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Operation Manual of Mechanical Harvesting, Treating and Packaging of Mango











Farm Machinery and Postharvest Process Engineering Division Bangladesh Agricultural Research Institute Joydebpur, Gazipur 1701, Bangladesh Operation Manual of Mechanical Harvesting, Treating and Packaging of Mango











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Operation Manual of Mechanical Harvesting, Treating and Packaging of Mango

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Preface

Mango is called the king of fruits in Bangladesh. Its annual production is 1.0 million ton with an area of 0.035 million hectares. Mango is a perishable commodity which gets spoiled within a couple of days after harvest because of its high moisture content. A huge quantity of the fruit is lost every year after harvest which results in significant economic and nutritional losses. These losses are known as postharvest losses which occur at different stages in the chain of harvesting, handling, packaging, transportation, storage and marketing. At maturity, the mango contains corrosive latex which should be removed quickly by appropriate measures (for example, by using BARI delatexing rack). Anthracnose and stem end rot diseases cause significant postharvest losses of mango which can be controlled by different methods such as chemical, fumigation, radiation and heat treatment. Hot water treatment is an effective heat treatment technology which is simple and nonchemical technique that can kill quarantine pests (insect and fungi) of perishable commodities and also controls some postharvest diseases. It also increases the shelf-life of mango and develops attractive colour. Mango harvester, delatexing rack, hot water treatment plant and multipurpose plastic crate and CFB carton are becoming popular among the farmers and traders of Bangladesh day by day. Now a days, most of the consumers are aware of food quality and safety issues and are ready to pay a higher price for safe and fresh fruits.

I am very pleased that FMPE Division of BARI has taken a step to prepare "Operation Manual of Mechanical Harvesting, Treating and Packaging of Mango" for making awareness and capacity building of the farmers, traders and exporters. This initiative is very encouraging step to reduce postharvest losses of mango, save money, time and drudgery. Finally it will help boosting mango production and getting safe and fresh products. This manual is very useful for farmers, traders, exporters, scientists, students, teachers and users. Users can achieve knowledge about mango harvester, delatexing rack, packaging, hot water treatment machine.

I wish to extend my deepest and heartfelt gratitude to the authors and concern scientists of the FMPE Division for publication of this useful manual.

(Dr. Abul Kalam Azad)

Foreword

More than 60 varieties of fruits are being grown in Bangladesh at different locations. Major fruits of the country include mango, banana, papaya, jackfruit, pineapple, guava, etc. Among the major fruits mango has the most intense seasonality. Postharvest loss of mango is very high during harvesting, handling, transportation and packaging. Both the qualitative and quantitative losses of mango occurr due to lack of proper harvesting, handling, treatment, transportation and packaging measures. Major loss of mango is found due to anthracnose and stem end rot diseases. BARI has developed a number of machinery and technologies such as mango harvester, delatexing rack, hot water treatment plant (non-chemical method), and packaging for mango to reduce postharvest losses and extend the shelf-life while also developing attractive colour of the mangoes. They are very important technologies for harvesting, delatexing, treating and packaging to make safe and fresh food. These technologies would be disseminated among the exporters, traders, farmers and entrepreneurs. This manual is an attempt, to introduce the technologies, make awareness and build up skillness on operational procedure, repair-maintenance, solve the problems instantly. BARI hot water treatment plant is a simple and fabricated it with MS (mild steel) or SS (stainless steel) in a local workshop. Two sizes of hot water treatment plants are made available -the small one has a capacity of 500 kg/h and the large one 1000 kg/h. It is, therefore, of the utmost importance and necessity that the farmers/trader's organizations get exposed to the modern treatment technologies and operational techniques.

This "Operation Manual of Mechanical Harvesting, Treating and Packaging of Mango" is a modest attempt in that direction and specifically deals with mango harvester, delatexing rack, hot water treatment machine and packaging. The goal is to bring in qualitative transformation in mango production. So that farmers/traders get benefitted and country earns more foreign exchange through increased export.

