

Influence of Yield and economic Viability of Tomato (*Solanum lycopersicum* Mill) under Varietal Replacement Demonstration in Bhagalpur District, Bihar, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was conducted to analyze the influence of yield and economic viability of tomato (*Solanum lycopersicum* Mill) under varietal replacement demonstration in Bhagalpur District, Bihar, India during *Rabi* 2018-2019. Varietal adoption demonstrations were conducted on tomato by the active participation of the farmers. The improved technologies consist disease resistant variety (Kashi Vishesh), balanced fertilizers (Soil test based) application and integrated pest and disease management, etc. (All the recommended practices were provided to the selected farmers. The data related to the cost of cultivation, production, productivity, gross return and net return were collected as per scheduled and analysed. Results of the study revealed the higher yield in the demonstrations was recorded (498 q/ha) as compared to farmers practice traditional adopted by the farmers (396 q/ha). The percentage increase in the yield over farmer's practice 25.75 was recorded. The technology gap, extension gap and technology index were computed 132 q/ha, 102 q/ha and 20.95% respectively. The demonstrated field gave higher net return Rs. 4, 02,000/- and B: C ratio

and incremental demonstrated B: C ratio is 1: 4.12 and 1: 5.18 respectively. The result of the study indicated the gap existed in the potential yield and demonstration yield is due to soil fertility and weather conditions. Present results clearly show that the yield and economics of tomato can be boost up by adopting recommended technologies.

Keywords: *Tomato; farmer FIRST; demonstration and economics.*

1. INTRODUCTION

Tomato (*Solanum lycopersicum* Mill.) is an important vegetable crop grown almost throughout the world including tropical and temperate regions. It is cultivated both in the green houses on protective structures as well as under natural conditions. Tomato is a rich source of vitamins A and C and is referred to as "poor man's orange". It adds variety of colours to the food. Tomato is a very good remedy for patients suffering from constipation. Lycopene that imparts red colour to ripe tomatoes is reported to possess anti-cancerous properties. It also serves as a natural anti-oxidant as the Beta-carotene functions to help prevent and neutralize free radical chain reaction and ascorbic acid is an effective scavenger of super-oxide, hydrogen peroxide, singlet oxygen and other free radicals [1]. Tomato can be grown in almost all states of India except in higher altitudes. Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Maharashtra, Madhya Pradesh, Punjab, Haryana and Assam are important tomato growing states in India.

In India, during 2017-2018 production Tomato was cultivated on an area in 789 thousand hectare with a total production output of 19,759 MT. In Bihar, total production of tomato was 941.56 Metric Tons from an area of about 45.01 thousand ha (2017-2018) which accounted for about 4.76% of the total production of tomato in the country. The productivity of tomato crop in Bihar was 20.92 MT/ha, which is found lower to all India average of 4.08 MT/ha. There exists a good scope to improve its average productivity in Bihar as well as the country at large so as to fulfil both domestic and national needs. The growth, yield and fruit quality of tomato are largely dependent on number of interacting factors. On the other hand, tomato is a long duration crop with high yield which removes large quantities of nutrients from the soil. Like macro-nutrients, micro-nutrients are equally significant in plant nutrition. There is a need to go for balanced fertilization of both macro and micro-nutrients since micro-nutrients play a profound role in various metabolic functions of plant. Zinc is an

essential component of a number of enzymes *i.e.*, dehydrogenase, aldolase, isomerise, proteinase, peptidase and phosphor-hydrolase [2].

A field trial was carried out on 10 farmer's field at Goradih and Pinpanti block of Bhagalpur district of Bihar in Agro-climatic zone of gangetic plains zone. Here, generally in winter's minimum temperature goes to 10-14°C and in summer maximum temperature reaches to 42-45°C, annual rainfall is 1000-1200 mm per year. There is lot of scope of tomato growing in this area. Dissemination of the technologies varietal adoption demonstration is playing a very important role for transfer of technologies and changing scientific treatment of the farmers by seeing and believing principle. In order to have better impact of the demonstrated technologies for farmers and field level extension functionaries, varietal adoption demonstrations were conducted at farmer's field, in a systemic manner, to show case the high yielding new varieties, to convince them to about the potential of improved production technologies to enhance yield of tomato. Generally, the agricultural technology is not accepted by the farmers as such in all respects. There is always gap between the recommended technology by the scientist and its modified form at the farmer's level which is major absentee in the efforts of increasing agricultural production in the country. It is need of the hour to reduce this technological gap between the agricultural technology recommended by the scientists or researchers and its acceptance by the farmers on their field. In view of the these facts, varietal adoption demonstrations were undertaken in a systematic manner on farmer's field to show the worth of improved practices and convince the farmers to adopt in their farming system.

