Indian Journal of Extension Education
Vol. 49, No. 3 & 4, 2013 (113-116)

Impact of Pre-and Post-harvest Technological Interventions and Social Mobilization on Area-Expansion of Mango in Tribal area of Odisha

H. S. Singh[1]

ABSTRACT

Mango based horticulture was promoted as a livelihood option as early as in seventies in Kashipur block of Rayagada district in Odisha but quite a few tribals took it seriously. Technological interventions over the period of eight years by experts made mango orchards commercial and paved the way for significant increase in mango area in the tribal villages. Fruit fly management, hot water treatment (HWT), fruit packing and transportation as pre and post harvest interventions and social mobilization through village meetings and orchard management were attempted regularly from 2003 to 2010 in the tribal areas. The interventions yielded healthy marketable fruits to a distance of 500 KM. Neighborhood effect in tribal villages motivated 260 households for mango planting in 13 hamlets of 5 Gram Panchyats (GPs) planted on an area of 588 acres under high density mode (5 X 5 m) on unused foot hills, gentle hillocks and sloppy land. The results indicated that technological interventions through result demonstrations, social mobilization and development of marketing channel could develop confidence among tribals for mango cultivation and thereby resulted in expansion of area under mango cultivation. The perceived constraints of the mango farmers in tribal areas were lack of result oriented demonstrations, motivation, marketing channel and confidence of mango growers.

Key words: Mango, tribals, fruit fly management, hot water treatment, social mobilization.

INTRODUCTION

Tribals dependence on shifting cultivation and forest based products for livelihood has led to the loss of land productivity and soil fertility and thereby reduced ecology and livelihood inter-relationship which has been spiraling down gradually with continued decrease in carrying capacity of the available natural resources. A significant proportion of tribals has been engaged in such practices especially on high slope land without conservation measures with a very high level of soil erosion in Kashipur block of Rayagada district of Odisha which is located in the interior of forest at 500 Km away from urban areas. In the area, many hillocks and foot hills are necked and abandoned as non-cultivable land. The situation has lead tribals to change their livelihood pattern and now many families depend on wage, business, migration, subsidized food, developmental programme and shifting cultivation in the area (Singh, 2010). As the high lands comprising of foothills and hillocks have gravels, these are suited only for tree based perennial horticultural crops. State government promoted horticulture in general and elite varieties of mango in particular as early as in seventies , however, till 1996 no specific mango orchard in the farmers' field was available. Lack of genuine planting materials, pest incidence and absence of bulk mango marketing channel were key constraints in the way of mango industry. Central Horticultural Experiment Station (IIHR) could realize this gap and worked from 2002 to 2010 in the area. Working over the period of 8 years in the area, the station could demonstrate the potential of mango cultivation to tribals. Present paper deals with the impact of technological intervention on mango area expansion in tribal belt of Odisha.

METHODOLOGY

There were four partners in the present programme Central Horticultural Experiment Station, a regional station of Indian Institute of Horticultural Research under Indian Council of Agricultural Research served as technology provider and demonstrator. Horticulture and Agriculture Related Panchatats' Association for Livelihood (HARPAL) which is a local society and worked as fund manager, social mobilizer, produce collector, packer, marketer and field executor. Department of Horticulture, Odisha worked as a monitor of technological execution in the field. Fruit stockiests, Bhubaneswar worked as consultants in getting the feedback of retailers and consumers preference pertaining to mango packing, retailibility, quality and perishibility and progressive farmers -as first risk bearer of the mango enterprise. Technological and socio-economic interventions were made during the period by above agencies. The package included pest, plant, produce and marketing management including social mobilization which are explained as under:

Head, Central Horticultural Experiment Station, IIHR P.O.Aiginia, 751019, Bhubaneswar, Odisha

Fruit fly and other pest management: Male Annihilation Technology (MAT) and Bait Application Technique (BAT) were adopted to manage the fruit flies. MAT consisted of impregnation of 5x5x1.2 cm ply wood blocks in Ethyl alcohol: Methyl eugenal: malathian (6:4:1) and placing them @ blocks 10/ha at 1.5 m height 45 days prior to fruit maturity in bottle traps. When blocks wetted in rains or failed to attract the flies, these were replaced after 30 days or even early. Bait Annihilation Technique (0.1% insecticide, 10% jaggery or banana in water) was used especially when fly pressure was high. BAT mixture was applied weekly starting 45 days prior to fruit maturity. Spray was done at 7- 10 days interval in spots of 40 ml at a rate of 200 spots/ha (approximately 8 L/ha) including surrounding hedges (Singh *et al*, 2008). Stone weevil, hoppers, powdery mildew and anthracnose were controlled as per standard practices.

