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Adoption of Good Agriculture Practices by Mango Growers

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A B S T R A C T

This study was conducted to know the attitude of the mango growers towards GLOBAL GAP Certification. Study was conducted in Ratnagiri and Sindhudurg districts of Konkan region of Maharashtra state, which contributes nearly 70 per cent area under mango in the state. The Ratnagiri and Sindhudurg districts were purposively selected for the present study, with the objectives of adoption of good agriculture practice. In all, 100 mango growers were selected from two districts. Overall adoption of good agriculture practice by the mango growers had 'medium' level of adoption (64.00 per cent), while 19.00 per cent of the respondents had 'low' level of adoption and 17.00 per cent of the respondents had 'high' level of adoption.

Introduction

In this scenario, the importance of microbial contamination is of major and has been the driving force behind the establishment of the USA Good Agricultural Practices (GAP) policies and surveillance systems. Currently, there are numerous systems that growers can adopt to ensure safe food production, which include amongst others Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Hazard Analysis Critical Control Points (HACCP), Good Hygiene Practices, etc.

One of the GAP systems that have taken off within the European community is GLOBAL GAP. The challenge of globalizing markets is nowhere greater than in the primary food sector. GLOBAL GAP (formerly known as EUREP GAP) has established itself as a key reference for Good Agricultural Practice (GAP) in the global market place, by translating consumer requirements into agricultural production in a rapidly growing list of countries currently more than 100 in each continent.

Apart from Germany and France, most other countries within the EU support this system, as do the major retailers, which consider it the minimum standard for food trade. It is important to note that these global standards will hopefully be harmonized but for the time

being, major retailers will still have their own set of requirements that growers will have to adhere to.

The concept of Good Agricultural Practices may serve as a reference tool for deciding, at each step in the production process, on practices and/or outcomes that are environmentally sustainable and socially acceptable. A multiplicity of Good Agricultural Practices (GAP) codes, standards and regulations have been developed in recent years by the food industry and producers organizations, but also governments and NGOs, aiming to codify agricultural practices at farm level for a range of commodities. Their purpose varies from fulfillment of trade and government regulatory requirements (in particular with regard to food safety and quality), to more specific requirements of specialty or niche markets. The objective of these GAP codes, standards and regulations to a varying degree includes, ensuring safety and quality of produce in the food chain, capturing new market advantages by modifying supply chain governance, improving natural resources use, workers health and working conditions, and/or creating new market opportunities for farmers and exporters in developing countries. Good Agricultural Practices are 'practices that address environmental, economic and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products' (FAO COAG 2003 GAP paper).

These four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability and food safety and quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. The implementation of GAP should therefore contribute to Sustainable Agriculture and Rural Development (SARD).

Good Agricultural Practices are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability. GAP may be applied to a wide range of farming systems and at different scales.

They are applied through sustainable agricultural methods, such as integrated pest management, integrated fertilizer management and conservation agriculture. They rely on four principles:

Economically and efficiently produce sufficient (food security), safe (food safety) and nutritious food (food quality).
Sustain and enhance natural resources.
Maintain viable farming enterprises and contribute to sustainable livelihoods.
Meet cultural and social demands of society.

Adoption of good agriculture practices by mango growers

An enquiry was made with the respondents about their willingness to adopt the good agriculture practices of mango. Based on their total score, they were grouped into three categories of symbolic adoption as shown in Table 1.

It is observed form Table 1 that nearly two-third (64.00 per cent) of the respondents had 'medium' adoption, while 19.00 per cent of the respondents had 'low' level of adoption and 17.00 per cent of the respondents had 'high' level of adoption. The mean adoption score was 70.29.

It can be concluded from these findings that majority of the respondents adopted the good agriculture practices. This may be probably because the respondents might be convinced about the utility of GAP

Practice wise adoption of good agriculture practices by the mango growers

The responses of the respondents about their willingness to adopt practice wise good agriculture practices of mango are summarised in Table 2 (a) to 2 (j).

Good agricultural practices of farm location

The data with regard to the adoption of good agriculture practices of farm location by the mango growers are presented in Table 2 (a).

It is noticed from Table 2 (a) that majority of the respondents had adopted 'prior land use of the farm evaluated for possible sources of chemical, biological or physical contaminants', 'soil analysed for possible heavy metal contamination', 'water analysis or water testing' practices 'completely' and near to cent per cent of the respondents adopted 'completely' practices like 'records of heavy metal analyses from government accredited / recognized laboratories must be kept and made available', while about soil and climatic conditions, cent per cent of the respondents adopted practices like pH of 5.5 – 6.5, flat to slightly rolling terrain, distinct wet and dry climate, temperature between 16-34°C and elevation between 0 to 600 m from sea level.

