum	Rabi, unirrigated	389	90-60-60	0.61	56	92	120
Maize	Kharif, unirrigated	53	90-60-60	1.23	85	107	129
Pearl millet	Kharif, unirrigated	207	90-60-60	0.50	54	110	130
Finger millet	Kharif, unirrigated	120	90-60-60	1.25	46	96	118
Chickpea	Rabi, unirrigated	1,325	20-40-20	0.75	36	59	77
Pigeon pea	Kharif, unirrigated	53	20-40-20	0.30	97	210	227

Source: Randhawa, N.S. and H.L.S. Tandon (1992). Fertiliser News 27(2) 11-26.
Note: Kharif season is planting in June-July. Rabi season is planting in October-November.

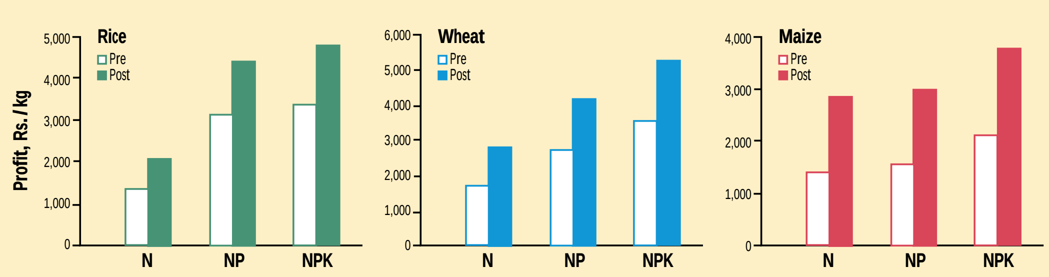

Figure 1. Profit from 9,634 rice, 10,133 wheat and 53 maize production trials before (pre) and after (post) fertiliser price changes in August 1992. Price in Rs./kg before August 1992: N=6.65, P_2O_5=7.57, K_2O=2.83, paddy rice=2.7, wheat= 2.75, maize=2.10. Prices after August 1992: N=7.96, P_2O_5=14.63, K_2O=6.62, paddy rice=3.8, wheat=4.15, maize=3.60.

tems in developing agriculture systems such as in India have a target NPK use ratio of 4:2:1. However, the nutrient use ratio provides no indication of the actual amounts of nutrients being applied in that region and does not give an accurate assessment of fertiliser use among crops.

Different crops demand soil nutrients in ranging proportions. For example, legumes may need nutrients in a ratio of 0:1:1, 1:2:2, or 1:2:3; root crops in a ratio of 2:1:2, etc. Therefore, crop requirements should only be based on fertiliser response data, nutrient offtake through harvest, and the specific nutrient supplying status of the soil.

Through considerable efforts, NPK use ratios in India narrowed to 5.9:2.4:1 in 1991-92 (**Table 3**). However, August of 1992 brought about the removal of subsidies on P and K fertilisers and a 10 percent decrease in the controlled price of urea. This intervention caused a drastic reduction in P and K consumption and widened India's NPK use ratio for years since. It may be noted that the NPK use ratio for 1996-97 had still not recovered to the level obtained in 1991-92.

Table 2. Average grain yields (kg/ha) in long-term (17 year) trials, India.

		Treatment						
Location	Crop	Control	N	NP	NPK	NPK+FYM	CD (5%)	CV
Barrackpore	Rice	1,947	3,952	4,245	4,398	4,468	176	13
	Wheat	785	2,083	2,245	2,342	2,430	90	12
Ludhiana	Maize	413	1,408	1,893	2,483	3,232	46	6
	Wheat	891	2,732	3,961	4,686	4,801	67	3
Coimbatore	Finger millet	687	945	2,640	2,604	3,093	138	15
	Maize	585	703	2,666	2,902	3,388	145	16
Jabalpur	Soybean	1,047	1,296	2,093	2,217	2,438	–	–
	Wheat	1,125	1,625	3,698	3,854	4,327	–	–
Hyderabad	Rice, kharif	1,630	2,756	3,276	3,499	4,086	–	–
	Rice, rabi	1,706	3,176	3,552	3,574	4,333	–	–
Ranchi	Soybean	952	502	1,125	1,470	1,753	–	–
	Wheat	1,175	640	2,248	2,488	2,624	–	–
Bhubaneswar	Rice, kharif	1,677	2,344	2,405	2,925	3,427	143	13
	Rice, rabi	1,493	2,465	2,824	3,076	3,682	143	12
Palampur	Maize	258	995	2,547	3,222	4,691	249	17
	Wheat	396	656	2,079	2,609	3,303	147	14

