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Assessment of Rejuvenation Technology and Integrated Plant Nutrient Management in Old Guava Orchard through Farmers' Participatory Approach

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ABSTRACT

An on-farm testing was conducted in old guava orchard on rejuvenation and IPNM technologies aimed to restoring yield and quality production from trees of cv. Allahabad Safeda. Before the implementation of trial, the farmers were unaware about pruning response and role of improved management practices. The eighteen year old trees of selected guava orchard were pruned drastically head back from a height of 2.00 meter in 2007. Topping and hedging of emerging shoots in months of May and October were performed up to year 2009 regularly to develop a good framework as well as better canopy management. Integrated plant nutrient management and other recommended cultural practices were followed in rejuvenated trees and unpruned plants of alternate rows and compared the performance with farmers practice in remaining trees of orchard. It was observed that topping and hedging increased the number of new shoots (below the cut portion) and spread of plant significantly resulting in reduced tree height and improved fruiting potential of trees as compared to farmers practice. The pruning practices resulted in increased flowering shoots (39.66%) and gave higher average yield 63.44 kg tree^{-1} followed by unpruned well managed trees (44.16 kg tree^{-1}) with increased yield of 107.72 per cent and 44.59 per cent over farmers practice (30.54 kg tree^{-1}). However, the yield in initial year was low in rejuvenated plants (29.00 kg tree^{-1}) as compared to T_2 (38.66 kg tree^{-1}) and farmers practice (35.50 kg tree^{-1}). The economic analysis revealed that B: C ratios were much higher in rejuvenated plants (3.76) than the T_2 (2.38) and farmers practice (1.43). The yield obtained from pruned trees had better quality as compared to farmers practice. The results of experiments provided an eye opening moment to farmers not only to rejuvenate old unproductive orchard, but also interaction effect of pruning response and better management practices of guava trees.

Key words: Heading back, canopy management, yield and quality attributes,

INTRODUCTION

Guava (*Psidium guajava L.*) popularly known as poor man's apple is commercially grown in nearby urban areas urban of Varanasi and Chandauli districts of Uttar Pradesh. Declining yield pattern from old guava orchard over the years is the major cause for shifting the interest of farmers towards other crops. There are various limiting factors related to production and productivity which are pertinent and grave for declining trends in bearing potential of old guava orchards (Singh *et al.* 2005). The average yield of traditional garden is very low in Chandauli district (7.5 mt/ha) than the national average *i.e.* 11.7 mt/ha (NHB data base, 2010). Based on several research investigations, it could be said that the fruiting potential of the tree is largely governed by architexture of tree, canopy density and photosynthetic efficiency (Burondkan *et al.* 2000; Singh and Singh 2003; Kalloo *et al.*2005). Overcrowded old orchard planted in unsystematic manner was the root cause of declining productivity of guava orchard in the district by decreasing photosynthetic activity and suitability for pathogen to invade. Realising the problems of unproductivity and mismanagement of orchard, an intensive extension approach was followed to rejuvenate old guava orchard in Chandauli ditrict of Uttar Pradesh.

METHODOLOGY

(1) Identification of technological gap and plan of on-farm testing (OFT):

A study conducted by *Krishi Vigyan Kendra* based on survey and group discussion with farmers interactive group (F.I.G.) of guava growers in the guava belt of chandauli district *i.e.* Rema, Digghi, Ganjkhwaja, Faguiya and Tajpur villages to identify root causes of low yield and technological gap between improved production technology and farmers' practice given in Table 1. An on-farm testing (OFT) on rejuvenation of old guava orchard was designed by Krishi Vigyan Kendra, Chandauli Uttar Pradesh at three farmers' guava orchard in two villages namely Faguiya in Sakadeeha block and Digghi in Sadar block from 2007 to 2010 as suggested by scientists P.F.D.C. (C.I.S.H., Lucknow, U.P.). A list of constraints experienced by farmers on socio-economic, cultural and behavioral factors was prepared and short listed in Table. After assessing the cognitive domain and perception of guava growers as well as potential hindrances to acceptance of technology, an intensive extension programme like informal meetings and focused

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group discussion, gosthies and scientist- growers interface with video shows were conducted in association with P.F.D.C., Lucknow and Department of Horticulture, Chandauli. Concentrated extension efforts led to change in the mind set of growers and at least nine growers came forward to participate in the trial in their old guava orchard. Among these, three farmers having 17-18 years old guava orchard with poor yield were selected for the trial. The farming situation studied of selected orchards is depicted in Table 3.