Good agriculture practices of farm structure and maintenance

The data with regard to the adoption of good agriculture practices of farm structure and maintenance by the mango growers are presented in Table 2 (b).

It is observed from Table 2 (b) that cent per cent (100.00) of the respondents had 'complete' adoption about 'storage and packing areas are kept clean and tidy', 'effective measures are taken to dispense of the trash or waste material on the farm', 'all equipments are associated with cultivation, harvesting and storage of mangoes clean and maintained at optimum operating conditions'. While nearly cent per cent of the respondents had 'complete' adoption about 'farm boundaries are enclosed and demarcated by a fence and the entrance and exit to the farm have gates' and 'adequate areas for waste collection and storage for biodegradable and non-biodegradable wastes are provided'.

Good agriculture practices of cultural management of small plants

The data with regard to the adoption of good agriculture practices of cultural management of small plants by the mango growers are presented in Table 2 (c).

It is observed from Table 2 (c) that about quality planting material cent per cent (100.00 per cent) of the respondents had 'complete' adoption about 'chose planting materials based on resistance to pest, suitability to the site, yield potential and market preference', 'minimum age of the planting material preferably be one year old or at least 1m high' and 'selection of variety', whereas 91.00 per cent of the respondents had 'complete' adoption about that 'record of the source of the planting materials, the number and date of purchase kept in the farm'.

Good agriculture practices of cultural management of young trees

The data with regard to the adoption of good agriculture practices of cultural management of young trees by the mango growers are presented in Table 2 (d).

It is observed from Table 2 (d) that with regards to early pruning about more than half of the respondents 'not adopted' practices like 'tree is about 1 to 2 m height, the terminal

portions are cut/pinched to encourage lateral branching', 'three to four branches are allowed to grow to 1m height', 'second cutting or pruning of terminal portions is done until the branches are evenly distributed', Whereas more than four-fifth (87.00 per cent) of the respondents had 'complete' adoption of 'removal of dead, diseased, infested and damaged branches'.

Good agriculture practices of cultural management of bearing trees

The data with regard to the adoption of good agriculture practices of cultural management of bearing trees by the mango growers are presented in Table 2 (e).

It is noticed from Table 2 (e) that with regards to pruning, it is observed that nearly three-fourth (70.00 per cent) of the respondents had adopted 'completely' 'removal of unnecessary branches such as water sprouts, dried, disease-infected branches and all branches that grow crowding the canopy'. It is observed that more than two-third (70.00 per cent) of the respondents had 'no' adoption of 'pruning done during summer months or dry and warm days'.

Good agriculture practices of integrated pest management

The data with regard to the adoption of good agriculture practices of integrated pest management by the mango growers are presented in Table 2 (f).

It is observed from Table 2 (f) that for ants control cent per cent (100.00 per cent) of the respondents had 'complete' adoption of 'apply insecticides during heavy infestation', while 69.00 per cent of the respondents did not adopt 'prune the mango tree and remove all unnecessary branches that provide favourable environment for ants'.

With regards to management of fruit fly, it is noticed that majority of the respondents had 'complete' adoption of 'use of *'Rakshak'* trap for controlling fruit fly' and 'collect the infested fruits and burry deep into the soil to prevent the insect from completing its life cycle', while 42.00 per cent of the respondents had 'complete' adoption of 'harvest fruits at mature green stage since fruit flies are attracted to them as soon as their surfaces become yellow'. Whereas in case of 'bag the fruits with appropriate bagging materials', 92.00 per cent of the respondents had 'no' adoption of this practice.

Good agriculture practices of integrated disease management

The data with regard to the adoption of good agriculture practices of integrated disease management by the mango growers are presented in Table 2 (g).

It is observed from Table 2 (g) that in case anthracnose disease, all (100.00 per cent) of the respondents had 'complete' adoption of 'spray fungicides for control of anthracnose' and 91.00 per cent of the respondents had 'complete' adoption of 'use spray schedule'.

With regards to powdery mildew, it is observed that more than four-fifth (94.00 per cent) of the respondents had 'complete' adoption of 'use spray schedule'. Whereas, more than four-fifth (83.00 per cent) of the respondents had 'no' adoption of 'use of sulphur smoke'.

