

Case Report

Technological intervention in sustaining mango productivity in a resource poor farmers' field of Uttar Pradesh

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Abstract

Mango productivity and production is low in Uttar Pradesh as compared to national average. It is further low in case of a resource poor farmer to support its orchard productivity. Proper dissemination of production and protection technologies and lack of timely intervention of these technologies makes it worse. The present work was undertaken under the financial assistance by National Horticulture Board and technological demonstration by ICAR-CISH at village Kitnakhera, Lucknow district. Age of orchards and suboptimal management of canopy, nutrient, water, diseases and insect pests are the major factors constraining the productivity and quality of mango. Interventions of ICAR-CISH technologies resulted it successful mango production with good remuneration to farmers. Results revealed that soils of the mango orchards had low water holding capacity (17.1 - 20.9%) and suffering from deficiency of zinc, copper and boron. Centre opening resulted in increased light penetration from 6100 to 6800 mol m⁻² yr⁻¹ to 10000-10500 mol m⁻² yr⁻¹. The fruit borer incidence was reduced from 70-80 to 1-2 per cent. Average fruit yield increased from 47.05 kg/tree in the previous years to 82.05 kg/tree due to the adoption of technological interventions. Percentage of 'A' and 'B' grade fruits increased from <5 and 20% to 17.3 and 54.0% respectively. Net incomes of farmers were also increased. Farmers were highly enthusiastic and satisfied with the involvement in different activities with their increased net income.

Key words: Mango, technology intervention, productivity, profitability, resource poor farmer

Introduction

Transfer of technology to the farmer's field is the utmost need for sustaining productivity. The success of such technology transfer depends

on the timeliness by the extension specialists as well as farmer's willingness to adopt new technology. Farmer's participation during the implementation of package of practices of available technology is one of the prerequisite for its full scale adoption. This is very important particularly in case of resource poor farmer. Contractual farming is one of the successful methodologies for ensuring better productivity and profitability by way of inclusion of advanced production, protection and post-harvest technologies (1). Sometimes expert system may also be useful in indicating and updating the farmers knowledge and skills for betterment of productivity (2). Conservation of traditional knowledge related to production technology not only enhanced productivity but also leads to better price in the market (3). In this connection, technological interventions play a key role in maintaining the satisfactory level of productivity.

Mango production at the resource poor farmer's field is lowest in some parts of Malihabad region of Uttar Pradesh. Low soil nutrition, lack of proper soil and crop management, dissemination of production and protection technologies and their timely intervention is found to be the best possible reasons for such lowest production in the cluster orchards (4). Maal, Malihabad and Kakori blocks of Lucknow, U. P. are famous for the Dashehari mangoes. The area is located at 26.92°N 80.72°E and has a subtropical climate. In winter, the maximum temperature is around 25 °C and the minimum is in the range of 3-7 °C. Fog is quite common from late December to last week of January. Summers are extremely hot with temperatures rising to 40-45 °C. The soil and climate of the area is suitable for production of Dashehari mangoes, however, since last few years decline in productivity and quality is being noticed in this belt in terms of reduced size of fruits and quality. Majority of the orchards are underfertilized and neglected in terms of judicious control of insect pests and diseases by the orchard owners, being absentee landlords in most of the cases (5, 6). Shifting of mango cultivation to rice is being prevailing due to low mango production in that cluster orchards. Keeping all these in view, the present study entitled 'Enhancing the productivity and fruit quality of mango through pre-harvest technological interventions in mango growing tracts of Uttar Pradesh and Uttarakhand' was implemented under the financial assistance of NHB in 10 ha area of 'Dashehari' orchard (25 to 30 years old) comprising a cluster of 21 farmers.

Materials and Methods

Majority of the farmers (99 %) in the cluster included small and marginal possessing less than one ha of orchard land and belonged to different age groups (25-70 years) are possessing lower to intermediate level of education (Table 1). Dashehari, Langra, Chausa and Lucknow

Table 1: Socio- economic profile of the adopted farmers

Sr. no.	Traits	No.	%
1.	Age (Years)		
	20-35	6	28.58
	35-50	7	33.33
	50-60	4	19.04
	>60	4	19.04
2.	Education		
	Illiterate	2	9.52
	Primary	3	14.28
	Middle	5	23.80
	High School	3	14.28
	Intermediate	5	23.80
	Graduate & above	3	14.28
3.	Category of farmers		
	Marginal (< 1ha)	13	61.90
	Small (1-2 ha)	8	38.09
	Large (>2 ha)	0	0

