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Effect of ICM practices on yield and economics of mango (*Mangifera indica* L.)

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Abstract
Mango (*Mangifera indica* L.) is one of the nutritionally important fruit being a good source of vitamin A, B and C and minerals. The field experiment conducted to study the effect of integrated crop management on yield and economics of mango at farmer's field of Mancherial district, Telangana state during the year 2018-19 to 2020-21. The treatments consist of farmer practice (T_1) with application of RDF (1.7 : 1.1 : 1.15 kg NPK Tree^{-1}) and direct sowing and T_2 consists of pruning-removal of dried, criss - cross and unwanted branches in June-July months, inter cultivation of orchard during rainy season, spraying of KNO_3 and micronutrients for uniform flowering in November-December months, spraying of NAA @1g 50 L^{-1} of water along with application of RDF (1.7 : 1.1 : 1.15 kg NPK Tree^{-1}). The data revealed that the total yield gap between actual yield and potential yield of mango was 34.86 percent, in which 12.16 percent of yield gap between demonstration plot and actual farmers plot with 22.7 percent of technological gap. The increased in adoption percent of package of practices were found to more in use of micro nutrients application (80.00%), recommendation for uniform flowering (66.66%), recommendation for fruit drop can be controled (50.00%), harvesting and packing (73.33%), plant protection measures to control pest and diseases (46.66%), inter cultivation (63.33%). The net returns and B: C ratio was found to increased in demonstrated plot as compared to farmers practice. The adoption of integrated management practices shows positive impact on yield and economics of mango through adoption of demonstrated technology.

Keywords: ICM practices, yield, economics, *Mangifera indica* L

Introduction
Mango (*Mangifera indica* L.) is called the king of fruits and belonging to family Anacardiaceae. It is the most important commercially grown fruit crop of the country. India has the richest collection of mango cultivars. In India Mango crop grown in an area of 2.29 million ha with a yearly production of almost 20.07 million tones (NHB 2018-19 3rd Advance Estimates), which accounts for more than 55 percent of the world's total production. The need of present era is to increase the productivity of each and every crop. This could be achieved by adopting improved production practice, high yield varieties and new technologies of crop. Krishi Vigyan Kendra, Bellampalli conducted frontline demonstrations at farmers' field. The main objective of frontline demonstration is to demonstrate newly developed crop production and protection technologies and its management practices at the farmer's field under different agro-climatic regions and farming situations, and also convincing farmers and extension functionaries together about the mango production technologies for further wide scale diffusion. Keeping in view of an effective extension approach of frontline demonstrations for dissemination of mango production technology, its impact of FLDs conducted to be assessed. Therefore, the present study was conducted with the specific objectives to evaluate the frontline demonstration in terms of adoption of integrated crop management practices in mango and to know the impact of FLD on mango growing farmers.

Main objectives
- To study yield gap acknowledged in mango production in Mancherial district.
- To study the extent of adoption of integrated crop management in mango production technology before and after conduct of frontline demonstration.
- To study the economics of mango production before and after frontline demonstration.

Materials and Methods

KVK, Mancherial, conducted FLD on effect of integrated crop management (ICM) practices in mango at farmer's field of Mancherial district, Telangana state during the year from 2018-19 to 2020-21. The mango (Banginapalli variety) orchards of uniform age and (30 years old, at a spacing of 10 m x 10 m) were selected at different villages of Mancherial district under technical programme of work. To create awareness among the mango growers and to upscale their knowledge, KVK conducted capacity building programmes (On and off campus training programmes), workshops as part of frontline demonstrations (FLD). Krishi Vigyan Kendra, Bellampalli is playing vital role in transfer of improved technologies to mango growers from vegetative stage to harvesting stage every year in selected orchards of the district since 2018. To create awareness among the mango growers and to upscale their knowledge, KVK conducted capacity building programmes (On and off campus training programmes), workshops as part of Front Line Demonstrations (FLD). The critical inputs were supplied to farmers and applied as per the package of practices of new technology for mango crop recommended by Sri Konda Laxman Telangana State Horticultural University, Telangana.

Randomly ten farmers from each village were selected to making a total sample size of thirty as mentioned in Table 1. The basic data on potential yield and demonstrated plot yield of the farmers were collected before and after initiation of frontline demonstration by regular monitoring of the 30 farmer's field with an area of 12 ha was selected under these FLDs. Further, information on actual yield obtained by the farmers on their farms under their own management practices was collected. The information on demonstrated package of practices and farmers' practices followed as mentioned in Table 2. The technological gap (Yield gap-I) obtained by the differences between potential yield and demonstration plot yield, difference between demonstration plot yield and actual yield as extension gap (Yield gap- II) and total yield gap obtained by difference between potential yield and actual yield were worked out. The data were analyzed with appropriate statistical procedures.

