ISSN: 2581-3749 (online) Advanced Agricultural Research & Technology Journal ▪ Vol. II ▪ Issue 2 ▪ JULY 2018

Low Cost Ripening Chamber - A Technology for Marginal Mango-Growers

K. H. Pujari*[1], P. P. Relekar [1], M. S. Shedge [1], V. K. Patil[2], A. D. Rane[2], P. M. Haldankar[3] and T. Bhattacharyya[3]

[1]Post Graduate Institute of Post Harvest Management, Roha, Raigad, Maharashtra (India) 402116
[2]College of Forestry (DBSKKV), Dapoli, Maharashtra (India) 415712
[3]Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (India) 415712

Abstract

Being a climacteric fruit, artificial ripening of mangoes has a great importance especially in marketing and export of mango fruits. General aim of early ripening of mango is to increase the respiration rate which helps to prepare the mango fruits for early marketing so that the mango growers would fetch higher prices. The ripening chamber developed by the Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli would be the effective technology for uniform ripening of mango cv. Alphonso at low cost and thereby helping in the doubling the farmer's income.

Keywords: Ripening, mango, Doubling Farmers' Income, DFI.

Introduction

Mango (*Mangifera indica* L.) a member of family, anacardiaceae is universally accepted as the finest tropical fruit of the world and is the 5th widely produced fruit crops of the tropics. Owing to its nutritional richness, unique taste and flavour, religious and medicinal importance, mango is rightly called 'National Fruit of India'. Mango is currently being grown in more than 111 countries spread over five continents in current FAO statistics. World scenario indicates that mango is grown on an area of 5.36 m ha with total annual production of 42.41 m Mt and average productivity is 7.9 tonnes ha^{-1}. (Anon. 2013). India ranks first in the world with total mango production of 18.00 m Mt from about 2.5 m ha area, and productivity is 7.2 tonnes ha^{-1}. In India, mango crop occupies 35.8% of total fruit crop area and 22.1% of total fruit crop production.

***Corresponding author**: khpujari@gmail.com
Received Date: 1.11.2017; Accepted Date: 20.3.2018

In Maharashtra state, currently mango crop is occupying the area of 4.82 lakh ha which is 19.28% of total area with a total production of over 6.33 lakh tonnes (3.5%) of country's mango production (Anon. 2013). Konkan is the major and famous Alphonso mango producing region on the west coast of Maharashtra, crop occupying the area of 1.80 lakh ha which is 7.2% of total area in country. Ratnagiri and Sindhudurg districts are mango baskets of Maharashtra. Almost 80% per cent area is covered by the single cultivar i.e. Alphonso which is locally called as '*Hapus*'.

India exports mango and mango based products to more than 80 countries, so it is an important foreign exchange earner, with an earning of ₹ 26,472 lakh from export of 55,585 Mt of fresh fruits and ₹ 60,856 million from the export of 1,47,816 Mt of mango pulp in year 2013 (Anon. 2013).

Ripening is a complex physiological process resulting into changes in softening, colouring, and sweetening; increases the aroma compounds so that the fruits become ready to eat. The ripening process is influenced by different factors such as temperature, humidity, ethylene production and exposure period to these environmental conditions. An increase in the temperature significantly increases the rate of respiration and total carotenoids in pulp. Increased ripening temperature up to 30 °C also increases ethylene production in fruit (Lalel 2004).

Being a climacteric fruit, artificial ripening of mangoes has a great importance especially in export of mangoes. General aim of early ripening of mango is to increase the respiration rate which helps in preparation of mango for early marketing so that the mango growers would fetch higher prices and thus help in the doubling the farmer's income.

Ethylene is a natural plant hormone that regulates the fruit ripening process (Jobling 2000). Exposure of unripe fruit to a lower dose of ethylene is sufficient to stimulate the natural ripening process until the fruit itself

starts producing ethylene in large quantities. These days' artificial fruit ripening has become a common practice (Siddiqui and Dhua 2009).

The different kinds of ethylene ripening rooms such as lock sock, NTH model, side curtain type, air bag system, tarped model, cold room or cold store, etc are used globally for ripening of fruits on large scale. In these ripening units, the fruit ripening is carried out under controlled conditions and technology for ethylene, temperature and relative humidity with uniform air flow circulation system, proper ventilation systems, exhaust fans for CO_2 emission and monitoring and control system and display devices. However, these sophisticated ripening chambers are very expensive and not suitable for ripening of fruits on small scale. Hence, a low cost ripening chamber has been developed by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth (DBSKKV), Dapoli for ripening of fruits especially mango and banana for small farmers.

Technological intervention

The details of the technology developed by DBSKKV, Dapoli for doubling the farmer's income are as given below.