2. MATERIALS AND METHODS

The study was conducted in Goradih and Pirpanti blocks of Bhagalpur district of Bihar under Farmer FIRST Project, Bihar Agricultural University, Sabour, Bhagalpur during 2018-2019. Technology that is use cultivar Kashi Vishesh is

a high yielding open pollinated variety with tomato leaf curl virus disease resistance. Fruits square round, medium large (90 g), deep red, firm and suitable for fresh market and better fruit quality attributes like uniform fruit weight, shape, colour and shelf life (7 days), gives 25.75% higher yield (132 q/ha) in 140 days. Improved yield with reduction in use of pesticides and fungicides due to its leaf curl virus resistance to important diseases. This variety is resistant to TLCV and has been developed using *L. hirsutum* f *glabratum* B'6013' as donor parent following backcross pedigree selection method. Plants are determinate, dark green, fruits red, spherical, size medium to large, weight of 90 g, first harvest at 70-75 days after transplanting; yield 450-500 q/ha. The genuine seeds of tomato cultivar Kashi Vishesh were procured and distributed to ten selected farmers. All the participating farmers were trained on various aspects of tomato production technologies. The field was prepared by deep ploughing and harrowing. The seeds were sown in well prepared raised bed during first week of October. All the recommended practices *i.e.*, seed treatment by carbandazim 50% W.P. at 3 g/kg seed, transplanting of one month old seedlings, maintain in grow spacing of 90 cm and 60 cm spacing with in rows. Recommended dose of manure and fertilizers (15 tonnes FYM, N: P: K 60:100:80 kg/ha, respectively) as basal application before transplanting and remaining 90 kg nitrogen by three split doses 30, 45 and 60 days after transplanting. Weed management, need based plant protection chemicals were used to manage the problem. The zinc sulphate, boric acid and ferrous sulphate at 50 mg. each per liter of water at 45 and 75 days after transplanting were sprayed additionally over farmers practice (control). The yield and economic performance of varietal adoption demonstrations, the data on output were collected from varietal adoption demonstrations as well as local plots from all selected farmers and finally the grain yield, cost of cultivation, net return with the benefit cost ratio was worked out. An average of cost of cultivation, yield and net returns of different farmers was analysed by the formula.

$$\text{Average} = [F_1 + F_2 + F_3 + \dots + F_n]/N$$

F₁ = Farmer
N= No. of Farmers

In this study, technology index was operationally defined as the technical feasibility obtained due to implementation of varietal adoption

demonstrations in tomato. To estimate the technology gap, extension gap and technology index as used by Sagar and Chandra [3] Markam et al. [4].

$$\text{Technology gap} = P_i (\text{Potential yield}) - D_i (\text{Demonstration yield})$$

$$\text{Extension gap} = D_i (\text{Demonstration yield}) - F_i (\text{Farmers yield})$$

$$\text{Technology index} = [(P_i (\text{Potential yield}) - D_i (\text{Demonstration yield}) / P_i (\text{Potential yield})) \times 100]$$

$$B: C \text{ ratio} = \text{Net income (Rs/ha)} / \text{Cost of cultivation (Rs/ha)}$$

$$\% \text{ Increased over farmer's practices} = ((\text{Improved practices} - \text{Farmers practices}) / \text{Farmers practices}) \times 100$$

3. RESULTS AND DISCUSSION

3.1 Performance of Varietal Adoption Demonstration

A comparison of productivity levels between demonstration and farmers practice is shown in Table 1. It is evident from results that under the demonstrated plots, performance of tomato (yield) was sustainable higher than in the local check. During the period of study, it was recorded the varietal adoption demonstrations tomato variety Kashi Vishesh recorded the higher yield (498 q/ha) than farmers practice (396 q/ha). The percentage increase in the yield (25.75) over farmers practice was recorded. Similarly, yield enhancement indifferent crops in varietal adoption demonstrations were documented by Mishra et al. [5], Markam et al. [4] and Dhaka et al. [6]. From these results it is evident that the performance of the technology demonstrated was found to be better than the farmers practice under same environment conditions. The farmers were motivated by seeing the results in term of productivity and they are adopting the technologies.

