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Integrated Plant Nutrient Management in Tomato for enhancing productivity and profitability under farmers Condition in Central Narmada Valley Zone of M.P.

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Abstract: Tomato (*Lycopersicon esculentum L.*) is one of the most remunerative and important vegetable widely grown and consumed in India. Injudicious use of fertilizers for harvesting higher yield in tomato is very common in farming communities which not only causes in reduction of total yield gradually but also is one of the major factors for higher incidence of biotic and abiotic stresses in commercial production. Looking the facts farmers participatory trails were conducted by Krishi Vigyan Kendra, Hoshangabad district at farmers field in two villages to assess the technological gap in tomato production and to evaluate IPNM technology for its effectiveness during Rabi 2010 and Kharif 2011. Eight numbers of technological gap including application of fertilizer and pesticide for commercial tomato production were identified. The package of IPNM includes application of 10 tons 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 experiment revealed that maximum marketable fruit yield 570 qt /ha in Kharif 2011 and 618 qt /ha in Rabi 2010 (Average 594 qt /ha), were obtained from IPNM plots and subsequently 50 and 53 percent (Average 51.50 %) increase in yield were recorded over farmers practice in respective season. The percent loss of yield from total production due to diseased and inferior quality fruits were increase in yield were recorded over farmers practice in respective seasons. The percent losses of yield from total production due to diseased and inferior quality fruits were observed 33.5 %. 8.65% as compared with IPNM plot (5.30%). Though the number of fruits per plants were found approximately same (+-54.10) in IPNM and farmers practice but higher average fruit weight in IPNM plot 95 g/fruit than the farmers practice 72.05 g/fruit and higher incidences of disease and pest were the major reasons of lower yield in farmers practice than the IPNM plot. Partial budget analysis revealed that the net returns obtained from IPNM plot in Rabi 2008 and Kharif 2009 were higher i.e., Rs. 228500 and Rs. 200350 (Average 214375) respectively than the farmers practice (Rs. 122840 and Rs. 104750) in respective season and on an average Rs. 113545. B:C ratio were found maximum 3.84 in Rabi 2010 and 3.36 in Kharif 2011, respectively (with average if 3.59) in IPNM plot whereas in farmers practices it were 2.71 and 2.32 in respective seasons with an average of 3.59 over farmers practice of 2.51.

Keywords: IPNM, Tomato, On farm testing, Economic impact, B:C ratio.

INTRODUCTION

Tomato is one of the most important vegetable widely grown in all over the country due to its wide adoptability and versatility. It is known as protective food as it contains vitamin C, minerals and famous for its medicinal values like blood purifier, anti carcinogenic properties and save from intestine infections when used as raw or cocked. Several processed items like juice, ketchup, puri, paste and powder are also made from tomatoes and open door for generation of employments for rural people. Being a remunerative cash crop its commercial cultivation is widely adopted by progressive farmers in an area of 8.599 million hectare with producing 11.15 million tones and productivity in India is 18 ton /ha (NHB database 2009).

Intensive cultivation of tomato in peri urban areas of district is very common due to continuous demand and market opportunity in Jabalpur City, which causes decline in soil fertility due to depletion of plant nutrients in larger quantity as tomato is heavy yielder. Unawareness and injudicious use of chemical fertilizers by the farmers for harvesting higher yield not only created imbalances in buffer stock of soil nutrients but adversely affect the plant growth and development with inviting severe attack of disease and pest. Injudicious use of chemical pesticide to control pest and disease also causes environmental disturbances as well. Seeking the

problems emphases on balanced fertilizer management were made through trainings and Gosthi but the farming communities were not very aware about the technologies are non-participation of farmers in technology development, assessment and demonstration.

Keeping the same in view adoptive trials on integrated plant nutrient management (IPNM) in tomato was conducted after specifying the location specific needs with the active participation of farmers. The module of IPNM on tomato given by IIVR Varanasi (Nirmal De *et al*., 2004) adopted after small modification accordingly.

METHODOLOGY

The On Farm Testing (OFT) on IPNM in tomato was carried out by Krishi Vigyan Kendra Hoshangabad during Rabi, 2010 and Kharif, 2011 at the 10 farmer's field in two villages i.e. Semariharchand and Barangi in Hoshangabad district. 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. The total numbers of farmers were 100. Out of these20 farmers were chosen randomly from selected villages and discussion were made on eight improved management packages to study the technological gap. A list of constraints experienced by farmers was prepared and shortlisted. It was observed that majority of problems were directly or indirectly related with use of imbalanced fertilizer applications.