Table.1 Distribution of the respondents according to their overall adoption

Sl.No.	Adoption (score)	Respondents (N= 100)	
		Number	Percentage
1.	Low (up to 64)	19	19.00
2.	Medium (65 to 75)	64	64.00
3.	High (76 and above)	17	17.00
Mean- 70.29	**Total**	**100**	**100.00**

Table.2 (a) Distribution of the respondents according to adoption of good agriculture practices of farm location

Sl. No.	Practices	Adoption (N= 100)		
		Complete	Partial	No
1	Prior land use of the farm evaluated for possible sources of chemical, biological or physical contaminants	94 (94.00)	06 (6.00)	--
2	Soil analysed for possible heavy metal contamination	87 (87.00)	13 (13.00)	--
3	Water analysis or Water testing	86 (86.00)	14 (14.00)	--
4	Records of heavy metal analyses from government accredited / recognized laboratories must be kept and made available	95 (95.00)	05 (5.00)	--
	a. Soil characteristics			
	1. pH of 5.5 – 6.5	100 (100.00)	--	--
	2. Flat to slightly rolling terrain	64 (64.00)	36 (36.00)	--
	b. Climatic conditions			
	1. Distinct wet and dry climate	100 (100.00)	--	--
	2. Temperature between 16-34°C	100 (100.00)	--	--
	3. Avoid plant from strong winds and typhoons	44 (44.00)	05 (5.00)	51 (51.00)
	c. Elevation			
	Elevation between 0 to 600m from sea level	100 (100.00)	--	--
5	Farm topography map made available showing the location of crop production sites, windbreakers, water resources, irrigation lines, drainage canals and outlets, roads, buildings, storage facilities and other farm structures	98 (98.00)	02 (2.00)	--

Table.2 (b) Distribution of the respondents according to adoption of good agriculture practices of farm structure and maintenance

Sl. No.	Practices	Adoption (N= 100)		
		Complete	Partial	No
1	Farm boundaries are enclosed and demarcated by a fence and the entrance and exit to the farm have gates	98 (98.00)	02 (2.00)	--
2	Designated areas or facilities for the working shed of workers and separate sheds for farm implements and equipments are available	94 (94.00)	03 (3.00)	03 (3.00)
3	Toilet is provide for the farm workers with proper maintenance	92 (92.00)	08 (8.00)	--
4	Storage and packing areas are kept clean and tidy	100 (100.00)	--	--
5	Litter and waste materials are removed immediately from the crop production area	65 (65.00)	35 (35.00)	--
6	Effective measures are taken to dispense of the trash or waste material on the farm	100 (100.00)	--	--
7	Irrigation system clean and well-maintained to provide effective delivery of clean water, prevent blockage and backflow	73 (73.00)	27 (27.00)	--
8	All equipments are associated with cultivation, harvesting and storage of mangoes are clean and maintained at optimum operating conditions	100 (100.00)	--	--
9	Adequate areas for waste collection and storage for biodegradable and non-biodegradable wastes are provided	95 (95.00)	05 (5.00)	--
10	Domestic and farm animals are excluded from the production site and packing shed during harvesting season	75 (75.00)	25 (25.00)	--

Table.2 (c) Distribution of the respondents according to adoption of good agriculture practices of cultural management of small plants

Sl. No.	Practices	Adoption (N= 100)		
		Complete	Partial	No
A.	**Quality planting materials**			
1	Choose planting materials based on resistance to pest, suitability to the site, yield potential and market preference	100 (100.00)	--	--
2	Record of the source of the planting materials, the number and date of purchase kept in the farm	91 (91.00)	9 (9.00)	--
3	Minimum age of the planting material preferably be one year old or at least 1m high	100 (100.00)	--	--
4	Selection of variety			
	i. Alphonso	100 (100.00)	--	--
	ii. Kesar	--	28 (28.00)	--
	iii. Ratna	--	68 (68.00)	--
	iv. Sindhu	--	18 (18.00)	--
	v. Other- 1. Payri 2. Totapuri 3. Langada	--	28 (28.00)	--
B.	**Land preparation**			
1	For steeper areas, practice minimum tillage around planting place by clearing about 2 sq. m	91 (91.00)	9 (9.00)	--
2	Land preparation is best done before the onset of the rainy season	78 (78.00)	17 (17.00)	5 (5.00)
3	For each plant a pit is dig at least 1x1x1 cu. m.	82 (82.00)	18 (18.00)	--
4	Refill the pit with rich top soil and fully decomposed organic compost at a ratio of 3 parts top soil and 1 part organic compost with minerals	89 (89.00)	11 (11.00)	--
C.	**Design and distance of planting**			
1	Planting design for mangoes square or quincunx	18 (18.00)	20 (20.00)	62 (62.00)
2	Lay-out follow an east-west orientation	19 (19.00)	22 (22.00)	59 (59.00)
3	Contour planting on highly sloping areas	68 (68.00)	24 (24.00)	8 (8.00)
4	Planting distance is 10mx10m 15mx15m	79 (79.00)	17 (17.00)	4 (4.00)

