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# Assessment of Integrated Plant Nutrient Management in Tomato through Farmers Participatory Approach

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**ABSTRACT**

Tomato (*Lycopersicon esculentum* Mill.) is one of the most remunerative and important vegetable crop widely grown and consumed in India. Injudicious use of fertilizers for higher yield in tomato is very common among farming communities which not only causes reduction of total yield gradually, but also is one of the major factors for higher incidence of biotic and abiotic stresses in commercial production. The farmers participatory trials were conducted by Krishi Vigyan Kendra, Chandauli district of Uttar Pradesh at farmers fields in two villages to assess the technological gap in tomato production and to evaluate IPNM technology for its effectiveness during *Rabi* 2008 and *Kharif* 2009. Eight technological gaps including application of fertilizer and pesticide for commercial tomato production were identified. The package of IPNM includes application of 10 tonnes FYM/ha + 150:80:60 kg NPK/ha + root dip of seedling in *Azotobactor* solution before transplanting + foliar spray of ferrous ammonium sulphate @ 20 ppm at 30, 45 and 75 days after transplanting. Findings of study revealed that maximum marketable fruit yield of 1025 qts/ha in *Kharif* 2009 and 955 qts/ha in *Rabi* 2008 were obtained from IPNM plots and 38.51 and 33.94 per cent increase in yield were recorded over farmers practice in respective seasons. The per cent loss of yield from total production due to diseased and inferior quality fruits were observed to be just double (8%) as compared with IPNM plot (4-5%). Partial budget analysis revealed that the net returns obtained from IPNM plot in Rabi 2008 and Kharif 2009 were higher *i.e.* ₹ 2,19,010 and ₹ 2,34,614 respectively than the farmers practice (₹ 1,42,240 and ₹ 1,43,235) in respective season. Reduction in cost of cultivation of ₹ 4,170 to ₹ 5,879 were also reported in IPNM plot in comparison with farmers practice . B:C ratio were found *i.e.,* maximum 4.25 in *Rabi* 2008 and 4.23 in *Kharif* 2009 respectively in IPNM plot whereas in farmers practices it was 2.98 and 2.82 in respective seasons.

**Key words :** IPNM, Tomato, farmer participation trials, technology gap

## INTRODUCTION

Tomato is one of the most important vegetable crop widely grown all over the country due to its wide adaptability and versatility. It is known as protective food as it contains vitamin C, minerals and medicinal values like blood purifier, and anti-carcinogenasic properties. Several processed items like juice, ketchup, paste and powder are also made from tomatoes. Being a remunerative cash crop, its commercial cultivation is widely adopted by farmers in an area of 0.599 million hectare with production of 11.15 million tonnes. The productivity of tomato in India is 18t/ha (NHB database 2009).

Intensive cultivation of tomato in peri urban areas of Chandauli district is very common due to continuous demand and market opportunity in Varanasi city, of Uttar Pradesh. Lack of awareness and injudicious use of chemical fertilizers by the farmers for harvesting higher yield not only create imbalances in buffer stock of soil nutrients, but adversely affect the plant growth and development with severe attack of disease and pest. Injudicious use of chemical pesticide to control pest and diseases also causes environmental disturbances as well. In the light of the above discussion, participatory study was conducted to assess the impact of IPNM technology in tomato in terms of soil health management yield potential and economic benefits.

## METHODOLOGY

The On Farm Testing (OFT) on IPNM in tomato was carried out by Krishi Vigyan Kendra Chandauli (U.P.) during *Rabi* 2008 and *Kharif* 2009 at five farmers fields in two villages *i.e.* Kanta Vishunpura and Amadpur in Chandauli district of Uttar Predesh. Technological gap between improved management package and farmers practices were studied based on survey and group discussion with farmers interactive group (FIG) of tomato growers in the selected villages. The tomato growers of these villages had small land holdings. Out of 100 farmers, 20 farmers were chosen randomly from selected villages and discussion were held on eight improved management package to study the technological gap. A list of constraints experienced by farmers was prepared and shortlisted.