The yield of the varietal adoption demonstrations and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index and technology gap. The technology gaps show the difference between potential yields over demonstration yield of the technology. The potential yield of the variety was 525 q/ha. The technology gap 132 q/ha was recorded (Table 3). The varietal adoption demonstration was laid

Table 1. Level of use and gap in adoption extent of tomato technologies in study area

S.N.	Package of practices (Technology intervention)	Varietal adoption demonstration (Recommended package of practices)	Farmers practice (Local/check)	Gap
01.	Selection of variety	Improved variety (Kashi Vishesh)	Obsolete variety	Partial gap
02.	Soil testing	Have been done in all the location	Not in practice	Full gap
03.	Seed rate	500 g/ha	500 g/ha	Partial gap
04.	Seed priming	Seed priming was performed for better germination. Seeds were soaked during night for 8-10 hours with natural water, drained out excess water and dried in shade before sowing.	Not in practice	Full gap
04.	Seed treatment	Seed treated with fungicide Carbendazin	Seed treatment is not common	Full gap
05.	Spacing	60 cm x 30 cm	80 cm x 45 cm	Partial gap
06.	Application of recommended dose of fertilizer	120 kg N + 60 kg P ₂ O ₅ + 80 kg K ₂ O per ha (50% N+ 100% P K at the time of planting and remaining 50% N applied at 40 days and 80 days after planting)	Imbalance and inadequate	Partial gap
07.	Application of vegetable special (micro-nutritional)	Foliar spray of vegetable special (micro-nutrients) 75 g + 15 lit water + lemon + 1 shampoo (Rs. 1).	Not applied any micro-nutrient	Full gap
08.	Irrigation	Furrow method of irrigation at once in a 7-11 days interval depend upon soil condition	Twice in a month	Partial gap
09.	Weed management	Pre-emergence herbicide pendimethalin @ 1.5 kg a.i/ha, followed by hand weeding depend upon weed intensity.	Weeding is not common	Partial gap
10.	Plant protection measures for control of insect pest and diseases	Need based application for control: Aphid and sucking pest-spraying with diamethoate (30 EC) 1.5 ml/L of water. Leaf eating caterpillar: spray NPV (250 LE/ha). Blight, pythium rot & leaf blight – Spraying of (COC) blitox 50-3 g/L of water.	Plant protection is not common	Partial gap
11.	Harvesting	Manual	Manual	No gap

Table 2. Economics of tomato through varietal replacement demonstrations

Variables	Yield (q/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit: cost ratio
Farmers practice	396	96000.00	396000.00	300000.00	4.12
Recommended practice	498	96000.00	498000.00	402000.00	5.18
					1.06*

* Incremental benefit: cost ratio

Table 3. Yield, technology gap, extension gap and technology index through varietal replacement demonstrations

Variables	Yield (q/ha)	Increase (%) over farmers practice	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
Farmers practice	396	-	-	-	-
Recommended practice	498	25.75	132	102	20.95

down under the supervision of Farmer FIRST Project, Bihar Agricultural University, Sabour, Bhagalpur specialists at the farmer's field. There exist a gap between the potential yield and demonstration yield. This may be attributed to dissimilarities in soil fertility, salinity and to erratic rainfall and other vagaries of weather in the demonstrations may become necessary to narrow down the gap. These findings are similar to Markam et al. [4] and Sharma and Sharma [7].

3.2 Economics of Varietal Adoption Demonstrations

Economics of tomato production under varietal adoption demonstrations was recorded and the results of the study have been presented in Table 2. The results of economic analysis of tomato production revealed that varietal adoption demonstrations recorded higher gross return (Rs. 498000.00) and net return (Rs. 402000.00) with higher benefit cost ratio (5.18) as compared to farmers practice. These results were in accordance with the findings of Mishra et al. [8], Markam et al. [4] and Dhaka et al. [6]. No additional cost of per hectare for cultivation. In demonstration has increased additional net return Rs.102000/ha. With incremental benefit cost ration 1: 1.06 suggesting its higher profitability and economic viability of the demonstration.

Similar results were also reported by Hiremath and Nagaraju [9] and Dhaka et al. (2010) on the basis of above finding in present study,

4. CONCLUSION

It was concluded that varietal replacement demonstrations of improved technology reduce technology gap to a considerable extent, thus leading to increased productivity of tomato in Bhagalpur district of Bihar. This also improved linkages between farmers and scientists, and built confidence for adoption of the improved technology. Productivity enhancement under varietal replacement demonstrations over farmer's practices of tomato cultivation created a greater awareness, and motivated other farmers

not growing tomato to adopt improved technologies of tomato production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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