Table.2 (d) Distribution of the respondents according to adoption of good agriculture practices of cultural management of young trees

Sl. No.	Practices	Adoption (N= 100)		
		Complete	Partial	No
A.	**Early pruning**			
1	Pruning is used to reduce the height of trees	29 (29.00)	25 (25.00)	46 (46.00)
2	Tree is about 1 to 2 m height, the terminal portions are cut/pinched to encourage lateral branching	22 (22.00)	27 (27.00)	51 (51.00)
3	Three to four branches are allowed to grow to 1m height	20 (20.00)	22 (22.00)	58 (58.00)
4	Second cutting or pruning of terminal portions is done until the branches are evenly distributed	15 (15.00)	29 (29.00)	56 (56.00)
5	Tree is top-pruned to control the height and for proper development of lateral branching for sunlight penetration, air circulation, and facilitates spraying, bagging and harvesting operations	45 (45.00)	16 (16.00)	39 (39.00)
6	Removal of dead, diseased, infested and damaged branches	87 (87.00)	6 (6.00)	7 (7.00)
B.	**Fertilization management**			
a.	**Use mineral fertilizers**			
1	Agricultural lime, magnesium, wood ash, carbonized rice hull or charcoal as source of carbon, magnesium, phosphorous, potash and other trace mineral elements	19 (19.00)	61 (61.00)	20 (20.00)
b.	**Use organic fertilizers**			
1	Compost, vermiwash, fermented plant and animal extracts with molasses as liquid fertilizer for drench and foliar spray	63 (63.00)	37 (37.00)	--
2	Organic foliar fertilizer for spraying	36 (36.00)	41 (41.00)	23 (23.00)
3	Beneficial Microorganisms for soil improvement	--	--	100 (100.00)
c.	**Use inorganic fertilizers (N,P,K)**			
1	Urea	29 (29.00)	-	71 (71.00)
2	SSP	100 (100.00)	--	--
3	Potash	100 (100.00)	--	--
d.	**Use Micronutrients**			
1	Iron	58 (58.00)	18 (18.00)	24 (24.00)
2	Zinc	71 (71.00)	18 (18.00)	11 (11.00)
3	Boron	71	18	11 (11.00)

		(71.00)	(18.00)	
4	Magnesium	54 (54.00)	22 (22.00)	24 (24.00)
5	Calcium	61 (61.00)	21 (21.00)	18 (18.00)
6	Other 1. 19-19-19 2. 12-32-16 3. 15-15-15	78 (78.00)	13 (13.00)	9 (9.00)
C.	**Irrigation**			
1	Irrigation is done by manual watering	12 (12.00)	16 (16.00)	72 (72.00)
2	Drip method	24 (24.00)	9 (9.00)	67 (67.00)
3	Use fertigation equipment	4 (4.00)	2 (2.00)	94 (94.00)
4	Water plants weekly	5 (5.00)	12 (12.00)	83 (83.00)
5	Use irrigation schedule	--	5 (5.00)	95 (95.00)
D.	**Mulching**			
1	To minimize evaporation, practice mulching using dry leaves or thick layer of rice hull (10-15cm) at the base of the mango tree	58 (58.00)	15 (10.00)	27 (27.00)
2	To prevent growth of weeds and source of organic matter	47 (47.00)	10 (10.00)	43 (43.00)
3	Cultivate and break the soil surface up to 3 inches at the start of the dry season	12 (12.00)	22 (22.00)	66 (66.00)
E.	**Drainage**			
	On sloping area provide shallow drainage between rows of trees to drain out excess rain water	7 (7.00)	9 (9.00)	84 (84.00)
F.	**Inter-cropping**			
1	Area between the rows of mango trees planted with vegetables or legumes	--	--	100 (100.00)
2	In addition, fruit trees such as papaya, pineapple, or banana	--	2 (2.00)	98 (98.00)
G.	**Weed control**			
1	Ring cultivation, about 1m radius from the trunk	63 (63.00)	14 (14.00)	23 (23.00)
2	Inter-row cultivation (plough / tractor/ grass cutter)	--	17 (17.00)	83 (83.00)
3	Cover cropping with leguminous creeping vines	--	--	100 (100.00)
4	Use of herbicides	6 (6.00)	22 (22.00)	72 (72.00)

Table.2 (e) Distribution of the respondents according to adoption of good agriculture practices of cultural management of bearing trees