Safeda were the main mango varieties being cultivated by them although the village is surrounded by the orchards of Dashehari mango which is the most prevalent mango cultivar in Malihabad Tahsil of Lucknow district. The mango trees in the cluster were in the age group of 25-35 years with a tree spacing of 10 × 10 m. Visual symptoms of copper, Zn and boron deficiency were observed in the trees. Majority of the farmers were not found applying any fertilizers except farm yard manure. Only two farmers reported that they have applied urea and DAP @ 1 kg/tree. There was no agro-input shop or school in the village. Maal block which is located 5 km away from the village, is the nearest market place for sourcing of different agro-inputs and for technical know-how the orchardists have to often approach State Governments HETC, Malihabad located at about 15 km or Central Institute for Subtropical Horticulture, Rehmankhera, Lucknow at 21 km. Reduction in fruit size, low percentage of fruit set, fruit drop and fruit cracking were recorded as the major problems associated with the nutrition of the orchards in the cluster. Undisturbed core soil samples were collected for estimating physical parameters; for the assessment of the nutrient status, 10 composite samples of both soil and leaf were collected randomly from the sampled orchards and analysed for ascertaining the availability of different nutrients. Sharda canal is the major source of irrigation in the village and farmers generally followed flood irrigation in their mango orchards.

Canopy of some of the trees in the orchards was very dense; need based centre opening was undertaken in entire cluster during December, 2012. The tallest branch in the centre of the tree was removed from its origin with the help of power chain saw to reduce the tree height and facilitate solar radiation infiltration into entire tree canopy. Nutrient application schedule was decided on the basis

of soil and leaf analysis carried out at ICAR-CISH, Lucknow. Application of urea (2.0 kg), Single Super phosphate (3.0 kg), Muriate of Potash (1.6 kg), copper sulphate (100 g), borax (50 g) along with 50 kg FYM per tree were applied during first week of September. Zinc sulphate @ 200 g / tree was applied in the basin soil separately after one month in the first week of October, 2012. Fertilizer was applied in 30 cm wide and 20 cm deep circular trench made at 2.0 m radius from the tree trunk (Fig. 1). To address the problem of small fruit size, fruit drop and fruit cracking two sprays of boron (Solubor) @ 2 g/L + Sulphate of Potash @ 5 g/L were given in first and last week of April. The orchards were irrigated to maintain the optimum soil moisture throughout fruit development stage. First irrigation was given at pea- marble stage during the first fortnight of April followed by 3 more irrigations at 15-20 days interval till last week of May.



Fig. 1: Fertilizers application in one the sampled orchard in the cluster

Leaf webber incidence was found very severe during July-August, 2012. It was effectively controlled first through use of web removal device developed by CISH, Lucknow followed by first spray of Lambda-cyhalothrin @ 1 ml/L. Chlorpyrifos dust @ 250 g/tree was applied to control mealy bug during January. Foliar applications of Carbosulfan @ 1.5-2ml/L and Dichlorvos @ 1ml/L of water were done to control already ascended mealy bugs as well as inflorescence midges during February, 2013. To control mango hoppers, Imidacloprid @ 0.3 ml/L water was sprayed during Feb-March, 2013 when the panicles were 8-10 cm long. The fruit borer incidence noticed during 2nd-3rd week of May was controlled by spraying Lamda-cyhalothrin @ 1ml/L water. Spray of copper hydroxide (0.3 %) was done on trees exhibiting symptoms of gummosis. Management of scale insects in sooty mould affected trees was undertaken through spray of dimethoate (2 ml/L). During February 2013, heavy occurrence of unseasonable rains made the emerging panicles prone to blossom blight infection and incidence of powdery mildew (around 5 %) was recorded in the second and third week of March 2013. Combination of Mancozeb (63%) + Carbendazim (12%) formulation @ 2 g/L was sprayed for the management of

blossom blight during the first week of March. Wettable sulphur @ 2 g/L was sprayed for the management of powdery mildew during third week of March when the panicles were 8-10 cm long. Fruit fly traps were kept in the orchards @ 10 traps/ha during May to check the incidence of fruit fly (Fig. 2). The farmers were demonstrated and made aware of the proper maturity stage indicator of mango fruits and harvesting of the fruits was done by using CISH mango harvester. The fruits were graded into A (>300 g), B (250-300 g), C (200-250 g) and D (<200 g) grades as per APEDA standards and transferred to plastic crates for transportation to the market outlets.