Source: Nambiar, K.K.M. (1994). Soil fertility and crop production under long-term fertiliser use., ICAR, N. Delhi.

Imbalanced Use of Nitrogen Accelerates Depletion of Other Nutrients in Soil

Neither yield nor profit can be sustained using imbalanced application of fertilisers as the practice may result in accelerating deficiencies of other soil nutrients. As an example, application of N alone in various crop sequences commonly depletes available soil P (**Table 4**).

Table 3. NPK (N-P_2O_5-K_2O) use ratios for India.

Year	NPK ratio
1970-71	6.3:2.3:1
1975-76	7.7:1.7:1
1980-81	5.9:1.9:1
1985-86	7.0:2.5:1
1991-92	5.9:2.4:1
1992-93	9.5:3.2:1
1993-94	9.7:2.9:1
1994-95	8.5:2.6:1
1995-96	8.5:2.5:1
1996-97	10.0:2.9:1
1997-98	7.9:2.8:1

Secondary and Micronutrients Are Equally Important in Balanced Fertiliser Use

Balanced fertilisation programmes must be developed to remove all yield-limiting factors. Therefore, nutrient balance must be considered beyond N, P and K. Shifts in consumption from low to high analysis fertilisers can create secondary and micronutrient deficiencies. Sulphur (S) application is now needed in pulse and oilseed based cropping systems. Yield responses to S in cereals are often recorded. In rice-wheat cropping systems, zinc (Zn) is now considered a deciding factor for crop success or failure. Average wheat yield responses (kg/ha) to different secondary and micronutrients in India are: S, 813; Zn, 360; iron (Fe), 190; manganese (Mn), 590; copper (Cu), 380; and boron (B), 380.

Table 4. Soil P depletion from use of N only in intensive cropping systems, India.

Location	Soil	Cropping sequence	kg/ha P_2O_5 removed by crops: Control plot	kg/ha P_2O_5 removed by crops: N only plot
Barrackpore	Alluvial	Rice-Wheat-Jute	321	642
Ludhiana	Alluvial	Maize-Wheat-Cowpea	183	412
New Delhi	Alluvial	P. Millet-Wheat-Cowpea	160	366
Coimbatore	Black	F. Millet-Wheat-Cowpea	344	458
Jabalpur	Black	Soybean-Wheat-Maize	275	366
Hyderabad	Red	Rice-Rice	527	847
Bhubaneswar	Laterite	Rice-Rice	275	458
Palampur	Hill	Maize-Wheat-Potato	155	252
Pantnagar	Terai	Rice-Wheat-Cowpea	893	1,420

Source: Beaton, J.D., Dev, G., and Halstead, E.H. (1993). FAI Seminar, SVI-3/1-3/8.

Soil Test Based Fertiliser Use Means Balanced Use

Soil test based fertiliser recommendations ensure balanced fertiliser use. India has 514 (including 133 mobile) soil testing laboratories with a total capacity for analysing about 6.8 million soil samples per annum. Despite this extensive network, there is a strong need to strengthen existing laboratories by increasing the number of plant nutrients they determine and by increasing their capacity to provide a faster and more meanigful service to farmers.

Conclusion

Balanced and adequate fertilisation is essential for increasing crop yields and ensuring sustainable agriculture. No developed or developing country in the world has been able to increase agricultural production without expanding the use of balanced fertilisation. In fact, in countries where consumption of plant nutrients is low and imbalanced, agricultural production is also low, and yields are stagnant or declining. India is no exception to this phenomenon. BCI

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