Sl. No.	Practices	Adoption (N=100)		
		Complete	Partial	No
A.	**Pruning**			
1	Removal of unnecessary branches such as water sprouts, dried, disease-infected branches and all branches that grow crowding the canopy	70 (70.00)	22 (22.00)	8 (8.00)
2	Pruning done during summer months or dry and warm days	19 (19.00)	11 (11.00)	70 (70.00)
B.	**Flower induction**			
1	Prior to spraying or smudging, the leaves of trees are checked for attributes of readiness to flower ie.			
	i. Age of the leaves at least 7 months from flushing	13 (13.00)	26 (26.00)	61 (61.00)
	ii. Leaves are dark green, coppery and brittle	20 (20.00)	35 (35.00)	45 (45.00)
	iii. Buds are prominent and dormant	25 (25.00)	39 (39.00)	36 (36.00)
2	Use flower inducers			
	1. Potassium nitrate (KNO_3)-based flower inducers	3 (3.00)	10 (10.00)	87 (87.00)
	2. Sodium nitrate ($NaNO_3$)	5 (5.00)	8 (8.00)	87 (87.00)
	3. Liquid ammonium nitrate (NH_4NO_3)	4 (4.00)	3 (3.00)	93 (93.00)
	4. Calcium ammonium nitrate ($CaNH_4NO_3$)	9 (9.00)	19 (19.00)	72 (72.00)
	5. Calcium nitrate [$Ca(NO_3)_2$]	9 (9.00)	36 (36.00)	55 (55.00)
	6. Ethylene (Ethryle)	7 (7.00)	34 (34.00)	59 (59.00)
C.	**Flowering and fruit management**			
1	Foliar application of liquid fertilizer at 18-25 days after flower induction (DAFI)	23 (23.00)	33 (33.00)	44 (44.00)
2	Pollinating insects like blue flies & bees are encouraged by avoiding spraying of pesticides during full bloom	17 (17.00)	57 (57.00)	26 (26.00)
3	Five percent (5%) sugar or honey solution is sprayed as spot application to attract pollinators during full bloom	--	13 (13.00)	87 (87.00)
4	Branches can be shaken after a rain or early in the morning during blooming to remove flowers affected by disease	--	40 (40.00)	60 (60.00)
5	Trees are irrigated weekly, during summer dry months approximately 100-300L of water per tree per week	--	12 (12.00)	88 (88.00)
6	Bagging is done at 55 to 60 DAFI	--	8 (8.00)	92 (92.00)

Table.2 (f) Distribution of the respondents according to adoption of good agriculture practices of integrated pest management

Sl. No.	Practices	Adoption (N=100)		
		Complete	Partial	No
a.	**Ants**			
1	Prune the mango tree and remove all unnecessary branches that provide favourable environment for ants	16 (16.00)	15 (15.00)	69 (69.00)
2	Apply insecticides during heavy infestation	100 (100.00)	--	--
b.	**Fruit fly**			
1	Collect the infested fruits and burry deep into the soil to prevent the insect from completing its life cycle	70 (70.00)	16 (16.00)	14 (14.00)
2	Bag the fruits with appropriate bagging materials	--	8 (8.00)	92 (92.00)
3	Use 'Rakshak' traps	80 (80.00)	13 (13.00)	7 (7.00)
4	Harvest fruits at mature green stage since fruit flies are attracted to them as soon as their surfaces become yellow	42 (42.00)	7 (7.00)	51 (51.00)
c.	**Mango thrips**			
1	Prune or cut off excess branches to improve aeration and to allow more light	16 (16.00)	10 (10.00)	74 (74.00)
2	Spray registered insecticides as a fine mist	100 (100.00)	--	--
d.	**Mango leafhopper**			
1	Light trapping before flower induction to reduce initial leaf hopper population	8 (8.00)	2 (2.00)	90 (90.00)
2	Use of insecticides	100 (100.00)	--	--
3	Avoid excessive application of fungicides to conserve beneficial fungi that attack the leafhopper	50 (50.00)	47 (47.00)	3 (3.00)
4	Apply insecticides only when there are at least three leafhoppers per panicle	67 (67.00)	23 (23.00)	10 (10.00)

Table.2 (g) Distribution of the respondents according to adoption of good agriculture practices of integrated disease management

Sl. No.	Practices	Adoption (N=100)		
		Complete	Partial	No
A.	**Anthracnose**			
1	Spray fungicides	100 (100.00)	--	--
2	Use spray schedule	91 (91.00)	7 (7.00)	2 (2.00)
B.	**Powdery Mildew**			
1	Use spray schedule	94 (94.00)	4 (4.00)	2 (2.00)
2	Use of sulphur smoke	12 (12.00)	5 (5.00)	83 (83.00)

Table.2 (h) Distribution of the respondents according to adoption of good agriculture practices of pesticide management