IPNM module given by IIVR, Varanasi viz. 5 tons press mud + 120:60:60 kg /ha NPK + root dip in 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 10tons FYM + 150:80:60 kg /ha NPK + root dip of seedling in Azotobactor solution 10 % + Spray of ferrous ammonium sulphate @ 20 ppm at 30, 45 and75 days after transplanting and applied at farmers field. All the participants raised their nurseries on raised bed with following improved nursery raising techniques jointly. The hybrid variety popular in the area Avinash-2 was selected for the trials. The area of each trial was 1000 meter^2.Recommended basal dose of NPK 75:80:60 kg /ha and FYM @ 10t /ha were applied before the last ploughing and making of layout and scientific cultivation practices were followed for the raising good crop. Top dressing of remaining nitrogen @ 75kg /ha was applied in two split doses at 30 and 75DAT. Plant protection measures as per need and availability were followed strictly. The data were recorded on different parameters and calculated accordingly. The percent increase in yield over farmers practice was calculated using following formula as given below:

$$\textit{Percent increase yield} = \frac{\textit{(Demo yield – Farmers yield)}}{\textit{(Farmers yield)}} \quad \textit{X 100}$$

RESULTS AND DISCUSSION

The data presented in table-1 revealed that farmers involved into tomato production in the district didn't aware about recommended crop production technology i.e. nursery raising, seed rate, seed treatment, sowing and transplanting methodology, balanced nutrition 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) respectively in anticipation to harvest maximum yield. Imbalanced fertilizer application not only reduces the proper development of plants and its potentiality to provide quality yield, but also invite 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.

The experimental findings summarized in Table 2, exhibited that increased plant height in both the seasons were recorded with farmers practice during the course of study as compared to IPNM plot of experiment. The differences in plant height were much higher between $T_{1\text{-}}$(FP)$_)$ and T2in Kharif 2011 than the Rabi 2010. It is observed that higher dose of nitrogenous fertilizer application was the major cause of increased plant height in T1 (FP).However, maximum number of primary branches was found in IPNM plot in

comparison with farmers practice, which is not only shows the importance of organic matter plant development and bearing of more no. of flower cluster but also exhibited the role of balanced fertilizer management in quality fruit production. The highest average yield 650 q /ha and 605 q /ha were found in T_2 (IPNM plot) during Rabi 2010 and Kharif 2011 respectively as compared with T_1 (FP) as 389+ q /ha and 366 q /ha respectively in Rabi 2010 and Kharif 2011. The average yield of both season was found 594 q /ha over farmers practice i.e., 377.5 q /ha, which was 51.50 % yield increase over farmers practices. The actual marketable yield after shorting and grading of commodity were 618 q /ha 570 q /ha from T_2 (Average 594 q /ha) in both the season respectively while the marketable yield of farmers practice reported only 389 q /ha and 366 q /ha in both Rabi 2010 and Kharif respectively. The data also showed that the loss of yield due to inferior quality and diseased fruits was much high as more than 8.65 in farmers practice as compared to IPNM plot which has only approximately 5.30 %. It may be correlated with higher incidence of disease and pest in farmers practice in comparison with IPNM plots. 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 1: Technological differences between improved production technology and farmers practice.

S. No.	Particulars	Technological Interventions (T_2)	Farmers practices (T_1)
1.	Variety	Hybrids (Avinash-2, NS-815)	Open pollinated (S-22, Navoday)
2.	Seed Treatment	Overnight dip in solution of carbendazim 0.1%	No seed treatment follows
3.	Seed rate	150-200 gram /ha	500-600 gram /ha
4.	Nursery raising	Raised bed technique, line sowing	Conventional flat bed technique
5.	Situation	Irrigated and medium black soil	Irrigated and medium black soil
6.	Irrigation facility	Tube well	Tube well
7.	Fertilizer application	Integrated nutrient management 10 ton FYM + 150:80:60 Kg NPK + Spray of Ferrous ammonium sulphate @ 20 ppm at 30, 45 and 75 DAT + Root dip in Azotobactor solution @ 10%	Application of 300 Kg N and 200 Kg P_2O_5 per ha.
8.	Plant Protection meauser	Need base application of pesticides	Use of pesticides in indiscriminate manner at higher doses