(2) Experimental plan and module of treatment:

Each selected farmer was provided 15 pruned plants with marked decline in yield from his garden in alternate rows to conduct the study and other fifteen unpruned plants of adjoining rows were also given all the package of rejuvenation technology, except for pruning treatment. Remaining plants of orchard were treated as farmers' practice in the study. The experimental module included the heading back of branches at 2.00 meter height from ground level during May 2007. The newly emerged shoots as a result of rejuvenation pruning were allowed to grow up to length of about 40 to 50 cm. These were further pruned to about 50 per cent of its length. These shoots were further pruned to about 50 per cent of total length in the month of October for emergence of multiple shoots below the pruning portion to modify tree structure and maintain canopy size. Shoot management was continued in 2008 and 2009 in May and October month for the purpose. Pasting of copper oxychloride on cut surface and white washing of tree with copper and lime were followed after each pruning. The trees were irrigated regularly to maintain moisture for proper growth of shoot and fruiting twig. Application of 20 kg vermicompost per pruned plant was made. After six months, first manure and fertilizer application as followed. It included 30 kg vermicompost + half kg neem cake + 1300 g urea + 1875 g single super phosphate and 500 g muriate of potash per plant in two split doses in the month of October and June. The details of treatments followed in the trial are as bellow.

T_1= Rejuvenation pruning followed by consistent pruning of emerging shoots at 50 per cent of length in October and May till 2010 + IPNM package + recommended management practices

T_2= Unpruned trees + IPNM package + recommended management practices

T_3= Farmers practice (Application of DAP @ 300 g plant^{-1})

Data on tree growth was recorded in the month of October every year. Similarly, flowering and fruiting were recorded after May and October shoot pruning. The observations on fruit analysis were recorded in composite sample of 5 fruits from 15 collected fruits of each rejuvenated and non-rejuvenated plants. Total soluble solids were measured by Erma hand refractometer. Per cent increase in yield was calculated by using following formula.

$$(1)\ \text{Percent increase in yield} = \frac{\text{Demonstration yield} - \text{Farmers' yield}}{\text{Farmers' yield}} \times 100$$

$$(2)\ \text{B:C Ratio} = \frac{\text{Gross return}}{\text{Cost of cultivation}} \times 100$$

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that farmers involved in guava production lack awarenes about recommended production technologies *e.g.* high yielding varieties, crop regulation, high density planting, nutrition management, mulching, intercropping, pruning response, use of bio-regulator and plant protection measures. The competitive inter-crops *i.e.* rice, bitter gourd and pigeon pea along with imbalanced nutrition management not only reduces the yield and canopy development of orchard, but also declines the product due to highers incidence of diseases and pests. The lack of knowledge and skill about management of overcrowded orchard and combined production management approach were the important causes responsible for grave orchard decline. These facts also in agreement with the findings of Singh *et al.* 2003.

Table 1: Technological gap between improved managements packages and farmers' practices

Technologies	Farmers Practices	Improved management package
Selection of high yielding variety	Not aware, insist only grafted plants	Improved varieties i.e. Allahabad Safeda, L-49, Lalit etc.
Crop regulation (Bahar treatment)	Not aware	I) Spray of urea 10-15% for deblossoming for rainy crop II) Root exposure and water withholding for enforcing heavy crop.
High density planting	Not aware	Accommodation of 555 plants at 6x3 meter spacing rather than 277 plants at 6x6 meter spacing
Nutrient management	Application of chemical fertilizers at injudicious doses 2 kg DAP/plant	IPNM technology consisted 20 kg FYM +250 g Azotobactor +300 g N + 200 g P_2O_5 +350 g K_2O in two split doses
Mulching	Not aware	Mulching with paddy straw/ banana leaf or with black polythene
Pruning and training	Not aware	Mild pruning in April in fruiting plants and rejuvenation of same orchard
Use of bioregulator	Not aware	Spray of NAA 100 PPM or GA_3 150 PPM or Ethephane 300PPM increasing fruit setting and reduces fruit drop
Selection of intercrop	Growing rice, wheat and bitter gourd ; causes garden decline	Okra, cowpea, dolichus and turmeric can be grown as intercrop in guava orchard synergistically
Pest and disease management	Injudicious use of pesticides	Application of IPM technique Fruit fly control by use of Methyleugenol pheromone trap and spray of carbaryl and anthracnose management by use of Thiophenol 0.01% and Wilt management by application of Trichoderma and Aspergillus niger

Table 2: Constraints experienced by farmers in adoption of rejuvenation technology

