# The Impact of Soil Test-Based Fertilization on Tomato

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**Current fertilizer use in tomato production in the central plain of Uttar Pradesh is generally confined to nitrogen (N) and phosphorus (P). This situation will not sustain tomato as an important cash crop system for northern India. A research and extension project has begun to effect positive change within the region.**

Winter season-grown tomato production occupies 60,000 ha within Uttar Pradesh (North India) and is the major commercial crop for the region. Despite this, tomato growers have long-standing complaints regarding low yields, undersized fruit, premature fruit drop owing to loosely attached fruit, poor pulp content, disease susceptibility, and poor shelf-life.

The area is dominated by light-textured sandy loam soils largely deficient in N, P, and potassium (K). A recent appraisal of soil fertility status revealed N, P, and K deficiencies in 95%, 70%, and 52% of sites, respectively. Analysis of soils from fields located within Kanpur district villages selected for this study supports widespread K deficiency, with available soil levels ranging between 46 and 117 mg/kg. While farmers generally apply urea and diammonium phosphate (DAP), K fertilizer use is practically non-existent and farmyard manure is spread in limited quantities. Continuous cultivation of tomato under this management has seriously depleted nutrient reserves.

**Farmers** compare differences in fruit quality at a community field day extending trial results.

In this study, a series of adaptive trials was designed to: 1) study the response of applied K on yield and quality of the tomato crop, and 2) monitor the impact of balanced fertilization on farmers. The experiments were conducted on farm fields for 2 consecutive years with the following three treatments:

1. (FP) farmers' practice, which generally is applied urea at 80 kg/ha 0 plus DAP applied at 30 kg $P_2O_5$/ha
2. (FP+K) farmers' practice plus 60 kg $K_2O$/ha
3. (BF) a balanced treatment of 150-75-75 kg N-$P_2O_5$-$K_2O$/ha.

Sixteen (year 1) and 18 (year 2) experimental sites were established within four villages (i.e., Pura, Chain Newada, Radhan, and Arjun Purawa) representing a 1,000 ha cross-section of the tomato-growing area. Selected farm fields were different in both years. All experimental sites were low to medium in available K. The full quantity of P and half the quantities of N and K were applied at transplanting. The remaining quantities of N and K were applied 45 days after transplanting, at the time of 'earthing' or hilling. Recommended cultural prac-

| Table 1. Effect of various treatments on growth and flowering parameters of tomato. | | | | | |
|---|---|---|---|---|---|
| Treatment | Plant height, cm | Basal girth, cm | Days till 50% flowering | No. of truss per plant | No. of fruit set per truss |
| BF | 81 | 4.9 | 41 | 23 | 3.6 |
| FP+K | 70 | 4.5 | 44 | 21 | 3.0 |
| FP | 65 | 4.3 | 46 | 17 | 2.6 |
| C.D.[1] at 5% | 5 | 0.4 | 3 | 2 | 0.3 |

[1]Denotes the critical difference

tices and plant protection measures were adopted uniformly for all treatments. Irrigation was provided as and when required. Standard chemical analyses of fruits were performed. Post-harvest storage life of tomato fruits was studied under ambient conditions.

| Table 2. Effect of various treatments on quality parameters of tomato. | | | |
|---|---|---|---|
| Treatment | Fruit weight, g | TSS (°Brix) at 14 days | Ascorbic acid at 14 days, mg per 100g juice |
| BF | 105 | 5.9 | 350 |
| FP+K | 70 | 4.5 | 304 |
| FP | 65 | 4.3 | 241 |
| C.D.[1] at 5% | 4 | 0.4 | 26 |

[1]Denotes the critical difference.
TSS (°Brix) - Total soluble solids

## Results and Discussion

Growth and development of reproductive parameters benefited significantly from balanced NPK fertilization. Plant height and basal stem girth were both increased compared to FP+K and FP. Time to crop flowering (50%) was reduced, and the number of flowers per truss was highest, for the BF treatment. In turn, a maximum number of fruit set per truss was noted under BF (**Table 1**).