This document is first of its kind Bangladesh. It is not unlikely that there may have some errors in the document. Any comments or suggestions on the contents of this manual would be highly appreciated for further improvement of the manual in future.

The Authors

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Background

There are various fruits grown throughout Bangladesh. Its annual production is about 3.5 million tons. Mango production was 1.0 million tons on an area 0.035 million hectare (BBS, 2015). Mango (Mangifera indica L.) is a very popular fruit in the country is the second most important fruit. Most of the people like mango for its taste, flavour and colour. Fresh matured mangoes are started ripening after harvesting due to climacteric nature. Magnitude of postharvest losses estimated in fresh fruits and vegetables range from 5 to 25% in developed countries, and 20 to 50% in developing countries, and while it is 50% in India. Postharvest losses in tropical fruits vary widely from 10 to 80% in both developed and developing countries. In Bangladesh, Meah (1990) estimated 10.2% loss of mango due to Anthracnose and Diplodia stem end rot disease. Azad (2000) stated that 27% postharvest losses of mangoes were due to improper harvesting, treating, handling and packaging. Mango harvester, delatexing rack, hot water treatment plant and packaging technologies would be used for reducing postharvest loss of mangoes.

The shelf life of matured mango is about 7-8 days. After harvesting the fruit is infected by different diseases and insects. Hot water treatment is regarded as an effective technology to reduce postharvest losses as much as to increase shelf-life of mango. If improved mango harvester, delatexing rack, hot water treatment plant and packaging are used, reduces postharvest disease and mechanical damage. To reduce this loss, chemicals are used to increase shelf-life which is harmful for human health. Considering these issues, mango harvester, delatexing rack, hot water treatment plant and packaging technologies of mangoes has been developed by BARI for commercial use. It saves money and time, and generates income of the farmers as well as mango traders and exporters. Dissemination of technologies among the users through 'Operation Manual of Mechanical Harvesting, Treating and Packaging of Mango' would be helpful. Therefore, an effort has been made to write and publish this manual.

BARI Mango Harvester

In Bangladesh, round shape bamboo basket is generally used for harvesting mango in which jute or nylon made net is connected with a pole. This basket is attached at the top of the bamboo. In this process, mango is stretched at the end of the pedicel which causes stem end rot disease. It reduces the shelf-life of mango and also reduces market price. So, a mango harvester has been developed by BARI to harvest mango with 10-20 mm pedicel. In mango exporter countries, mangoes are harvested with pedicel which protects mangoes from stem end rot diseases.

Advantages

- Mangoes can be harvested with its pedicel
- The harvester is 20% faster than traditional harvesters
- It can be fabricated with iron and fibre materials in any engineering workshop
- One man or woman can operate the harvester

Specifications

- The harvester is made of GI wire, high speed steel, GP sheet and jute/nylon rope
- A V-shaped blade is welded to one side of the GI ring
- A narrow bamboo is inserted to GP sheeted clamp which is connected to the side of the ring
- When mango is harvested from the ground, it is set at 45 degree angle to the bamboo
- Diameter of ring: 230 mm
- Weight: 325g (without bamboo pole)



BARI mango harvester





Detail specifications of mango harvester

Item	Value
Length, m	2–3
Weight of harvester without pole, g	325
Angle ranged	45–180°
Diameter of harvester ring, cm	23
Capacity, fruits/h	150–200
Price, Tk	350 (US \$ 4.37) (without bamboo pole)

Working Principle

Narrow portion of the thin bamboo pole is inserted to the clamp of the mango harvester. When mango tree is taller, the mango can be picked up sitting on a suitable place of the tree using the harvester. Otherwise, mango tree is shorter; mango can be easily picked up from the ground using the harvester. The mango is to be kept at the middle of the harvester and to be hold at lower part of the harvester. Keeping pedicel length 10-15 mm at the middle of two blades which are connected to the ring, the bamboo is pulled. Then pedicel is cut and mangoes will fall in the net with pedicel. After harvesting several mangoes, these will be kept in a suitable place.





