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## Enhancing livelihood security of tribal community of Dehradun, Uttarakhand through technological interventions in tomato

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**Abstract**

The field demonstrations were carried out based on the technological interventions on the tomato crop in three tribal villages namely Kota Kwanu, Majhgaon Kwanu and Malot Kwanu in Chakrata block of Dehradun district of Uttarakhand in 30 ha area (10 ha in each village) during March to August, 2016 and 2017 under centrally sponsored project i.e. Tribal Sub Plan (TSP). The average yield was 275.72 Q/ha in Kota Kwanu, 280.75 Q/ha in Majhgaon Kwanu and 272.23 Q/ha in Malot Kwanu during 2016. However, net income was maximum i.e. Rs. 3,65,500/ha in Majhgaon Kwanu while it was Rs. 3,55,440/ha and 3,48,460/ha in Kota Kwanu and Malot Kwanu, respectively in farmers practice whereas, during 2017 the average yield was higher in Kota Kwanu which was 227.27 Q/ha followed by 213.45 and 211.77 Q/ha in Majhgaon Kwanu and Malot Kwanu respectively. The net income was also highest in Kota Kwanu i.e. Rs. 3,68,175/ha while it was Rs. 3,33,625/ha in Majhgaon Kwanu and Rs. 3,29,425/ha in Malot Kwanu during 2017. The impact of field demonstrations revealed that yield and income was doubled in the demonstrated tomato crop as compared to farmers practice. The average yield was maximum in Majhgaon Kwanu i.e. 489.36 Q/ha while it was 471.63 and 460.72 Q/ha in Kota Kwanu and Malot Kwanu, respectively during 2016. Similarly, the net income was also highest in Majhgaon Kwanu which was Rs. 7,40,720/ha followed by Rs. 7,05,260 and Rs. 6,83,440/ha in Kota Kwanu and Malot Kwanu, respectively during 2016. During 2017, the average yield was low but net income was similar of 2016 as the sale price of tomato in 2017 was higher to 2016.

**Keywords:** Tomato, yield, net income, technology, tribal village, incidence, yield

**1. Introduction**

Tomato, *Lycopersicon esculentum* L. (Solanaceae), is an economically important vegetable crop and grown extensively round the year in our country. In India, The tomato is grown in 0.809 million ha while the total production is 19.697 million tones and the average productivity is 24.34 MT/ha<sup>[1]</sup>. Tomato is also very remunerative crop in mountain region of Uttarakhand. It occupied an area of 8626.81 ha with the total production of 94005.13 MT in the state of Uttarakhand and the average productivity is 10.89 MT/ha<sup>[2]</sup>. The productivity in the State of Uttarakhand can be doubled or even increases three fold by intervention of various high yielding varieties and hybrids, pest, disease and nutrient management practices. Tomato is widely cultivated in tribal and hilly region of Dehradun, Uttarakhand from the last one and half decades. From the last 4-5 years, its area has increased significantly because of the handsome return to the farmers from tomato cultivation as compared to other crops grown in the region. Tomato is grown from March to October and production started from May onwards in hilly and tribal areas of Dehradun which is the off season as during this period tomato is hardly grown in the plains. It is true that considerable progress has been made in tomato production but still the productivity of this commercially important vegetable crop is low. Keeping these realistic points in view, Ministry of Agriculture and Farmers Welfare launched a project i.e. Tribal Sub Plan (TSP) at National level to enhance the livelihood security of tribal community of the country. Under the centrally sponsored project, Krishi Vigyan Kendra, Dhakrani, Dehradun has taken initiative during 2014-15, 2015-16, 2016-17 and 2017-18 to uplift the economy of tribal families through technological interventions in tomato. In order to find out the existing scenario of tomato cultivation, diagnostic survey was conducted in tribal areas of Dehradun district. During survey, discussion was held with tomato growers to find out their practical difficulties in obtaining maximum yield from their crops. It has been emerged out from the survey that poor availability of high yielding hybrids and