Soil and plant management: Trainings in nursery technology, zero orchard tillage to reduce erosion, planting under high density of 5x5 m distance in 1x1x1 m pit size with standard practice of pit filling, nutrient supply and plant canopy architecture techniques were adopted. As the orchards were located in sloppy land, foot hills and hillocks, *in situ* rain water harvesting technique i.e. half moon basin structure with front trenching were adopted which helped holding 5-6 buckets of rain water. Orchard management practices like mulching with grasses, providing live fencing and standard canopy management were applied to plants during this period.

Hot Water Treatment (HWT) of mango: Green fruits were harvested at appropriate stage of maturity. After harvesting, fruits were kept to discharge sap and then kept in plastic crates. These fruits were subjected to hot water treatment plant constructed near the orchard itself. The hot water treatment plant was manufactured locally, using 2000 liters capacity zinc tank fitted with heating rods, thermostat and circulating fan to mix the water to assure uniformity of temperature within the tank. Using pulley and chain, the mango crates were submerged in hot water tank 10 inches below the water surface. The ratio of volume of water to fruit stock was large enough to prevent a significant drop in temperature when the mango stock was added. Fruits were treated at 46^0C for 60 min and were allowed to cool and dry before grading and packing. In one shift, 0.55 ton mango was treated and such 10 shifts were managed in a day. As such, some 50 tons of fruits were treated with hot water in 2007 and then 120, 200 and 300 tons during 2008, 2009 and 2010, respectively. For research purpose nearly 0.10 ton fruits from fruit fly untreated orchard and treated orchards as well as without hot water treated mangoes were collected for two years.

Produce management and marketing: After cooling and drying, fruits were packed in corrugated card board boxes of 5 kg capacity. Paddy straw was used as cushioning material for the packaging of fruits. Mangoes selected for study were loaded along with other mango packets in trucks (10 ton per trip) for transportation and sale up to more than 500 km in urban areas. Based on treatment, fruits were divided as "only pre-harvest treated", "only post harvest treated", "pre and post harvest treated" and "untreated" categories. On arrival at city, packets of each of the category were earmarked and taken for laboratory related studies at CHES Bhubaneswar. As such, a total of 2000 fruits were used in study weighing nearly 0.40 ton each year. In order to improve the process, the feed back and views of fruit stockiest and retailers were collected pertaining to packing, perishability and retailability of the produce. The consumers' preference was also collected in an informal way. Based on market reports, the fruits were packed in plastic crates of 20 kg afterwards.

Social mobilization: Training on various aspects of mango cultivation, mango day, farmers gathering in tribal mango growers' field on recurring basis, group meeting in village panchayats, personal persuasion and confidence building visits were some of the methods for tribal mobilization. The results of the interventions have been interpreted in terms of reduction in pest damage and impact of various technological, social and motivational interventions on mango area expansion.

RESULTS AND DISCUSSION

Seven years estimates of fruit fly infestation, revenue realization and area expansion of mango have been presented in Table 1 which includes farmers practice (2000 and 2001), and large area application of MAT and BAT (2002 to 2007). Data reveals that before application of treatment, the incidence of fly was high (up to 40 per cent fruit damage). In first year itself, the fruit fly damage was reduced below 3 per cent and farmer earned ₹ 3, 00000 by the sale of mango due to implementation of MAT and BAT control of fruit fly. In following years, a handsome amount was realized and area expanded slowly. However, due to transportation loss, the rate given by trader was not satisfactory.

The effectiveness and cost benefit ratio of the fruit fly management technology is presented in Table-2. MAT and BAT together utilized 33.33 times less insecticide and 1.40 times less cost but resulted in nearly double protection (93.08%) as well as double cost benefit ratio (1: 23.04) than that of cover spray (53.24 and 1:10.99, respectively). A high level reduction in incidence of fruit

fly through the implementation of MAT and BAT (Singh *et al*. 2008, Stonehouse *et al.* 2000) or HWT (McIntyre *et al*. 1993) have been reported.