Sl. No.	Practices	Adoption (N=100)		
		Complete	Partial	No
A.	**Good Agricultural Practices (GAP) pertaining to the use of pesticides:**			
1	Use registered pesticides	100 (100.00)	--	--
2	Read and follow the labelled instructions	--	--	--
	a. Product information			
	i. Active ingredient(s)	100 (100.00)	--	--
	ii. Solvent	100 (100.00)	--	--
	b. Directions for use			
	i. Crops	98 (98.00)	2 (2.00)	--
	ii. Target pests	100 (100.00)	--	--
	iii. Dosage, frequency and timing of application	100 (100.00)	--	--
	iv. Pre-cautionary measures	98 (98.00)	2 (2.00)	--
	v. Storage and disposal	91 (91.00)	9 (9.00)	--
3	First aid and medical treatment in case of poisoning	83 (83.00)	17 (17.00)	--
4	Emergency contact number	100 (100.00)	--	--
B.	**Good agriculture practices for the proper use and handling before mixing**			
a.	**Before mixing**			
1	Keep spraying equipment in good condition	100 (100.00)	--	--
2	Check sprayer for defects	100 (100.00)	--	--
3	Maintain a record of maintenance check-up of spraying equipment	96 (96.00)	--	4 (4.00)
4	Clean the nozzles with water or a soft-probing device	100 (100.00)	--	--
5	Use of appropriate personal protective equipment (PPEs) used, read the product label	100 (100.00)	--	--
b.	**During mixing**			
1	Use a measuring cup or graduated cylinder in measuring the concentrated formulated pesticide	100 (100.00)	--	--
2	Use clean water for mixing pesticides to avoid microbial contamination of the mango fruits	100 (100.00)	--	--
3	Contents of the pesticide bottle are used up, rinse the bottle 3 times with water and pour into the last sprayer tank load	100 (100.00)	--	--
4	Use appropriate gloves to minimize dermal exposure	87 (87.00)	13 (13.00)	--
c.	**During application**			
1	Wear the necessary protection cloths i.e. cover nose and mouth, wear long-sleeved shirts and long pants	95 (95.00)	5 (5.00)	--
2	Spray when wind is slow	82	18 (18.00)	--

		(82.00)		
3	Spray inner canopy first before spraying the outer canopy	100 (100.00)	--	--
4	Use a power sprayer with an extended boom	100 (100.00)	--	--
5	Maintain a record of spray application indicating information of pesticide used, volume used, area sprayed, and operator	95 (95.00)	5 (5.00)	--
d.	**After spraying**			
1	Clean spray equipment by flushing the remaining pesticide solution using detergent and clean water	100 (100.00)	--	--
2	Dispose contaminated water or rinsed outside the waterways	100 (100.00)	--	--
3	Change working clothes immediately after spraying	100 (100.00)	--	--
4	Wash your hands with soap and water	100 (100.00)	--	--
5	Soak clothes in water and detergent	100 (100.00)	--	--
C.	**Good agriculture practices for storage and disposal**			
a.	**Storage**			
1	Store pesticides in their original labelled containers	97 (97.00)	3 (3.00)	--
2	Keep pesticides locked in a storeroom and out of children's reach	100 (100.00)	--	--
3	Keep pesticides away from fire or open flame, stove or lamps	100 (100.00)	--	--
4	Partially used pesticide bottles must be placed inside a thick plastic bag to avoid hand contamination	100 (100.00)	--	--
b.	**Disposal**			
1	Dispose of empty pesticide bottles and cartons into a pesticide disposal pit	100 (100.00)	--	--
2	Dig disposal pit in an area away from people and animals, and far from water sources	100 (100.00)	--	--
D.	**Good agricultural practices of insect resistance management**			
1	Use products according to the recommended dosage	100 (100.00)	--	--
2	Use appropriate, well-maintained equipment to apply insecticides / fungicides	100 (100.00)	--	--
3	Use recommended water volume and spray pressure in order to obtain optimal coverage of the canopy	100 (100.00)	--	--
4	Target the pests at their vulnerable stage, (young instars, larvae) where possible	100 (100.00)	--	--
5	Use appropriate economic thresholds level and spray intervals	100 (100.00)	--	--
6	Use alternately products of different modes of action or from different chemical groups	100 (100.00)	--	--
7	Mix different pesticides	84 (84.00)	12 (12.00)	4 (4.00)

Table.2 (i) Distribution of the respondents according to adoption of good agriculture practices of harvesting and post-harvesting management technology