Design of the Fruit Ripening Chamber

The ripening chamber developed is a collapsible plastic chamber of polypropelene with a dimension of 7 ft x 7 ft x 7 in. The ripening chamber has a capacity to hold and ripen 500 to 700 kg of mango/banana fruits. It is supported by a framework of 1.5 in PVC pipes with a thickness of 0.33 mm. The silpaulin plastic makes the ripening chamber airtight. The chamber has four outlets at the base of the four corners of chamber which are closed tightly with a plastic string and are released manually as and when required to have a ventilating effect in the ripening room. The chamber has a plastic door opening provided with a zip for closing and making the chamber airtight.

Methodology

Initially, a layer of empty plastic crates is arranged in inverted position in the ripening chamber. A second layer of crates filled with freshly harvested mature mango fruits or banana hands is arranged over the first layer of empty crates. Likewise, two to three layers of plastic crates with fruits are made one over the other. Ethylene Gas @ 100 ppm per 500 to 700 kg fruits is then flushed into the chamber through one of the outlets provided at the base of the chamber and the fruits are allowed to ripen inside the chamber. The humidity inside the chamber can be maintained above 85 per cent by keeping double layer of moist cotton cloth on plastic pipes inside the chamber. The fruits are removed after exposure period of 12 -24 hrs to the ethylene gas, packed in the CFB boxes without paddy straw. The treated fruits ripen within 3 to 4 days depending upon the type of the fruit and its maturity.

Research output

A trial was conducted to study the effect of the low cost ripening chamber on the ripening behaviour and quality

Table 1. Effect of low cost ripening chamber on number of days for ripening , TSS and acidity of mango fruits Cv. Alphonso

Treatments	Number of days		Pooled mean (days)	TSS (^{0}B)		Pooled mean (days)	Acidity (%)		Pooled mean (days)
	2008-09	2009-10		2008-09	2009-10		2008-09	2009-10	
T_1	6.67	7.00	6.83	16.07	16.20	16.13	0.24	0.27	0.24
T_2	6.33	6.33	6.33	16.13	15.47	15.80	0.25	0.25	0.25
T_3	6.33	6.33	6.33	16.27	15.73	16.00	0.24	0.26	0.24
T_4	6.00	6.33	6.17	16.33	15.87	16.10	0.27	0.26	0.27
T_5	5.33	5.33	5.33	16.17	16.20	16.18	0.26	0.27	0.26
T_6	9.00	8.67	8.83	15.87	15.47	15.67	0.25	0.25	0.25
T_7	13.33	13.00	13.17	15.93	15.53	15.73	0.29	0.28	0.29
SE ±	0.20	0.20	0.14	0.12	0.16	0.11	0.01	0.01	0.01
CD at 1 %	0.83	0.83	0.59	--	--	--	--	--	--
Results	SIG	SIG	SIG	NS	NS	NS	NS	NS	NS

of mango Cv. Alphonso.

The pooled data presented in the Table 1 to 3 indicate that there was no significant difference observed between fruits ripened in low cost ripening chamber and control fruits with respect to TSS, acidity, total sugars, ascorbic acid and organoleptic qualities of mango fruits cv. Alphonso. However, there was a significant difference for the period of ripening of mango fruits. The mango fruits kept in low cost ripening chamber ripened within 6 to 7 days earlier than control and 2 to 3 days earlier than ethylene treated fruits. The cost of ripening is 36 paise per kg of fruits.

Table 2. Effect of low cost ripening chamber on total sugars and ascorbic acid content of mango fruits Cv. Alphonso (**T_1**- Ethylene 100 ppm, mango kept for 24 hrs. T_2- Ethylene 100 ppm, mango kept for 48 hrs. T_3- Ethylene 100 ppm, mango kept for 72 hrs. T_4- Ethylene 100 ppm, mango kept for 96 hrs. T_5- Ethylene 100 ppm, mango kept for 120 hrs. T_6- Ethrel deep (Ethylene 100 ppm for 5 min.) T_7- Control)

Treatments	Total sugars (%)		Pooled mean (days)	Ascorbic acid (mg 100 g^{-1})		Pooled mean (days)
	2008-09	2009-10		2008-09	2009-10	
T_1	34.96	34.62	34.79	34.96	34.62	34.79
T_2	34.93	33.93	34.43	34.93	33.93	34.43
T_3	34.64	34.83	34.73	34.64	34.83	34.73
T_4	33.79	34.74	34.27	33.79	34.74	34.27
T_5	34.89	35.51	35.20	34.89	35.51	35.20
T_6	35.85	35.73	35.79	35.85	35.73	35.79
T_7	33.69	34.46	34.08	33.69	34.46	34.08
SE ±	0.45	0.38	0.37	0.45	0.38	0.37
CD at 1 %	--	--	--	--	--	--
Results	NS	NS	NS	NS	NS	NS

Table 3. Sensory Evaluation (Colour, Flavour, Texture) of mango fruits Cv. Alphonso treated in low cost ripening chamber