Identified constraints
Lack of awareness and knowledge about rejuvenation technology
Unwillingness about deep pruning in guava tree
Lack of faith in rejuvenation techniques and risk of survival of orchard after deep pruning
Fear of economic loss by missing two crops
Lack of risk taking willingness
Unavailability of skilled labour and equipments
Fear of forest law and police
Complexity of work

The farming situation as given in Table 3 favours the commercial growing of guava in the district. It consists of sandy loam soil with pH 7.5- 8.00, lower N & P with medium K_2O and sufficient rainfall, which are suitable for guava production, but unmanaged, poorly nourished, overcrowded orchard taken under study were unable to produce higher yield and tend to become uneconomic. In the present trial, increase in tree canopy was directed by shoot pruning effectively. The growth of terminal and lateral shoots during the framework development of tree may be stimulated during growth period (Singh *et al.* 2005) but these excessive growths must be well managed by pruning and removal of overcrowded shoots.

Table 3: Details of farming situation of OFT on rejuvenation of guava

Treatment	Duration of study	Variety	Age of plant	Farming situation	Soil type	pH	Soil status			Seasonal rainfall	Avg. no. of rainy days
							N	P	K		
T_1- Rejuvenated trees T_2- Unpruned well managed trees T_3-Farmers practice	May 2007 to Nov. 2010	Allahabad safeda	18 years	Irrigated	Sandy loam	7.5-8.0	Low	Low	Medium	560 mm	29

The experimental findings summarized in Table 4 revealed that significantly and consistently profuse flowering were observed in rejuvenated guava trees than well nourished unpruned guava trees (T_2) and farmers practice (T_3). Increased branching complexity resulted in more fruiting shoots in young trees, promoting precautious flowering and fruiting (Campbell and Wasielewski, 2000). Pooled fruit yield data of a year indicated that rejuvenated tree (T_1) had maximum fruiting shoots (39.66 per cent) in comparison to unpruned well managed tree (T_2) *i.e.* 24.66 per cent and farmers practice, (T_3) *i.e.* 15.66 per cent. It is very clear that consistent pruning responded well and stimulated new growth to convert in fruiting shoots. The data related to yield presented in Table 4 exhibited that rejuvenated trees consistently and significantly produced higher yield (29.00 to 96.00 kg $tree^{-1}$) over the farmers practice (35.50 to 28.80 kg $tree^{-1}$). However, the yield from T_2 was also found consistently in increasing trend (38.66 to 51.33 kg $tree^{-1}$), but lower than rejuvenated trees. It is because of increased new growth in T_2 due to management practices but less conversion of new shoots in bearing shoots in unpruned trees. Declining in productivity of orchard could largely be due to poor photosynthesis efficiency, besides several other compounding factors *i.e.* age of plants, dense and intermingling branches, neglected and poor management of the orchard (Kalloo *et al.* 2005). The per cent increase in average yield of three years period reported highest in rejuvenated trees (107.72 per cent) in comparison with unpruned well managed trees (44.59 per cent) over the farmers practice. The data pertaining to quality parameters revealed that number of fruits/plant were found maximum in farmers practice (330) followed by T_1 (305) and T_2 (300).While the average fruit weight recorded highest (206.66 g) in rejuvenated plants followed by T_2 (146.66 g) and T_3 (93.33 g).Total soluble solids were observed maximum (12%) in fruits of rejuvenated plants in comparison to T_2 and T_3 (11%). The differences in qualitative characters may be due to location of fruits and light distribution within canopy.

Table 4: Effect of rejuvenation pruning and nutrition management on growth flowering and yield of guava cv. Allahabad safeda

Treatment	Avg. tree height (m)	Emergence of new shoots (no.)	Flowering shoots (%)	Yield in kg/tree			Avg. yield kg/tree	% increase in yield	Quality parameter		
				Ist year	IInd year	IIIrd year			No. of fruits/plants	Avg. fruit wt.(g)	TSS (brix^{0})
T_1- Rejuvenated trees	2.0	7.8	39.66	29.00	65.33	96.00	63.44	107.72	305	206.66	12.00
T_2- Unpruned well managed trees	7.4	4.0	24.66	38.66	42.50	51.33	44.16	44.59	300	146.66	11.00
T_3-Farmers practice	7.4	3.15	15.66	35.50	27.30	28.80	30.54	-	330	93.33	11.00