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varieties was one of the major constraints in production of tomato crops. Besides, most of the farmers were not aware about quality and effective chemical pesticides in the area which resulted in a high incidence of pests and diseases especially late blight disease, fruit borer, bacterial wilt, cut worm etc [13,9,6,10]. It has also been observed that due to poor nutrient management, productivity and quality was also low. During the base line survey and group discussion held with the farmers helped in understanding that prevailing agro climatic conditions are very conducive for commercial tomato cultivation and farmers are cultivating tomato on a large scale but poor awareness about the viable technologies they are helpless to harvest comparatively low yield and quality of tomato. The observations on varieties, hybrids, incidence of pests and diseases, judicious use of chemical pesticides, their time of application, pest monitoring, nursery raising, nutrient management etc were recorded during group discussion with farmers. It was found that the majority of the tomato farmers were not aware about the high yielding varieties, hybrids, incidence of pests and diseases and nutrient management. Hence, to mobilize the farmers towards technological advancement in tomato production, trainings were imparted. During the training of the farmers, sites were also selected for conducting demonstrations.

## 2. Materials and Methods

The studies were carried out in three tribal villages namely Kota Kwanu, Majhgaon Kwanu, Malot Kwanu in Chakrata block of Dehradun district of Uttarakhand during 2016 and 2017 under centrally sponsored project i.e. Tribal Sub Plan (TSP) by Govind Ballabh Pant University of Agriculture and Technology, Krishi Vigyan Kendra, Dhakrani, Dehradun, Uttarakhand during March to August, 2016 and 2017. The main objective of the studies was to uplift the livelihood security of the tribal community through technological interventions in the tomato crop. The demonstrations were conducted in 30 ha area (10 ha in each village) from March to August, 2016 and 2017. Under the investigation, 50 farmers were selected from each village thus there were 150 farmers identified from three villages who grew tomato. Selection of farmers was done on the basis of extension tools in which questionnaire were formulated to collect the information on existing farmers practices. Observations were taken from 10 randomly selected farmers in each village out of 50 farmers. The data on late blight disease was recorded on three leaves from the top, middle and bottom at weekly interval started 30 days after transplanting in all the three villages. Observations on per cent fruit borer infestation were recorded at 5, 10 and 15 days of each spray from ten randomly selected plants from a farmer. For per cent fruit damage, the number of infested and healthy as well as weight of healthy and infested fruits from ten observational plants was recorded at each picking. The total weight of healthy and infested fruits for all picking was pooled and total yield per farmer was computed and converted into quintals per hectare. During study and interaction held with the selected farmers following points were emerged out:

1. Farmers were growing Heamsohna hybrid of tomato from the last 10 years which became susceptible against many pests and diseases particularly incidence of late blight was increasing year after year.
2. Planting of this hybrid was done by the farmers in the first fortnight of March, 2016 and 2017.
3. They maintained planting distance of 1 m from row to

row and 10-15 cm from plant to plant.

4. They applied DAP @120 kg/ha and FYM @ 300 Q./ha during planting.
5. Farmers also applied urea @ 100 kg/ha two times in standing crop. Most of the farmers applied urea 20 and 40 days after planting.
6. Staking was done by wood of locally grown forest trees.
7. Intercultural operations were done by the farmers 15 and 30 days after planting.
8. For management of fruit borer in their tomato crop they used quinalphos @ 2 ml/lit of the water 3-4 times during flowering and fruit setting.
9. Farmers applied mancozeb @ 2 g/lit of water 4-5 times in standing crop For the management of late blight disease.
10. Harvesting started 80 days after planting and was continued up to 130 days after planting.

### Technological interventions made in tomato crop

Keeping in view the enormous potential and increasing demand of tomato particularly off season tomato in the domestic and Delhi markets, initiatives were taken to mobilize and sensitize the farmers towards commercial tomato cultivation. Accordingly, diagnostic survey was undertaken in which meeting and survey were organized in the adopted villages to find out their views on commercial tomato production. It was observed that almost all the farmers were convinced for demonstration of technologies suitable for them. It was observed during farmers scientist interaction that farmers were already cultivating tomato but due to lack of awareness on various aspects of tomato production such as high yielding varieties and hybrids, pest and disease management, nutrient management etc., they were getting low productivity of tomato. After conducting diagnostic survey, encouraging attitude of the farmers and seeing the potential, training and demonstrations had been started organizing which gave tremendous impact on the farming community within very short span of time. Following interventions were taken in three adopted villages:

1. All the selected farmers were mobilized by imparting practical training in their villages from time to time to expose them on various aspects of commercial tomato production. During training programme literature was also given to each and every farmer in which all the practices pertaining to integrated crop management of tomato were mentioned in very simple language.
2. Demonstrations were organized in 30 ha area in all the three adopted villages (10 ha in each village). In demonstrations, Abhinav hybrid of tomato was demonstrated. Planting was done in first fortnight of March in which row to row distance was 1 m while plant to plant distance was maintained at 30 cm.
3. During planting NPK @ 150 kg/ha and FYM 500 Q./ha were applied. Urea @ 120 kg/ha was also given 30 and 45 days after planting for proper vegetative growth and development. Water soluble NPK 18:18:18 and NPK 0:0:50 were applied by the farmers at weekly interval @ 5 g/ lit of water on rotation basis. Application of both the water soluble NPK was started 50 days after planting and was continued till the end of the crop.
4. Insecticides namely profenophos + cypermethrin @ 2 ml/lit of water along with sticker was applied two times, first spraying was given 40 days after planting while the second was 60 days after planting for management of fruit borer.

- For management of late blight disease, three applications of cymoxanil + mancozeb @ 2 g/lit of water along with sticker were done at 50, 70 and 90 days after planting.
- Intercultural operations were done 20 and 35 days after planting. Earthing was also done after the intercultural operation to conserve the soil moisture and to avoid root zone of the plants from sun light.
- Crop monitoring was done at regular interval by the farmers and chemical pesticides for management of fruit borer and late blight disease was applied on need basis. Scientist also visited the demonstrations from time to time, interacted with the farmers During a visit and took their feedback about the demonstrations

**Table 1:** Production and income of tomato hybrid Heamsohna recorded from farmers practice during 2016

Village	Incidence of late blight disease in plants (%)	Incidence of late blight disease in fruits (%)	Infestation of fruit borer (%)	Maximum yield (Q./ha)	Minimum yield (Q./ha)	Average yield (Q./ha)	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	C:B Ratio
Kota Kwanu	22.50	16.22	12.66	312.42	239.02	275.72	1,96,000	5,51,440	3,55,440	2.81
Majhgaon Kwanu	25.48	19.88	15.30	304.80	256.70	280.75	1,96,000	5,61,500	3,65,500	2.86
Malot Kwanu	27.06	22.05	16.75	296.65	247.82	272.23	1,96,000	5,44,460	3,48,460	2.77

**Table 2:** Production and income of tomato hybrid Heamsohna recorded from farmers practice during 2017

Village	Incidence of late blight disease in plants (%)	Incidence of late blight disease in fruits (%)	Infestation of fruit borer (%)	Maximum yield (Q./ha)	Minimum yield (Q./ha)	Average yield (Q./ha)	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	C:B Ratio
Kota Kwanu	26.04	22.70	10.80	246.05	208.50	227.27	2,00,000	5,68,175	3,68,175	2.84
Majhgaon Kwanu	29.80	24.22	13.65	232.25	194.66	213.45	2,00,000	5,33,625	3,33,625	2.66
Malot Kwanu	28.50	27.84	15.04	240.80	182.75	211.77	2,00,000	5,29,425	3,29,425	2.64

**Table 3:** Impact of demonstration on production and income of tomato hybrid Abhinav recorded during 2016

Village	Incidence of late blight disease in plants (%)	Incidence of late blight disease in fruits (%)	Infestation of fruit borer (%)	Maximum yield (Q./ha)	Minimum yield (Q./ha)	Average yield (Q./ha)	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	C:B Ratio
Kota Kwanu	4.08	5.08	2.65	496.05	447.22	471.63	2,38,000	9,43,260	7,05,260	3.96
Majhgaon Kwanu	3.62	3.92	2.02	512.45	466.28	489.36	2,38,000	9,78,720	7,40,720	4.11
Malot Kwanu	5.20	4.33	3.25	482.64	438.80	460.72	2,38,000	9,21,440	6,83,440	3.87