The IPNM module given by IIVR, Varanasi *viz.* 5 tonnes press mud + 120 :60:60 kg/ha NPK + root dip in

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Azotobacter solution + Foliar feeding of ferrous ammonium sulphate @ 20 ppm on 30, 45 and 75 days after transplanting was modified on the basis of soil testing report and availability of organic matter and fertilizers. Finally module of IPNM was designed with the active participation of selected farmers as 10 tonnes FYM + 150 :80:60 kg/ha NPK + root dip of seedlings in *Azotobactor* solution + Spray of ferrous ammonium sulphate @ 20 ppm at 30, 45 and 75 days after transplanting and applied in farmers fields. All the participants raised their nurseries on raised bed and following improved nursery raising techniques. The hybrid variety popular in the area Avinash-2 was selected for the trials. The area of each trial was 1000$m^2$. Recommended basal dose of NPK 75:80:60 kg/ha and FYM @ 10t/ha were applied before the last ploughing. Scientific cultivation practices were followed for raising good crop.Top dressing of remaining nitrogen @ 75 kg/ha was applied in two split doses at 30 and 75 DAT. Plant protection measure as per need and availability were followed strictly. The data were recorded on different parameters and calculated accordingly. The per cent increase in yield over farmers practices were calculated using following formula as given below:

$$\text{Percent increase in yield} = \frac{\text{Demonstration yield} - \text{farmers' yield}}{\text{Farmers' yield}} \text{ X } 100$$

## RESULTS AND DISCUSSION

The data presented in Table1 revealed that farmers involved in tomato production were not aware about recommended crop production technology *i.e.* nursery raising seed rate, seed treatment, sowing and transplanting methodology, balanced nutrient management and plant protection measures.

They were using disease susceptible hybrid varieties along with high dose of nitrogen and phosphorus (300:200 kg/ha N:P) in anticipation to harvest maximum yield. Imbalanced fertilizer application not only hampers proper development of plants and its potentiality, but also causes higher incidences of disease and pest resulting in reduced marketable yield.

To control incidence of disease and pest, farmers used higher doses of pesticides in injudicious way which adversely affects the ecology and environment. The lack of knowledge and skill about production technology and plant protection measures in tomato crop were the important reason behind it.

**Table 1: Technological differences between improved production technology and farmers' practices' in tomato**

| Particulars | Technological interventions | Farmers' practices |
|---|---|---|
| Variety | Hybrids (Avinash-2, NS-815) | Open pollinated (S-22, Navoday) |
| Seed treatment | Overnight dip in Solution of Captan 0.2% | No seed treatment follows |
| Seed rate | 200-250 gram/ha | 500-800 gram/ha |
| Nursery raising | Raised bed Technique, line sowing | Connventiaral flat bed technique |
| Situation | Upland sandy loam irrigated | Upland sandy loan irrigated |
| Irrigation facility | Private tube well | Private tube well |
| Fertilizer application | Integrated nutrient management 10t FYM + 150:80 :60 Kg NPK + Spray of Ferrous ammonium sulphate @ 20 ppm at 30, 45 and 75 DAT + Root dip in | Application of 300 kg N and 200 Kg $P_2O_5$ per ha. |

The findings summarized in Table 2, exhibited that increased plant height in both the season were recorded with farmers practice during the course of study as compared to IPNM plot of experiment. The difference in plant height was much high between T( F.P.) and $T_2$ in *Kharif* 2009 than the *Rabi* 2008. It was observed that higher dose of nitrogenous fertilizer application was the major cause of increased plant height inT1(F.P.). However, maximum number of primary branches were found in IPNM plot in comparison with farmers practice, which not only shows the importance of organic matter in plant development and bearing of more member of flower cluster, but also exhibited the role of balanced fertilizer management in quality fruit production. The highest average yield of 1005 q/ha and 1087 q/ha were found in $T_2$ (IPNM plot) during *Rabi* 2008 and *Kharif* 2009 respectively as compared with $T_1$(FP) as 780 q/ha and 812 q/ha respectively in *Rabi* 2008 and *Kharif* 2009. The actual marketable yield after sorting and grading of commodity were 955 q/ha and 1025 q/ha from $T_2$ in both the seasons respectively, while the marketable yield of farmers practice reported only 713 q/ha and 740 q/ha in both *Rabi* 2008 and *Kharif* 2009 respectively. The data also showed that loss of yield due to inferior quality and diseased fruits was much higher *i.e.* as more than 8 per cent in farmers practice as compared to IPNM plot which had only approximately 5 per cent. It may be correlated with higher incidence of disease and pest in farmers

practice in comparison with IPNM plot. It was due to application of higher dose of nitrogenous fertilizers and mismanaged plant protection practices in tomato in respective season. The present findings are in agreement with Singh *et al.* 2002.