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

Year	Treatments	Data on Parameters				Average Yield q/ha	Increase in yield q/ha (%)	Market-able yield q/ha	Loss of yield from total production (%)	Major disease & pest in percent		
		Avg. Plant height (mt.)	Avg. No. of primary branches	Avg. Fruit wt. (gm)	Avg. No. of fruit /plant					LCV	Blight	Fruit borer
Rabi 2010	T1 (FP) No use of organic matter and 300 kg N + 200 kg P per ha.	90.31	6.89	73.00	52.07	425	-	389	8.5	8	16	15
	T2 (IPNM Module)	85.90	7.15	94.80	55.00	650	53	618	4.9	3	10	5
Kharif 2011	T1 (FP) No use of organic	99.41	7.32	74.10	50.40	401	-	366	8.8	12	6	4

	matter and 300 kg N + 200 kg P per ha											
	T2 (IPNM Module) 10 ton /ha FYM + 150:80:60 kg /ha NPK + Seedling root dip in azotobactor solution + foliar spray of ferrous ammonium sulphate @ 20 ppm at 30, 45 & 75 DAT	90.71	7.77	96.00	53.20	605	50	570	5.7	5	4	2
Avg.	**T1 (FP)**	**94.86**	**7.10**	**72.05**	**51.27**	**413**	**-**	**377.5**	**8.65**	**10**	**11**	**9.5**
	T2 (IPNM Module)	**88.30**	**7.54**	**95**	**54.10**	**627.50**	**51.50**	**594**	**5.30**	**4**	**7**	**3.5**

Table 3: Economic performance of tomato production using IPNM modules in Hoshangabad district

Year	Treatment	Marketable yield q /ha	Gross return (Rs.)	Gross cost of cultivation (Rs.)	Net returns (Rs.)	BCR
Rabi 2010	T1 (FP)	389	194500	71660	122840	2.71
	T2 (IPNM Module)	618	309000	80550	228500	3.84
Kharif 2011	T1 (FP)	366	183000	78750	104250	2.32
	T2 (IPNM Module)	570	285000	84750	200250	3.36
Avg.	**T1 (FP)**	**377.5**	**188750**	**75205**	**113545**	**2.51**
	T2 (IPNM Module)	**594.0**	**297000**	**82650**	**214375**	**3.59**

The Study also exhibited in table-3 that adoption of IPNM module for production of tomato not only gives the opportunity of higher yield, but also provide higher benefit cost ratio 3.36 to 3.84 in IPNM Plot in respective years with getting net return from Rs.113545 to 214375 on an average 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 as reduced pesticides application. The similar findings were also reported by Chavhan *et al.* 2009 and *Sathi Yamurth et al. 2009.*

CONCLUSION

There were technological gaps between the improved management packages and farmers practices in tomato productions in Hoshangabad district. The present on form testing conducted at the farmer's field, produced a significant positive result and provides potentials and profitability of improved technology under real situation, which they have been advocating for a long time. The IPNM module assessed during the study proved as an effective tool in changing attitude, skill and knowledge of integrated nutrient management in eco-friendly tomato production which gives better yield due to proper utilization of plant nutrient, improved soil health and minimizing disease incidences. The farmer's feedback, ti was observed the use of IPNM module in tomato was highly acceptable, easily compatible in existing production and cropping system in Hoshangabad district.

The OFT programme on IPNM in Tomato was found as effective tool to rest and verify nutrient management technology for specific location and need of the farmers of Hoshangabad district. Use of biofertilizer, Vermicompost and micronutrients in proper proportion at right time not only proved its importance in sustainable cultivation, eco-friendly and conservation of fertility status but also played vital role in reducing cost of production, also increased yield and high quality production. This also improved the relationship between farmers and scientist and built confidence between them. The selected farmers of the demonstration acted also as a source of information and involved in wider dissemination of nutrient management technology for the other farmers. The productivity gain under OFT over conventional practices of Tomato cultivation created greater awareness and motivated the other farmers to adopt appropriate recent production and protection technologies of Tomato in the district. The selection of critical input and participatory approach in planning and conducting the demonstration definitely help in the transfer of technology to the farmers.

Availability of high quality planting materials, balanced fertilizer management and advanced production technology are the major keys in higher and sustainable production of tomatoes in Central Narmada Valley zone. Policy makers advised to prepare a plan to start a campaign for soil testing at farmer's field level and promotion of IPNM technology through demonstration and trainings to reduce the burden over availability of chemical fertilizer. Arrangement of selective biofertilizer and organic manure can be ensure by promoting resource rich farmers to establish new production unit a block level by giving subsidy.

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