Data related to economic impacts of the study reminisced in Table 5. After conversion of yield in ha (277 plants/ha at 6x6 meter spacing) from per plant, economics of the study was calculated accordingly. Data revealed that the margin (net return) was very poor in rejuvenated plants (₹ 2953/ha) in 2008 than the T_2 (₹ 17544/ha) and farmers practice T_3 (₹ 21167/ha). However, it was found

maximum in T_1 *i.e.* ₹ 56982/ha and ₹ 97690/ha in ensuing years 2009 and 2010 respectively than the T_2 (₹ 23162/ha and ₹35192/ha) and T_3 (₹11352/ha and ₹ 12088/ha). The trend of negative net gain over farmers practice (₹-18234/ha) in rejuvenated plants (T_1) and T_2 (₹-3623/ha) were reported due to increased cost of production in 2008. It is because of higher input cost of heavy pruning of plants and better management practices. The B: C ratio was maximum in farmers practice (1.75) in initial year, while it was too high in rejuvenated plants (2.70 and 3.76) in comparison to T_2 (1.64 and 2.38) and T_3 (1.42 and 1.43) in the year 2009 and 2010 respectively. It might be suggested that the yield loss in first year due to rejuvenation technology can be recovered by sale of pruned wood and better yield from intercrops in pruned orchard having more light and open space. Raising of intercrop like vegetables (potato, cucurbits, turmeric *etc.*) fetched income about ₹ 45000 to 55000/ha.

During the course of study (2007 to 2010), several field days and farmers visits were made by department of Horticulture, Chandauli. Growers with scientific temperament and entrepreneurial orientation appreciated the potential of technology and showed willingness to adopt refinement in technology by way of alternate row pruning. Farmers also appreciated the better management practice followed in T_2 as well.

Table 5: Economic impact of rejuvenation technology on guava production cv. Allahabad safeda

Year	Total yield (q/ha) (@ 277 trees/ha)			Avg. cost of inputs (₹/ha)			Avg. gross return (₹/ha) *					Net return (₹/ha)			Net gain over Farmers practice (₹/ha)		B: C ratio		
	T_1	T_2	T_3	T_1	T_2	T_3	T_1			T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_1	T_2	T_3
							Yield	Pruned wood	Total										
2008	80.33	107.08	98.33	53832	36000	28000	40165	16620	56785	53544	49167	2953	17544	21167	-18234	-3623	1.05	1.48	1.75
2009	180.96	117.72	75.70	33500	35700	26500	90482	-	90482	58862	37852	56982	23162	11352	45630	11810	2.70	1.64	1.42
2010	265.92	142.18	79.77	35270	35900	27800	132960	-	132960	71092	39888	97690	33192	12088	85602	23104	3.76	2.38	1.43

* Sale of commodity @ ₹ 500/q T1- Rejuvenated trees T2 - Unpruned well managed trees T3- Farmers practice

CONCLUSION

The result of On Farm Trial convincingly brought out that rejuvenated trees consistently and significantly produced higher average yield (29.00 to 96.00 kg tree^{-1}) over the farmers practice (35.50 to 28.80 kg tree^{-1}). However, the yield from T_2 was also found consistently in increasing trend (38.66 to 51.33 kg tree^{-1}), but lower than rejuvenated trees. It may be concluded that the success of this technique largely depends upon the proper management of shoots through precise and timely pruning. The constraints experienced by farmers in adoption of technology may be taken under consideration by policy makers to launch a campaign to popularise the technology.

REFERENCES

Burondkar, M.M.; Rajput, J.C. and Waghmare, G.M.2000. Recrrent flowering: A new physiological disorders in 'Alphanso' Mango. *Acta Horticulture*, 509. 669-673.

Compbell, R.J. and Wasielewaski, J. 2000. Mango tree training for the hot tropics. *Acta Horticulture*, 509. 641-651.

Kallo, G.; Reddy, B.M.C.; Singh, G. and Lal, B. 2005. Rejuvenation of old and senile orchard. Pub. CISH, Lucknow, 40p.

Padaria R. N. ; Lal, B. and Pathak, R.K. 2006.Through participatory extension intervention popularizing rejuvenation technology in Mango. *Indian Horticulture*. March-April, pp 4-5.

Singh, H.P.; Singh, G.; Samuel, J. C. and Pathak, R. K.2003. Precision farming in horticulture, NCPAH, DAC, MOA, PFDC, CISH, Lucknow, pp 1-354.

Singh, H.P.; Singh, Gorakh; Samuel S.C. and Pathak, R.K. (Eds.) 2005 NCPAH, DAC, MOA, PFDC, CISH, Lucknow, pp 75-91.