Sl. No.	Practices	Adoption (N=100)		
		Complete	Partial	No
A.	**Maturity indices**			
1	Fruits harvested upon reaching maturity of 105-115 DAFI (late flower induction – January, February, March)	53 (53.00)	33 (33.00)	14 (14.00)
2	120-130 DAFI (early induction - October, November, December).	53 (53.00)	31 (31.00)	16 (16.00)
3	Flattening or expansion of shoulders	92 (92.00)	08 (8.00)	--
4	Presence of "bloom" or powdery deposit on the fruit	58 (58.00)	11 (11.00)	31 (31.00)
5	Yellow green colour near pedicel	30 (30.00)	08 (8.00)	62 (62.00)
6	Floatation of fruits in 1% salt solution (100g salt/10L of water)	--	4 (4.00)	96 (96.00)
7	Use physical method	48 (48.00)	38 (38.00)	14 (14.00)
B.	**Harvesting**			
1	Harvesters must wash their hands before harvesting	70 (70.00)	11 (11.00)	19 (19.00)
2	Good personal hygiene practice to avoid cross-contamination of the produce	81 (81.00)	19 (19.00)	--
3	Fruits harvested between 9:00 am and 3:00 pm for lesser latex flow	50 (50.00)	34 (34.00)	16 (16.00)
4	Leave about 2.0 cm pedicel on the fruit to minimize latex flow which may burn the fruit	100 (100.00)	--	--
5	Minimize damage and contamination of fruits with soil, pathogens, fertilizers or other agro-chemicals	89 (89.00)	11 (11.00)	--
6	Harvested fruits kept away from direct sunlight and brought immediately to the shade or packing house for sorting and other post-harvest activities	100 (100.00)	--	--
7	Harvesting crates/containers (e.g. bamboo baskets, stackable plastic crates, etc.) regularly cleaned and maintained	100 (100.00)	--	--
8	Containers of harvested fruits clearly identified with names or codes containing date of harvest, time, block number, volume and name of harvester/farmer	98 (98.00)	02 (2.00)	--
C.	**Post-harvest handling**			
1	Harvested fruits sorted/packed on-farm or transported to a common packinghouse facility	100 (100.00)	--	--
2	Fruits to be sorted out and placed on paper in packinghouse to avoid cross-contamination of the produce	100 (100.00)	--	--
3	Sorters/packers wash their hands with soap or detergent before handling the produce	100 (100.00)	--	--

4	For packinghouse facilities, the packing room separated from toilet facilities and kept clean, tidy, well ventilated and free of foul smell at all times	100 (100.00)	--	--
5	Mangoes sorted according to size and quality	100 (100.00)	--	--
6	Sorted and graded mangoes should be inspected and trimmed of stems connected to the fruits	100 (100.00)	--	--
7	Fruits washed clean with a mixture of potable water and mild soap	100 (100.00)	--	--
D.	**Post-harvest treatments:**			
a.	**Hot water treatment (HWT)**			
1	Newly harvested fruits are dipped in warm water (about 52-55°C) for about 10 min	--	--	--
2	Fruits are then rinsed in cool running water for 10 min (hydro-cooling), air-dried and packed	--	--	--
b.	**Rapid hot water treatment**			
	Fruits are submerged in hot water (60°C) for 30 sec to one (1) min	--	--	--
c.	**Extendedhot water treatment**			
1	Fruits are submerged in hot water (46 or 47°C) for two (2) hours	--	--	--
2	Temperature is maintained for 15 min at 46°C or 10 min at 47°C	--	--	--
3	Fruits are then allowed to cool by air-drying	--	--	--
d.	**Vapour heat treatment**			
	Fruits are heated in a chamber with vapour-saturated air until the pulp reaches a temperature of 46°C which is maintained for 10 min	--	--	--
e.	**Packaging**			
1	Mangoes sorted, washed and subjected to post-harvest treatment(s) are then packed in suitable packaging containers	98 (98.00)	02 (2.00)	--
2	Each packaging container clearly labelled with the following information			
	i. Mango grower's accreditation code	100 (100.00)	--	--
	ii. Name of commodity	100 (100.00)	--	--
	iii. Net weight	100 (100.00)	--	--
	iv. Batch number and date of packing	100 (100.00)	--	--
	v. Name of Plant Quarantine Service (PQS) signing officer	14 (14.00)	--	86 (86.00)
	vi. Name of brand (Ratnagiri Hapus)	100 (100.00)	--	--
f.	**Storage facilities for fruits**			
1	Storage facilities sanitized and free from decaying plant waste and foul smell	74 (74.00)	05 (5.00)	21 (21.00)
2	Packed mangoes stored in a cold room (temperature 12-14°C; relative humidity 85-95%) immediately after packing	43 (43.00)	05 (5.00)	52 (52.00)
3	Cooling equipment cleaned and inspected frequently	45 (45.00)	03 (3.00)	52 (52.00)