Table 1: Infestation level of fruit fly in mango orchards under various types of treatments and area expansion

Year	Treatment	Fruit fly damage (%)	Revenue Realized (Rs.)	Area expansion (Acres)
2000	Carbaryl cover spray (farmers practice)	15-20%	95000	-
2001	Carbaryl cover spray (farmers practice)	35-40%	25000	-
2002	MAT and BAT cover spray	0-3%	3,50000	-
2003	MAT and BAT spot application	0-3%	5,00000	8.50
2004	MAT and BAT spot application	0-2%	6,50000	6.00
2005	MAT and BAT spot application	0-4%	7,00000	30.00
2006	MAT and BAT spot application	0-3%	8,50000	10.00

Table 2: Cost benefit analysis in fruit fly management using MAT and BAT

Treatment	Fruit yield (q/ha)	Marketable yield (q/ha)	Infestation (%)	Protection (%)	Insecticide (ml)	Cost benefit ratio
MAT+ BAT	73.17	71.33	2.43	93.08	144	1:23.04
Cover spray	74.34	62.25	16.43	53.24	1600	1:10.99
Non Treated	68.57	43.94	35.14	0.00	0.00	
C.D at 5 %	NS	7.70	6.60	-	-	

In order to improve the marketing life and fruit quality, a local and low cost hot water treatment plant was designed and installed. Hot water treated mangoes were packed in card board packs; however, HWT and transportation in these packets did not go easily. Heavy loss was sustained due to heat injury and pressure damage. Then the hot water treatment system and packing was further modified to avoid the loss and mango packing was done in 4 kg card board boxes as suggested by whole saler and retailers.

The results of HWT have been presented in Table 3. Results indicated that market life of pre-treated and un-treated fruits ranged from 6-10 days with a mean of 8.70 days whereas, in hot water treated fruits, it ranged from 15-20 days with a mean of 17-18 days. At 16th day of harvesting, more than 87 per cent fruits were saleable in hot water treated lots whereas, in pre-treated or un-treated, it was less than 22 per cent (Table 4). Results clearly indicated that HWT was essential to extend market life even if mango is pre-treated in the orchards. Ripening of mango starts by 25th June in the area and rains commence from 15th June. Being a hot, humid and high rainfall area (1500mm), the incidence of anthracnose in mango is high. As a matter of fact, the HWT eradicates the disease inoculums from fruit surface and brings about reduced enzymatic activity therefore, reduced decay process in mango (Yahia and Pedro-Campos 2000). Further, the possibility of accidental fruit fly larval presence in ripe fruits is also ruled out, hence longer market life.

Table 3: Impact of hot water treatment on mango shelf life

Treatment	Fruit fly	Market life in days		
	Infestation	Range	Mean	% Marketable fruits at 16th day
Only pre-harvest treated fruits (MAT+BAT and Topsin -M spray)	1.25	6-10	8.71±1.81	22.00
Only post harvest treated fruits (HWT)	0.58	15-20	17.86±2.60	87.40
Pre and post harvest treated fruits MAT + BAT+ Topsin M spray +HWT)	0.53	15-20	18.14±2.30	91.20
Untreated fruits(Wash only)	28.01	6-10	8.28 ±1.79	7.80

Experiment results revealed that there was heavy reduction in incidence of fruit fly and diseases in mature mango fruits due to pre- and post- harvest treatment which made possible to keep mango fruits for 17-18 days. However, deterioration in quality started much early in un-treated fruits than treated ones, therefore, poor marketability of untreated fruits.

Gradually, the fruit fly management technology was adopted by some more farmers and the society (HARPAL) started fruit collection from local farmers, did hot water treatment, card board boxes packing and transportation for distant area marketing. Many tribals became confident by now that mango could be cultivated commercially and were willing to go for mango planting. However, some farmers who planted mango saplings, previously were not fruiting even after 3 years, whereas, local material of Amrapali was giving fruit in third year itself. Therefore, most of the tribals were reluctant to outside mango sapling but prefer local planting material of variety Amrapali. However, mango sapling of Amrapali was not available in huge quantity in the area.

On the persuasion of CHES, the society, led by progressive farmers came farward to multiply the sapling of mango variety Amrapali in 2009 and a team of 30 local tribal boys was trained in mango rootstock development and grafting. As a result, large number of Amrapalli graft were ready in 2010. A meeting of tribals of 10 villages was convened in fruiting mango orchard for motivation where they decided to execute the mango planting jointly in *mass*. Data presented in Table-4 reveals that a total of 89,398 mango saplings were planted on the land of 50 SCs, 186 STs, 23 OBCs in the area of 120.95, 362.05 and 75.24 acres, respectively. The planting programme was executed in the month of August and monitored by the CHES scientist. Pit digging, filling, planting technique and soil management on sloppy land were same as was done earlier orchards.