**Table 4:** Impact of demonstration on production and income of tomato hybrid Abhinav recorded during 2017

Village	Incidence of late blight disease in plants (%)	Incidence of late blight disease in fruits (%)	Infestation of fruit borer (%)	Maximum yield (Q./ha)	Minimum yield (Q./ha)	Average yield (Q./ha)	Cost of cultivation (Rs./ha)	Gross Income (Rs./ha)	Net Income (Rs./ha)	C:B Ratio
Kota Kwanu	6.26	7.74	3.05	403.68	372.40	388.04	2,56,000	9,70,100	7,14,100	3.78
Majhgaon Kwanu	7.98	8.22	4.27	382.25	359.85	371.05	2,56,000	9,27,625	6,71,625	2.62
Malot Kwanu	8.60	9.80	5.16	368.07	342.44	355.25	2,56,000	8,88,125	6,32,125	2.46

### 3. Results and Discussion

The field demonstrations conducted in three selected tribal villages to sensitize the farmers on various aspects of technological interventions and their impact in enhancing production and income of tomato. The result of the demonstrations showed that incidence of late blight disease in

plants varied from 22.50 to 27.06 per cent however, incidence of late blight disease in fruits between 16.22 to 22.05 per cent during 2016 (Table 1). Infestation of the fruit borer was also recorded which varied from 12.66 to 16.75 per cent in the same year. The average yield of tomato was higher in Majhgaon Kwanu village i.e. 280.75 Q/ha whereas in Kota

Kwanu and Malot Kwanu 275.72 and 272.23 Q/ha yield were observed respectively (Table 1). Similarly, the net income was also maximum in Majhgaon Kwanu which was Rs. 3,65,500/ha while it was Rs. 3,55,440/ha in Kota Kwanu and Rs. 3,48,460/ha in Malot Kwanu. The field demonstrations carried out during 2017 revealed that incidence of late blight disease in plants ranged from 26.04 to 29.80 per cent while incidence of late blight disease in fruits varied from 22.70 to 27.84 per cent. The data on infestation of fruit borer recorded during study indicated that it was in between 10.80 to 15.04 per cent during 2017 (Table 2). The observations on yield taken during investigation showed that the average yield of tomato was maximum in Kota Kwanu village i.e. 227.27 Q/ha however it was 213.45 Q/ha in Majhgaon Kwanu and 211.77 Q/ha in Malot Kwanu (Table 2). Almost same trend was found in gross income and net income in all the three villages. The highest net income was observed from Kota Kwanu which was Rs. 3,68,175/ha whereas, Rs. 3,33,625/ha and Rs. 3,29,425/ha received from Majhgaon Kwanu and Malot Kwanu respectively. The field demonstration laid out in three villages covering 150 farmers under the Tribal Sub Plan project during 2016 and 2017 manifested that incidence of late blight disease in plants and fruits and infestation of fruit borer was higher in 2017 as compared to 2016. Hence, the average yield of tomato was comparatively low during 2017 in comparison of 2016 but gross income and net income were almost same in both the years. It was due to the high average sale price of tomato i.e. Rs. 2500/Q. in 2017 while it was Rs. 2000/Q. in 2016. It is also important to mention that tomato in tribal and hilly areas of Dehradun district Uttarakhand is grown from March to October and harvesting started from the last week of May onwards which considered as off season thus farmers get remunerative price of their produce. It was found that incidence of late blight disease and fruit borer was high in the tomato crop grown by the farmers as compared to demonstrated crop. The investigation revealed that major reason of high incidence of late blight disease and fruit borer was close planting done by the farmers. They maintained planting distance of 1 meter from row to row which was optimum but plant to plant distance was very close i.e. 10-15 cm. The planting was done in the first fortnight of March during 2016 and 2017 and flowering started about 45-50 days after planting. During that time the height and canopy of the plant became vigorous due to which penetration of sunlight and ventilation in the crops adversely affected. Due to very poor penetration of sunlight and ventilation, the humidity in the crops increases which provide very congenial condition for incidence of late blight disease and fruit borer. During this period temperature is also ideal which favours the incidence of late blight disease and fruit borer. It was also observed that farmers do not follow pruning of unwanted branches in their tomato crop. Thus close planting done by the farmers, conducive climatic conditions during flowering and fruiting, lack of pruning, poor adoption of management strategies for the control of late blight disease and fruit borer due to low awareness among the tribal farmers was one of the major factors of low productivity and quality of tomato. Singh *et al.*<sup>[11]</sup>, Singh *et al.*<sup>[10]</sup> in their studies found that by maintaining proper plant to plant distance i.e. 30 cm, pruning of unwanted branches at weekly interval and application of cymoxanil + mancozeb @ 2 g/lt of water on need basis for management of late blight disease and spraying of profenophos + cypermethrin @ 2ml/lt of water for management of fruit borer showed outstanding results which support the present

technological interventions made in large scale demonstrations of tomato crop.