Technology gap = Potential yield-Demonstration yield

Extension gap = Demonstration yield- Potential yield

$$\text{Technology index} = \frac{\text{Potential yield - Demonstrated yield}}{\text{Potential yield}} \text{X } 100$$

Results and Discussion

The average yield of mango was 14.9 q/ha in the year 2018-19, 25.3 q/ha in the year 2019-20 and 65.2 q/ha in the year 2020-21. There was no significant difference in mango yield between the year 2018-19 and in the year 2019-20, whereas the average yield in the in the year 2020-21was significantly higher than that of the other two years. The maximum yield was 65.2 q/ha in the year 2020-21.

Accordingly, the farmer-based yield gap (the gap between the average yield and the maximum yield obtained by farmers) was the highest in the year 2020-21, followed by the year 2019-20, and the lowest in year 2018-19. The yield gaps are presented in Table 3. The potential yield of mango was found to be 60.00 q/ha and the demonstrated plot average yield obtained through frontline demonstrations was 46.4 q/ha. The actual average yield obtained by the farmers on their farm with their own resources and management practices was 39.1 q/ha. The magnitude of technological gap (Yield Gap-I) was 13.6 q/ha, which was 22.7 percent lesser than the maximum attributable yield. Extension gap (yield gap-II) refers to the difference between demonstration plot yield and actual yield and it was 7.3 q/ha. There was 12.16 percent reduction in yield of farmers practice as compared to demonstration plots yield. A sizable total yield gap of 20.9 q/ha was observed and it accounted for 34.86 percent.

The large total yield gap may be due to attributed by environmental differences between research stations, extension worker and farmer's fields and also non adoption of production technology (Mishra *et al.*, 2007 and Kiran, 2003) [17, 13]. It can be reduced through considerable co-ordination between researchers, extension workers and farmers. These findings are with Hire math and Hilli (2012).

The adoption level of package of practices in ICM of Mango

The data found that (Table 4) the maximum number of farmers adopted recommended pruning management (86.66%) followed by timely irrigation (83.33%), FYM application (70.00%), RDF application (90.00%). The increased in adoption percent of package of practices were found to more in use of micro nutrients application (80.00%), recommendation for uniform flowering (66.66%), recommendation for fruit drop can be control (50.00%), harvesting and packing (73.33%), plant protection measures to control pest and diseases (46.66%), inter cultivation (63.33%). Similar results were reported by Niharika *et al.*, (2022) and Changadeya *et al.*, (2012). The increased in adoption percent package of practices were found to more in spraying of mango special (56.67%) and spaying of growth regulators (46.67%).

Economics of mango production

The economic impact of demonstrated production practices of mango was worked out by calculating total cost of cultivation, gross return, net return and B:C ratio (BCR) of before and after frontline demonstrated plot. Total cost of cultivation was calculated by total sum of expenditure of land preparation, manure, seed and fertilizers, plant protection measures, weeding, labour required, irrigation, and harvesting.

The data (Table 5) revealed that yield of mango was obtained 39.1 t/ ha before FLD and 46.4 t/ha after FLD. The farmers sold mango Rs. 3900 per quintal at farmer field and base on that profitability was calculated (Balaji *et al.*, 2013). Which shows that net returns Rs. 1,76,933/ha from mango before FLD, while the net returns Rs. 1,17,733/ha from mango after FLD. The B: C ratio for before FLD was 2.55, which was increased to 2.73 after FLD. It was evident from the results that B:C ratio of mango in FLD was higher than before FLD. It may due to high implementation of all the package of practices recommended for mango production in the region.

Impact of ICM on yield of Mango

The yield of mango was significantly differences before and after conduct of FLD. The information about the impact of integrated crop management on yield of mango through frontline demonstration is presented in Table 6. The data revealed that the increased in yield of mango per hectare by 18.67 percent in FLD plots. It means after FLD, there was wider implementation of demonstrated technologies. These findings are in line with research of Sowjanya, *et al.*, (2017) [27].