Fruit quality characteristics also suggest great potential for improvement as the highest weight for individual fruits was noted under BF, followed by FP+K and FP (**Table 2**). The FP treatment resulted in maximum physiological weight loss after 14 days in storage. Storage advantages seemed apparent with fruits receiving BF, though the variation among treatments, prevented any statistical differences (data not given). Total soluble solids (TSS) in freshly harvested fruits varied little among treatments though the highest value did correspond with the BF treatment. The treatment effect on TSS became more pronounced during storage. However, after 14 days, fruits grown under BF still had the highest TSS content.

Treatments providing balanced fertilization appeared to enhance acid accumulation in freshly harvested fruits. Ascorbic acid (vitamin C) content was significantly higher in freshly harvested fruits under BF followed by FP+K (data not given). As described with TSS, ascorbic acid content tended to increase with storage duration. After 14 days, maximum ascorbic acid content was still observed under BF, followed by FP+K and FP.

Mean fruit yields were 41.5, 29.0, and 23.5 t/ha under BF, FP+K, and FP, respectively. An additional 60 kg $K_2O$/ha brought a 23% yield increase for FP+K over FP, while the BF treatment supported a 43% increase over FP **(Table 3).** Serious yield losses are apparent due to the omission of K, although an almost equivalent yield gap between FP+K and BF highlights the advantages gained through balanced nutrient supply. In economic terms, the mean net return from BF plots was 21.3 rupees (INR) per

| Table 3. Mean yield (t/ha) of tomato under different treatments. | | | | |
|---|---|---|---|---|
| Year | No. of trials | BF | FP+K | FP |
| First | 16 | 42.0 | 30.0 | 26.0 |
| Second | 18 | 39.0 | 28.0 | 21.0 |
| Mean | – | 41.5 | 29.0 | 23.5 |
| Increase over FP, % | – | 43 | 23 | – |

**Table 4.** Net returns over common farm practice.

| Year | No. of trials | Net return, Rs/Rs invested | | Net return, Rs/ha | |
|---|---|---|---|---|---|
| | | BF | FP+K | BF | FP+K |
| First year | 16 | 20.0 | 17.9 | 32,000 | 8,000 |
| Second year | 18 | 22.5 | 31.5 | 36,000 | 14,000 |
| Mean | 34 | 21.3 | 24.7 | 34,000 | 11,000 |

1 US$ = 46.58 INR

unit invested above that from farmers' fertilizer practice (**Table 4**). Use of FP+K supported an additional INR 24.7 return per unit invested. Total returns over FP were INR 34,000/ha (US$730) in BF plots, and INR 11,000/ha (US$236) in FP+K plots.

**Table 5.** Impact analysis of balanced NPK fertilization.

| Item | Number |
|---|---|
| Number of villages surveyed | 6 |
| Number of farmers contacted | 96 |
| Number of farmers who adopted balanced use of NPK as per recommendation | 77 |
| Average yield of farmers who adopted balanced fertilization | 33.8 t/ha |
| Average yield under farmers' practice | 22.8 t/ha |
| Mean yield increase with balanced use of NPK over farmer's practice | 48% |

## Impact Analysis

An impact analysis was conducted during the second year to assess outcomes and outreach from the first year's efforts. Farmer adoption of balanced fertilization in adjoining villages would largely be an outcome of a community field day. A survey was designed and 96 farmers from six neighboring villages were contacted to provide details about their fertilizer schedules for tomato.

A majority of farmers appeared convinced of the benefits of proper K use in their crops as 77 admitted to already adopting balanced fertilization (**Table 5**). For example, in the village of Makhan Newada, where no trials were conducted, farmers emulated those in nearby trial villages as 11 out of 12 farmers interviewed had enthusiastically adopted balanced use of NPK. Based on yield surveys, inclusion of K along with N and P sources was a gainful practice. The average yield was 34 t/ha for those using BF against 23 t/ha under a particular farmer practice. Most farmers indicated that fruit size and pulp content were also increased due to K fertilization and consequently their market prospects were enhanced. The impact would depend on the resources presently available to individual tomato growers, and would be expected to increase in significance as improved fertilization systems become more established. BC


**On-farm** trials with CSAUAT in Kanpur have caused many farmers to improve fertilization practices.

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