Fig. 2: Fruit fly trap for control of fruit fly

Results and discussion

Soil, tree component and pest control

The soil of the mango orchards was sandy loam in texture with low water holding capacity (17.1 - 20.9%). Bulk density and particle density were averaged around 1.51 and 2.5 Mg m⁻³ respectively. Soil and leaf analysis of adopted cluster orchards showed deficiency of organic carbon with medium status of available P and K. The status of micro nutrients in the soil was in the high range, except Mn, which was medium. However, the leaf analysis showed the deficiency of zinc, copper and boron.

It was revealed that centre opening resulted in 12.5-180 % reduction in tree height. Total radiation below canopy, which was in the range of 6100 to 6800 mol m⁻² yr⁻¹ prior to centre opening, increased to 10000-10500 mol m⁻² yr⁻¹ following centre opening (Fig. 3). Increase in the emergence of new panicles and shoots by 15-20 per cent was also observed in the treated trees. The leaf webber incidence which was very severe at the start of the project (Table 2) was effectively controlled. Mango mealy bug and hoppers incidence was also controlled. The fruit borer incidence was reduced from 70-80 % to 1-2 per cent. Disease incidence like gummosis, scale insects in sooty mould affected trees; powdery mildew and blossom blight

Table 2: Impact of pre-harvest technologies optimised by CISH, Lucknow for cv. Dashehari

Sr. no.	Items	Before	After
Practice Change			
1	Ploughing / inter culture in orchards	1-2%	100%
2	Irrigation	50-60% (Flooding)	100% (Basin method)
3	Application of basal doses of fertilizer/ balanced fertilization	10 % (only FYM application by majority of farmers)	100 %
Crop management issues			
4	Incidence of leaf webber	30%	Nil
5	Spraying of chemical for the control of hopper and powdery mildew	70-80% (After opening the flower)	100% (Before opening the flower)
6	Incidence of fruit borer	70-80 %	1-2 %
7	Emergence of new shoots	5-10 %	25-30 %
8	Increase in flowering	-	20-30 %
Post- harvest handling issues			
10.	Use of harvester	10-20 %	100 %
11.	Grading	Nil	100 %
12.	Fruit size		
	“ A” grade (>300g)	< 5%	17 %
	“B” grade (250-300g)	20 %	54 %
	“C” grade (200-250g)	30 %	24 %
	“D” grade (<200g)	45 %	5 %
13.	Packaging	No packaging/use of wooden boxes	Use of plastic crates
14.	Marketing	Local mandi (Dubbaga)/ Maal)	Dubbagga, Allahabad and Chandigrah mandis
15.	Average sale price of fruits per box / crate realized by the orchardists	Rs 80 -100 / box (10 kg)	Rs 350-650/ crate (25kg)

were also satisfactorily controlled. Pheromone traps kept in the orchards checked the incidence of fruit fly completely.



Fig. 3: Centre opening and fruiting in the sampled orchard in the cluster (A and B)

Yield, quality and economics

Harvesting and grading of fruits is very important for

marketing and realizing better price. Hence, fruits were harvested with utmost care to see that there are no bruises on the fruits (Fig. 4). Harvested fruits were graded into A,

Table 3: Effect of technological interventions on the quality of fruits obtained by the orchardists in the cluster

Sr. no.	No of plants	Area (ha)	Grade of fruits (%)			
			'A'	'B'	'C'	'D'
1.	30	0.25	20	60	20	0
2.	38	0.50	20	55	20	5
3.	44	0.50	18	50	20	12
4.	53	0.50	15	55	30	0
5.	45	0.50	18	60	20	2
6.	44	0.50	20	50	20	10
7.	75	0.75	15	60	25	0
8.	26	0.25	20	65	15	0
9.	50	0.50	15	55	20	10
10.	41	0.50	20	50	20	10
11.	47	0.50	15	50	35	10
12.	115	1.00	20	55	25	0
13.	65	0.62	17	70	13	0
14.	28	0.25	20	60	20	0
15.	23	0.25	20	50	25	5
16.	40	0.37	15	45	40	0
17.	28	0.25	15	60	20	5
18.	55	0.50	15	40	35	10
19.	69	0.75	15	50	30	5
20.	20	0.25	15	45	40	0
21.	64	0.62	15	50	25	10
Total	1000	10.00	363	1135	493	94
Average			17.28	54.04	23.47	4.47