Treatments	Sensory evaluation									Overall mean
	Colour			Flavour			Texture			
	2008-09	2009-10	Pooled mean	2008-09	2009-10	Pooled mean	2008-09	2009-10	Pooled mean	
T_1	7.67	8.17	7.92	7.17	8.17	7.67	7.50	8.17	7.83	7.81
T_2	7.67	8.00	7.83	7.17	7.17	7.17	7.50	7.50	7.50	7.50
T_3	8.17	8.17	8.17	7.17	7.33	7.25	7.00	7.67	7.33	7.58
T_4	7.67	8.17	7.92	7.17	7.83	7.50	7.17	7.83	7.50	7.64
T_5	7.83	8.00	7.92	7.50	7.67	7.58	7.00	7.50	7.25	7.58
T_6	7.67	8.00	7.83	7.33	7.67	7.50	7.17	7.67	7.42	7.58
T_7	7.67	8.00	7.83	7.33	7.33	7.33	7.17	7.50	7.33	7.50
SE ±	0.16	0.18	0.10	0.30	0.20	0.14	0.29	0.13	0.13	
CD at 1 %	--	--	--	--	--	--	--	--	--	
Results	NS	NS	NS	NS	NS	NS	NS	NS	NS	

Hence, the low cost ripening chamber is suitable for early ripening of mango cv. Alphonso fruits and the technology is economically viable.

The essential requirements of low cost ethylene ripening system are

- A reasonably air tight condition during exposure to ethylene gas
- Flushing of recommended concentration of the ethylene gas
- Opening of the outlet to ensure better ventilation depending upon the exposure period
- Proper humidity level inside the chamber

Features of low cost ethylene ripening system

- The low cost ripening chamber has been recommended by DBSKKV during the year 2010 for quality and early ripening of mango fruits.
- It is observed that the mango cv. Alphonso fruits treated with 100 ppm ethylene gas in the ripening chamber ripened 6 to 7 days earlier than the conventional ripening method and 2 – 3 days earlier than the ethrel treated fruits.
- Ripening chamber is easily collapsible and portable.
- Cost of ripening chamber is ₹ 4500 only
- Cost of ripening of mango fruits is ₹ 0.36 kg^{-1}.

Economics of the low cost ethylene ripening system

A. Cost of ripening chamber:

1. Cost of silpaulin : ₹ 3000
2. Cost of PVC framework : ₹ 1500

Total: ₹ 4500

B. Recurring cost: which is recurring cost is for ripening of every 500-700 kg fruits

1. Cost of ethylene gas cylinder (100 ppm): ₹ 150 per cylinder

Total: ₹ 150

Impact of technology

The demonstrations of low cost ripening chamber were carried out at different research stations *viz* Regional Fruit Research Station, Vengurle; Mango Research Sstation, Rameshwar; Agricultural Research Station, Mulde and Central Experimentation Station, Wakawali and it was observed that about 94 per cent mango fruits ripened properly and only 6 per cent of the fruits were spoiled during ripening, indicatiing effective technology for artificial ripening of mango cv. Alphonso.

This technology has been developed for the small scale farmers who cannot afford the huge investment in commercial automated ripening chambers for ripening of mango fruits. A series of demonstrations have been organized to disseminate the technology among the mango growers in Deogad, Lanja, Rajapur, Malvan, Ratnagiri and Vengurle area of the Konkan region where world famous Alphonso mango is grown on large scale. Besides this, demonstrations have also been arranged in Pune, Rahuri, Satara, Nigose for mango as well as banana growers and more than 10,000 farmers attended these demonstrations. Moreover the farmers from Gujarat and Karnataka States also visited DBSKKV, Dapoli to get the technical knowhow of the fruit ripening chamber. At present, about 25-30 farmers are adopting this technology for ripening of mango fruits in Maharashtra.

Way Forward

- Extension work in terms of On-farm demonstrations for transfer of technology
- Need to develop low cost mechanism to maintain the optimum temperature and humidity inside the chamber

References

Anonymous 2010. USDA National Nutrients Database for standard Reference, Release. 23.

Anonymous 2013. National Horticulture Board, Govt. of India, Database file. pp. 229.

Jobling J. 2000. Post Harvest Ethylene: A critical factor in quality management. Sydney Post Harvest Information sheet, pp 1-4.

Lalel H. J. and Singh, Z. 2004. Biosynthesis of aroma volatile compounds and fatty acids in 'Kensington Pride' mangoes after storage in a controlled atmosphere at different oxygen and carbon dioxide concentrations. J. Hort. Sci. Biotechnol. 79: 343-353

Siddiqui Md. W. and Dhua R. S. 2009. Standardization of ethrel treatment for inducing ripening of mango Var. Himsagar. Inter. Confer. Hort. 21: 1641-146.