**Table 2: Impact of IPNM on the yield and its contributing characters as compared with farmers practices in tomato**

| Year | Treatments | Data on parameters | | | | Average Yield q/ha | Per cent increase in yield q/ha | Marke-table Yield q/ha | Percent Loss of yield from total Production | Major Disease& pest in per cent | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Plant height (M) | No. of primary branches | Avg. fruit wt. (gm) | No. of fruit per plant | | | | | LCV | Blight | Fruit borer |
| Rabi 2008 | **T1** -( F.P.) No use of organic matter and 300 kg N + 200 kg P per ha | 90.31 | 6.89 | 73.00 | 55.00 | 780 | - | 713 | 8.5 | 8.0 | 16.0 | 15.0 |
| | **T2**-(IPNM Module) | 85.90 | 7.15 | 94.80 | 52.07 | 1005 | 33.94 | 955 | 4.9 | 3.0 | 10.0 | 5.0 |
| Kharif 2009 | **T1** -( F.P.) No use of organic matter and 300 kg N + 200 kg P per ha | 99.41 | 7.32 | 74.10 | 56.61 | 812 | - | 740 | 8.8 | 12.0 | 6.0 | 4.0 |
| | **T2**-(IPNM Module) 10 t/ha fym + 150 : 80:60 kg/ha NPK+Seedling root dip in azotobactor solution + foliar spray of ferrus ammonium sulphate @ 20 ppm at 30, 45 & 75 DAT | 90.71 | 7.77 | 96.00 | 55.79 | 1087 | 38.51 | 1025 | 5.7 | 5.0 | 4.0 | 2.0 |

The data presented in Table 3 depicted that adoption of IPNM module for production of tomato not only gives the opportunity of higher yield, but also provides higher benefit cost ratio *i.e.* 4.23 to 4.25 in IPNM plot in respective seasons as well as minimizing cost of production from ₹ 4,170 to ₹ 5,879 per hectare as compared to farmers practice. It also opens a way for sustainable production of tomatoes by improving soil texture, reduces the chemical concentration in soil and reduced pesticides application. Similar findings were also reported by Chavan *et al*. 2009 and Sathi Yamurth *et al.* 2009.

**Table 3: Economic performance of tomato production using IPNM module in tomato**

| Year | Treatments | Marketable yield q/ha | Gross Return* (₹) | Gross cost of cultivation (₹) | Effective saving over cost of cultivation (₹) | Net returns (₹) | BCR |
|---|---|---|---|---|---|---|---|
| *Rabi* 2008 | T1 | 713 | 213900.00 | 71660.00 | - | 142240.00 | 2.98 |
| | T2 | 955 | 286500.00 | 67490.00 | 4170.00 | 219010.00 | 4.25 |
| *Kharif* 2009 | T1 | 740 | 2,22000.00 | 78765.00 | - | 143235.00 | 2.82 |
| | T2 | 1025 | 307500.00 | 72886.00 | 5879.00 | 234614.00 | 4.23 |

*Rate Rs. 300/q

## CONCLUSION

The IPNM module assessed during the study proved as an effective tool in changing attitude, skill and knowledge of integrated nutrient plant management in eco-friendly tomato production which gives better yield due to proper utilization of plant nutrients, improved soil health and minimizing disease incidences. Based on farmer`s feedback, it was observed that the use of IPNM module in tomato was highly acceptable, easily compatible in existing production and cropping systems. The productivity gain under OFT over conventional practices of Tomato cultivation created greater awareness and motivated other farmers to adopt appropriate scientific production and protection technologies of tomato. The selection of critical inputs and participatory approach in planning and conducting the demonstration definitely help in the transfer of technology to the farmers.

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