Table 1: Particulars of Front Line Demonstration

S. No.	Year	No. of Villages	No. of locations	Area (ha.)	
				FP	Demo
1.	2018-19	4	10	4	4
2.	2019-20	5	10	4	4
3.	2020-21	5	10	4	4
	Total	14	30	12	12

Table 3: Yield gap identified in Mango production

Particulars	Potential yield (q)	Demonstration plot yield (q)	Actual yield (q) (Farmers practice)	Technological gap (Yield gap I)	Extension gap (Yield gap II)	Total yield gap
Yield (q/ha)	60.00	46.40	39.10	13.60	7.30	20.90
Percentage gap	--	--	--	22.7	12.16	34.86

Table 4: The adoption level of package of practices in ICM of mango (n=30)

Sl. No.	Package of practices	Adoption (Before FLD)		Adoption (After FLD)		Increased in adoption	
	Technologies	No.	Percent	No.	Percent	No.	Percent
1.	Pruning and management	02	6.66	26.00	86.66	24	80.00
2.	Inter cultivation	09	30.00	28	93.33	19	63.33
3.	Irrigation	07	23.33	25	83.33	18	60.00
4.	FYM application	12	40.00	21	70.00	09	30.00
5.	Recommended dose of Fertilizer application	04	13.33	27	90.00	23	76.66
6.	Micro nutrients application	4	13.33	28	93.33	24	80.00
7.	Recommendation for uniform flowering	06	20.00	26	86.66	20	66.66
8.	Recommendation for Fruit drop can be control	4	13.33	19	63.33	15	50.00
9.	Harvesting and packing	3	10.00	25	83.33	22	73.33
10.	Plant protection measures to control pest and diseases	5	16.66	19	63.33	14	46.66

Table 6: Yield of mango before and after frontline demonstration (n= 30)

Average yield of mango (q/ha)	
Before FLD (Farmers practice)	46.40 q/ha
After FLD (Demonstrated production)	39.10 q/ha
Percent increased in yield	18.67

Table 5: Economics of mango production before and after Front Line Demonstration

Particular	Cost of cultivation (Rs/ha)	Yield of mango (q/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C ratio
Before FLD	59,200	39.10	1,51,039	95,339	2.55
After FLD	64,700	46.40	1,76,933	1,17,733	2.73

Table 2: Demonstrated package of practices and farmers practices for ICM in Mango

Technologies	Pruning and management	Intercultivation	FYM application	Fertilizer application	Micro nutrients application
Frontline demonstration (Demonstrated package)	By using pruning saw unwanted, diseased, dried criss –cross twigs pruned and removed so that inner branches are exposed and center of the tree is opened out to sunlight. Pruning of the dried twigs and branches should be done with pruning saw during June-July. Pruning in mango encourages production of new shoots.	Grown vegetables like okra, brinjal and leguminous crop like green gram to improve soil fertility	Applied 20-25 kg per tree per year	730 g N + 180 g P_2O_5 + 680 g K_2O per tree per year (50% NPK after harvesting and remaining 50% NPK applied at Oct-Nov.) based on soil sample analysis report	Sprayed $ZnSO_4$ 5g, Boran 2 g and 10 g urea per liter of water is recommended at the onset of monsoon.
Farmers practices (Local check)	Not followed	Intercropping not followed	Applied 5-6 per tree per year	20:20:0 NPK mixed chemical fertilizer as 500 gr /plant	Not followed

Technologies	Irrigation	Recommendation for uniform flowering	Recommendation for Fruit drop can be control	Harvesting and packing	Plant protection measures to control pest and diseases			
Frontline demonstration (Demonstrated package)	Drip System of Irrigation	Spraying of KNO_3 @ 10 g/l during November helps in opening of the flower bud and uniform flowering	Fruit drop controlled by spraying 2,4 – D at 10 ppm or Naphthalene acetic acid (NAA) at 20 ppm twice at an interval of 15 days during the early stage (peanut stage) of fruit development.	Harvesting the fruits with a long poll having a net at the end (Gowka) lowering them gently on a gunny cushion minimized the injuries	1) Mango leaf Webber management: Sprayed Chlorpyrifos @ 2 ml/L of water.	2) Powdery mildew management: Sprayed Hexaconazole 5 EC @ 1 ml/L of water	3) Fruit fly management: used pheromone traps 10 No./ha.	4) Anthracnose: Sprayed Carbendazim @ 1 g/L of water.
Farmers practices (Local check)	Not followed	Not followed	Not followed recommended spray	Harvesting the fruits with shaking tree	Irrespective of disease and pest, used plant protection chemical sprayings			

Conclusion

It was observed that different package of practices had significant influence on percentage of healthy fruits per plant. The study reported that the ICM in mango demo was found useful in enhancing the knowledge and adoption level of farmers in various aspects of mango production technologies.

Declaration: The authors declare no conflict of interest.

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