Table.2 (j) Distribution of the respondents according to adoption of good agriculture practices of farm management

Sl. No.	Practices	Adoption (N=100)		
		Complete	Partial	No
1	All records updated and kept up to two years	73 (73.00)	27 (27.00)	--
2	Copies of laboratory analysis and certificates that verify compliance with this code must be filed	90 (90.00)	10 (10.00)	--
3	Records of lot number must be maintained for all produce leaving the farm	97 (97.00)	03 (3.00)	--
4	Staff training records also be maintained	78 (78.00)	04 (4.00)	18 (18.00)
5	First aid kit available on farm	100 (100.00)	--	--
6	Record of orchard/field /plot/number	100 (100.00)	--	--
7	Records of application of pesticides or insecticides	100 (100.00)	--	--
8	Location, date of application, trained person assigned and maintenance properly recorded	98 (98.00)	02 (2.00)	--

Good agriculture practices of pesticide management

The data with regard to the adoption of good agriculture practices of pesticide management by the mango growers are presented in Table 2 (h).

It is revealed from Table 2 (h) that among the good agriculture practices of pesticide management, cent per cent (100.00 per cent) of the respondents had 'complete' adoption of 'use registered pesticides' and 'read and follow the label instructions' in case 'product information' i.e. active ingredients and solvent. In case directions for use, it is observed that near to cent per cent or cent per cent of the respondents had 'complete' adoption of 'crops', 'target pest' and 'dosage, frequency and timing of application', 'pre-cautionary measures' and 'storage and disposal'. Whereas, 'first aid and medical treatment in case of poisoning' (83.00 per cent) and 'emergency contact number' (100.00 per cent) had 'complete' adoption.

Good agriculture practices of harvesting and post-harvesting management technology

The data with regard to the adoption of good agriculture practices of harvesting and post-harvesting management technology by the mango growers are presented in Table 2 (i).

It is noticed from Table 2 (i) that with regards to maturity indices, more than four-fifth (92.00 per cent) of the respondents had adopted 'flattening or expansion of shoulders' 'completely', whereas majority of the respondents had adopted 'fruits harvested upon reaching maturity of 105-115 DAFI (late flower induction – January, February, March)' 'completely', '120-130 DAFI (early induction - October, November, December)', 'presence of "bloom" or powdery deposit on the fruit' and 'use physical method'. Whereas it is observed that more than three-fifth (62.00 per cent) of the respondents did not adopt 'yellow green colour near pedicel' practice and more than four-fifth (96.00 per cent) of

the respondents did not adopt 'floatation of fruits in 1% salt solution (100g salt/10L of water)'.

Good agriculture practices of farm management

The data with regard to the adoption of good agriculture practices of farm management by the mango growers are presented in Table 2 (j).

It is noticed from Table 2 (j) that near to cent per cent and cent per cent of the respondents had 'completely' adopted 'first aid kit available on farm', 'record of orchard/field /plot/number' and 'records of application of pesticides or insecticides', 'location, date of application and a trained person assigned and maintenance properly recorded' and 'records of lot number must be maintained for all produce leaving the farm'. Whereas, majority of the respondents had 'completely' adopted practice 'copies of laboratory analysis and certificates that verify compliance with this code must be filed', 'all records updated and kept up to two years' and 'staff training records also be maintained'

In conclusion mango has become a cash crop for the farmers of the Konkan region. Efforts are being made at different levels to maximize the area, production and productivity of mango in Konkan region. The GLOBAL GAP standard is primarily designed to reassure the consumers about how food is produced on the farm by minimizing detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to worker health and safety, as well as, animal welfare. GAP is a series of principles, rules and technical recommendations, with the aim of providing a safe product for direct consumption or industrial processing. Considering the scope and opportunity in the world market, there is a need to give importance to quality assurance of mango fruits. So also, there is a need to keep quality, hygienic conditions and standard residue control, so that the fruits qualify all analytical tests. The findings of the study pertaining to personal, socio-economic, communicational and psychological characteristics of the mango growers may help the agricultural development agencies to identify the prospective mango growers and to plan out strategy to speed up the adoption of GAP in mango cultivation. The study pointed out that the mango growers had differential attitude about GAP certification for mango. The concerned organizations and personnel need to intensify the efforts in that direction. It also suggests that only possessing favourable attitude about GAP certification is not enough to promote adoption and induce positive perception about GAP among the mango growers. But, it is necessary to give the actual experience with hands on training, support of Government for certification and provide them services to practice GAP at their field condition.

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