Phosphate and Potash Use in Vegetable Crops

By B.S. Prabhakar

India is endowed with favorable tropical, sub-tropical and temperate climates, making it conducive for producing high quality, high value vegetables year round in various parts of the country. At present, 50 million tonnes of vegetables are produced from about 5 million hectares which account for less than two percent of the cropped land.

There is an appalling gap between potential yields and actual yields harvested by farmers. For most vegetable crops, yields realized are less than 50 percent of the potential (Table 1). By the year 2000, India will need to produce 100 million tonnes of vegetables from less than 6 million hectares by increasing productivity from 10 t/ha to 15 or 20 t/ha. This task calls for better crop husbandry including the use of optimum rates of nitrogen (N), phosphorus (P), and potassium (K). On average, a 35 t/ha crop of vegetables removes 151, 57 and 195 kg N, P_2O_5 and K_2O, respectively (Table 2).

Phosphorus Management

About 98 percent of India's soils require fertilizer P application to augment crop yields. Crop recovery from added P seldom exceeds 20 percent during the year of application. Placement of P fertilizer at 5 cm depth results in better absorption and utilization of applied P, effecting savings of up to 20 percent in tomato and onion and up to 40 percent in brinjal. Okra also responds to placement of P at 10 to 15 cm depth. French bean varieties with high yield potential (Akra Komal, IIHR 909 and Contender) exhibit higher P uptake and utilization. Genotypes with low yield potential exhibit low P utilization.

Although P uptake by the first crop is usually below 20 percent, with smaller amounts being absorbed by the subsequent crops, applied P utilization can be increased with intensive cropping systems.

Table 1. Area, production, productivity and potential of vegetable crops (NHB 1992-93).

Crop	Area, 1,000 ha	Production, 1,000 tonne	Productivity, t/ha Actual	Productivity, t/ha Potential	Productivity, t/ha Percent
Potato	1,260	20,284	16	40	40
Onion	381	5,781	15	35	43
Tomato	309	4,850	16	50	32
Cabbage	216	4,357	20	70	29
Cauliflower	222	4,221	19	50	38
Okra	222	2,487	9	20	45
Peas	194	1,492	8	20	40
Others	2,240	27,596	12	40	30
Total	5,103	71,006	14	40	35

Table 2. Nutrient removal by some vegetable crops.

Crop	Yield, t/ha	Nutrient Removal, kg/ha N	P_2O_5	K_2O
Beans	15	130	40	160
Cabbage	70	370	85	480
Carrot	30	125	55	200
Cauliflower	50	250	100	350
Cucumber	40	70	50	120
Okra	20	60	25	90
Onion	35	120	50	160
Radish	20	120	60	120
Tomato	50	140	65	190
Peas	20	125	35	80
Mean	35	151	57	195
Nutrient Ratio		2.65	1.00	3.42

In a cropping system including French bean/cabbage/tomato fertilized with two levels of P, the residual, direct and cumulative effects of P fertilization depended on the crop in sequence and the level of P added to the previous crop.

Evaluation of P sources has mostly involved those with varying water solubility. For short duration vegetable crops, water soluble P is superior to citrate soluble P, though the latter holds some advantages in vegetable rotations.

Most of the vegetable crops favor basal application because of their poor ability to utilize soil P in early crop growth stages. Split applications of P may be useful in cases where the initial supply of the nutrient is adequate. Soaking seeds in P solution and dipping seedlings in a P solution or slurry have been found useful in meeting the initial requirement. Coating single superphosphate (SSP) with a biogas slurry or cow dung has also been shown to increase the efficiency of P fertilizer.

Potassium Management

In India, about 13 percent of the soils are low, 53 percent medium and 34 percent high in available K. Though the removal of K by vegetable crops is of the same order or higher than that of N, its application is no where near that of N. The response to added K varies with the crop, but its application to each individual crop in a sequence is beneficial.

Muriate of potash is the most common source for the supply of K. However, root and bulb crops often respond more to potassium sulfate.

Future Fertilizer Needs

Fertilizer recommendations for vegetable crops from different parts of India show that these crops require NPK in ratio of 2:1:1 (Table 3). However, nutrient ratios applied by the growers vary significantly from that recommended.

It is estimated that the present population of 900 million may reach one billion by the turn of the century and 1.7 billion by 2025. Whether India's farmers will be able to produce 100 million tonnes of vegetable crops by 2000 and 170 million tonnes by 2025 will depend largely on government policies.

Imbalances in productivity in different regions and environmental concerns about high input, intensive agriculture are some of the issues affecting vegetable production. However, we cannot lose sight of the fact that the productivity levels of major vegetables are far below the projected yield levels needed, and the major constraint to higher productivity is still the limited use of mineral fertilizers. Export oriented production of vegetables under protected

Table 3. Fertilizer recommendations for some vegetable crops.

Crop	Nutrient, kg/ha		
	N	P_2O_5	K_2O
Cabbage	150	125	100
Cauliflower	150	60	40
Tomato	110	60	95
Brinjal	120	80	80
Okra	60	50	30
Carrot	56	28	56
Radish	84	30	30
Onion	135	45	22
Peas	50	50	25
Bitter Gourd	56	28	28
Mean	96.21	51.71	53.14
NPK Ratio	2	1	1

structures is also dependent on the use of these commercially produced fertilizers.

The production of 100 million tonnes of vegetables from 8 million hectares by 2000 and 170 million tonnes by 2025 will require 0.35 and 0.5 million tonnes each of P and K, respectively (Table 4). During the same periods, India will need 140 and 200 million tonnes of farmyard manure at the recommended rate of 25 t/ha. Its application is an accepted and popular practice followed by vegetable growers. Any correction in supply of nutrients through organic sources is not going to reduce the demand for mineral fertilizer plant nutrients. BCI

Table 4. Projection of plant nutrient needs of vegetable crops.

Particulars	Year		
	1995	2000	2025
Population (m)	900	1,000	1,700
Requirement of vegetables (m.t.)	90	100	170
Area under vegetables (m.ha.)	5	6	8
Productivity (t/ha)	14	20	30
Farm yard manure (m.t.)	125	150	200
Nitrogen (m.t.)	0.50	0.70	1.00
Phosphorus (m.t.)	0.25	0.35	0.50
Potash (m.t.)	0.25	0.35	0.50
Total NPK (m.t.)	1.00	1.40	2.00

(m = million)

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Liu Rongle Joins PPI/PPIC Beijing Staff as Agronomist

Mr. Liu Rongle has joined the international staff of PPI/PPIC.

He was appointed to the position of Technical Assistant (Agronomist) in the Beijing office on May 1, 1996. He will be assisting Dr. Jin Ji-yun, Deputy Director of the PPI/PPIC China Program, in agronomic research and education efforts with focus on north China.

"Mr. Liu brings a strong background in soil and fertilizer research to our China program," said Dr. David W. Dibb, President of PPI.

During 1986-1995, Mr. Liu was employed as assistant and associate professor at the Scientech Documentation and Information Center of the Chinese Academy of Agricultural Sciences (CAAS), working on soil and fertilizer related information processing and retrieving. Before joining PPI/PPIC, Mr. Liu had transferred to the Science and Technology Management Department of CAAS, as an associate professor for coordinating national research projects.

Born in Hebei, China, Mr. Liu completed his undergraduate training in agronomy at Hebei Agricultural University in 1982-83. He continued with graduate study at CAAS and received his M.Sc. Degree in Soil Science in 1986. BCI