Table 4: Effect of technological interventions on production and income of adopted orchardists in the cluster

Sr. no.	No of trees	Area (ha)	Production (kg)		Gross Income (Rupees)		B:C
			Before	After	Before	After	
1.	30	0.25	2500	3500	*50000	70,000	1.31
2.	38	0.50	3000	4000	60000	80000	1.37
3.	44	0.50	450	2500	9000	50000	1.97
4.	53	0.50	1200	2500	24000	50000	1.67
5.	45	0.50	3000	4000	60000	80000	1.45
6.	44	0.50	2250	3000	45000	45000	2.21
7.	75	0.75	3000	4100	60000	82000	2.05
8.	26	0.25	450	2550	9000	51000	1.39
9.	50	0.50	1500	3000	30000	60000	1.87
10.	41	0.50	1500	3200	30000	64000	1.55
11.	47	0.50	2000	3000	40000	60000	1.78
12.	115	1.00	12000	14000	240000	280000	1.29
13.	65	0.62	2000	3000	40000	60000	2.54
14.	28	0.25	1000	2500	20000	50000	1.45
15.	23	0.25	500	2500	10000	50000	1.34
16.	40	0.37	500	3000	10000	60000	1.59
17.	28	0.25	700	2000	14000	40000	1.64
18.	55	0.50	3000	4500	60000	90000	1.54
19.	69	0.75	4000	6000	80000	120000	1.47
20.	20	0.25	1000	2500	20000	50000	1.28
21.	64	0.62	1500	4600	30000	92000	1.63
Total	1000	10.0	47050	82050	9,41,000	14,92,000	34.39
Yield and income (per ha)			4705	8205	94100	14,92,000	
Average B:C for the cluster							1.63

*Sale price of fruit @ Rs 2000/q *Cost of cultivation Rs 560/tree

B, C and D grades following APEDA criteria. Graded fruits were then packed in plastic crates and transported to the markets. Increase in the use of mango harvester followed by fruit grading was noticed among the adopted farmers which was a major practice change. Use of plastic crates was cent per cent for the collection and transport of the harvested mango fruits amongst the adopted farmers. Average fruit yield increased from 47.05 kg/tree in the previous years to 82.05 kg/tree due to the adoption of above technological interventions. Percentage of 'A' and 'B' grade fruits increased from <5 and 20 % to 17.3 and 54.0 % respectively (Table 3). Net incomes of farmers were also increased (Table 4).

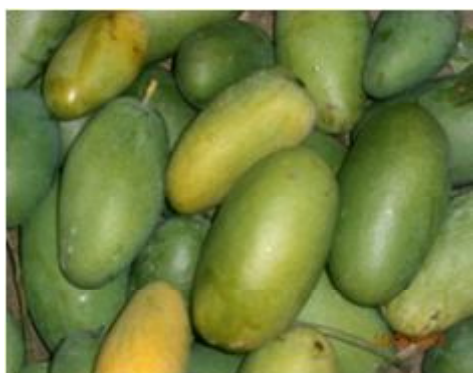


Fig. 4: Harvested fruits free from blemishes, pests and diseases attack

Conclusion

Majority of the farmers were small and marginal resources poor, hence, cluster approach was found effective in implementation of horticultural interventions. Productivity of the sampled orchards in the cluster was very low prior to the start of the project. Technological interventions not only enhanced mango productivity and fruit quality (4.705 t/ha to 8.205 t/ha with 15-20 per cent 'A' (>300 g) grade fruits realised as against 10-15 per cent as found in the baseline survey of previous years performance) but also lead to higher income to the adopted

farmers. Farmers were highly satisfied by participating in different activities and with good remunerative benefits.

Author contributions

Dr. Kailash Kumar, Tarun Adak, Vinod Kumar Singh, conducted the experiments, collected soil and leaf samples, performed soil analysis data and wrote the manuscript. Dr B Lal and Subhas Chandra actively involved in transfer of technologies and proper implantation of the project. Dr. PK Shukla and Balaji Rajkumar involved in implantation of protection technologies.

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