Tomato has become lifeline in tribal and hilly areas of Dehradun but most of the farmers get low productivity and quality despite of spending sufficient money on critical inputs like seed, chemical pesticides and fertilizers but it was noticed during interaction with them that due to lack of proper awareness, majority of the farmers were not applying recommended integrated crop management practices including high yielding hybrids Singh *et al.*<sup>[12]</sup>. Thus under the project tomato crop was taken keeping in view its enormous potential. Hence, technological interventions were made in all the three selected villages in 30 ha area covering 150 farmers. The impact of the demonstrations conducted on farmers field revealed that incidence of late blight disease in plants and fruits was very low which was 3.62 to 5.20 per cent and 3.92 to 5.08 per cent respectively during 2016 (Table 3). The infestation of fruit borer was also recorded which varied from 2.02 to 3.25 per cent. The net income was almost doubled in the demonstrations as compared to farmers practice. The net income of Rs. 7,40,720/ha was obtained from Majhgaon Kwanu followed by Rs. 7,05,260/ha and Rs. 6,83,440/ha in Kota Kwanu and Malot Kwanu respectively during 2016 (Table 3). The technological interventions were also made and demonstrated in 2017 also in already three selected villages. The data recorded on various aspects of pest, disease, yield and income indicated that during 2017 the incidence of late blights disease in plants and fruits were slightly higher as compared to 2016. The incidence of late blight disease in plants found between 6.26 to 8.60 per cent whereas The incidence of late blight disease in fruits ranged from 7.74 to 9.80 per cent. Similarly, observation on infestation of fruit borer was also recorded which varied 3.05 to 5.16 per cent during 2017 (Table 4). The average yield of tomato was maximum in Kota Kwanu i.e. 388.04 Q/ha whereas it was 371.05 and 355.25 Q/ha respectively in Majhgaon Kwanu and Malot Kwanu. Almost same trend observed in gross income and net income in all the three villages. The maximum net income of Rs. 7,14,100/ha was received from Kota Kwanu followed by Rs. 6,71,625/ha in Majhgaon Kwanu and Rs. 6,32,125 /ha in Malot Kwanu during 2017 (Table 4). Like farmers practice, the yield was also comparatively low during 2017 in the field demonstrations as compared to 2016 but due to premium market price i.e. Rs. 2500/Q almost same net income was received by the farmers. During 2016, the yield was higher in farmer practice and field demonstration both but sale price was Rs. 2000/Q. The earlier studies laid out by Kumar *et al.*<sup>[3]</sup>, Pawar *et al.*<sup>[4]</sup>, Sardana and Bambawale<sup>[5]</sup>, Sardana *et al.*<sup>[7]</sup>, Singh S.S.<sup>[8]</sup> on high yielding hybrid, integrated pest, disease and nutrient management also supported the results obtained in the demonstrations carried out in tribal and hilly areas of Dehradun district of Uttarakhand during 2016 and 2017. It is true that such kind of studies on technological intervention in tomato crops for large scale demonstration to mobilize the tribal farmers in hilly areas have not been reported. But F1 hybrid (Abhinav), insecticide like profenophos + cypermethrin for management of fruit borer, fungicide such as cymoxanil + mancozeb for management of late blight disease, application of water soluble nutrients i.e NPK 18:18:18 and NPK 0:0:50 for proper vegetative growth of the plants and to improve the fruit quality which have been incorporated in the demonstrations were reported effective By the above authors on tomato crop in different parts of the country.

#### 4. Conclusion

It is clear from the field demonstration that proper adoption of various integrated crop management strategies mentioned in Materials and Methods can double the production and income of the tribal farmers as reflected in the large scale demonstrations carried out on farmers field by participatory mode. The study based on demonstrations of viable technologies among the tribal farmers who were already cultivating tomato but receiving low yield and income get convinced that if they adopt the demonstrated technologies in their tomato crop in true letter and spirit, they can double their productivity and income by minor changes in their existing crop management practices which is largely accepted by the farmers.

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