Table 4: Number of grafts, farmers and area under mango planting

Category	Number of grafts, farmers and area(acres)*					
	Kashipur	Sunger	Taljhari	Chandragiri	Gorakhpur	Total
SC	0 0 0	9152 24 57.20	4010 9 25.06	4390 9 27.43	1800 8 11.25	19352 50 120.95
ST	23867 71 149.17	29147 102 182.16	200 1 1.25	3320 6 20.75	1400 6 8.75	57934 186 362.05
OBC	538 1 3.36	10500 20 65.62	1000 2 6.25	0 0 0.00	0 00.00	12038 23 75.24
GEN	0 0 0.00	74 1 0.46	0 0 0.00	0 0 0.00	0 0 0.00	74 1 0.46
Total	24405 72 152.53	48873 147 305.45	5210 12 32.56	7710 15 48.18	3200 14 20	89398 260 588.70

*Presented in vertical sequence

The impacts of important interventions have been presented in Table 5. It is seen that fruit fly management, hot water treatment, social mobilization and development of marketing channel were key interventions to bring about significant impact on mango enterprise.

Table 5: Impact of technological and socioeconomic interventions on mango enterprise

Technological / Socio economic intervention	Impact
Fruit fly management and other pest management practices	• Complete control of fruit fly incidence.[1] • Removal of defamation tag that mango from Kashipur is insect infected[1] . • Production of healthy mango[1.] • Quantum improvement in income[1.]
Hot water treatment	• Increase in mango shelf life.[1] • Long area transportation for marketing.[1] • Reduction in retailing loss.[2] • Better response from consumers.[2] • Freedom from ripening aid.[2]
Packing	• Reduction in transportation loss such as heat injury, pressure change.[1] • Preferred by stockist and retailer.[2] • Easy direct to home service[3].
Zero tillage, basin management and mulching in orchard	• Reduction in soil erosion.[1] • Water retention and moisture conservation.[1] • Vigorous mango plants.[3]
Canopy management and pruning	• Better light and air penetration in canopy[1] • Controlled canopy volume[3]. • Easy cultural practices[3]. • Plant uniformity[3].
Improving nursery skill	• Availability of genuine planting material in local area . • Empowerment of rural youths in grafting[1].
HDP with Amrapali	• Amrapali gives fruit in 3rd year whereas other varie ties produce fruit late[1]. • Orchard development cost is realized in 3 year only[1]. • Orchard becomes economical from 4th year onwards for having more number of fruiting terminals per unit of land area[1].
Development of marketing channel	• Tribals became confident of mango sale.[1]
Social mobilization	• More insistence of women to their counterparts for mango cultivation[1]. • Confidence in tribals toward assured income from mango cultivation and marketing[1]. • Large area plantation of mango[1].

*1- Most important, 2-Important, 3- Less important

CONCLUSION

The multiplying impact of the area expansion of mango is quite visible in the tribal areas of orissa. The technological backup is needed for converting tribal area into a mango belt. Most of the present plantations have been done on sloppy land having 10-50 per cent slope, it will need good management of soil water, micro-nutrient (as foliar spray) as most of the orchard soils are poor and have disadvantageous location. All the fields are having high density plantation which will need perfect canopy management strategies after one year. Area is prone to hoppers, stone weevil, fruit borer and fruit flies, hence, management techniques need to be updated from time to time to control these pests. Disease awareness especially powdery mildew would be needed. More number of hot water treatment plants in each Panchayat would be required. Developing facilities for collection and packaging infrastructure and developing new marketing channels would be needed.

REFERENCES

McIntyre A. , Wickham L., Wilson L. , Malins A. 1993. Hot water treatments for the post-harvest control on fruit fly and anthracnose in the Caribbean mango, 'Julie'. IV International Mango Symposium, *Acta Hortic.* 341. ISHS, USA

Singh Abha, 2010. Nutritional security of tribals as affected by livelihood pattern. PhD thesis submitted to Utkal University.pp203

Singh H. S., A. Verghese, J. M. Stonehouse, J. D. Mumford, S. George, G. Naik and V. Pandey. 2008. Developing bait and lure based IPM module for mango fruit fly management in Orissa , *Indian Journal of Agricultural Science,* 78(7):609-13.

Yahia Elhadi M and Pedro-Campos J. 2000. The effect of hot water treatment used for insect control on the ripening and quality of mango fruit. *Acta Hortic* 509:495-514. ISHS,USA