Mango harvesting methods traditional practice (Fig. 2) and improved method (Fig.3)

Performance

Field capacity: 150-200 fruits/h

Field efficiency: 90%

Harvesting cost: 0.13 Tk/kg by harvester, 0.15 Tk/kg by manual

bamboo basket (traditional)





Repair & maintenance

- Blade and net of the harvester should be replaced every 2-3 years.
- The harvester need to be cleaned, washed, dried and stored in a dry place after the seasonal use.
- Cutting oil may be used in blade in storage period/off season

Precautions

Mango has to be harvested by the harvester carefully without any injury of the mango surface

BARI Mango Delatexing Rack

In Bangladesh, matured mangoes are harvested with or without pedicel by bamboo basket (traditional practice). After harvest, mangoes are laid on the ground to remove latex. A major portion of fruit marketed locally in Bangladesh is stained with latex. Latex flow causes several problems including skin injury, prevention of adequate development of color, and promotion of decay. In addition to reduce the quality appearance of the fruit (burning of skin, influence on the development of natural pigments), latex can be injurious for people, especially to pickers and packers. The flow of latex is augmented when the fruit is picked very early in the morning, or right after rainfall. To solve the problem, BARI has developed a delatexing rack to remove latex easily.

Advantages

- It can be fabricated with rubber tube pipe and rubber coated wire in local workshop
- Mango fruits can be kept downward on the rack
- It is portable and low cost



BARI Mango delatexing rack



Specifications of delatexing rack

Overall size: 1×1×1 m

Name of parts	Specifications
Size of hole	55×55 mm
Number of holes	144
Size of remover	1×1×1m
Hard wire diameter	4 mm
Rubber diameter, outer	7 mm
Angle bar size for frame of net	190 ×190×31 mm
Angle bar size for frame of stand	250 ×250×31 mm
GP sheet	22 SWG
Weight	22 kg

Working principle

Rack have to be placed in open, clean and plain shady place. Harvested mangoes with long stem (5 cm or longer) and accumulate the fruits in the field boxes. Latex does not drip from fruit with a long stem attached. Trim stems to the abscission zone (approximately 1 cm) and immediately place the fruit with the stem end down to allow latex to drip without touching the fruit's peel. Rack holds the mango fruits while the latex drips and protect the fruit from direct contact. The duration of latex removal varies from 20 minutes to up to 4 hours.

Performance

Capacity: 144 mangoes per batch

Price: Tk. 6000 (US\$ 75)

Limitation

• Small size (*Ghuti*) mango fruit can not be delatexed



Removing mango latex using rack

Repair and maintenance

- Rack need to be cleaned, washed, dried and stored in a dry place after the seasonal use.
- Painting should be done when it will be discoloured





Precautions

Before delatexing mango, rackshould be cleaned with water mixed with detergent

BARI Hot Water Treatment Plant

After harvesting mango fruits are infected by different diseases and insects. To prevent diseases and insects and thus to increase shelf-life, chemicals are used which is harmful for human health. Hot water treatment is a hygienic alternative to reduce postharvest losses as much as to increase shelf-life. Considering these issues, a hot water treatment plant has been developed by BARI.

Advantages

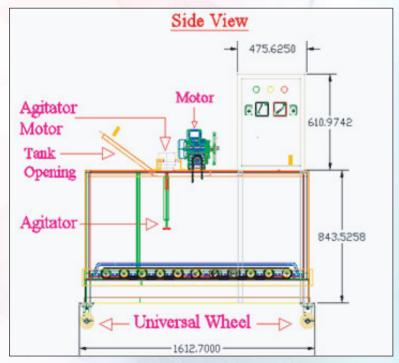
- Hot water treatment plant can be fabricated with iron material in local workshop
- Water is heated by electric heater LP gas/ kerosene fire wood
- Conveyer roller is rotated by an electric motor to carry the fruit filled plastic crate
- Water temperature is controlled by a digital temperature controller
- Water is circulated by a stirrer
- Three to four persons are required to operate the machine
- It can save money, time and reduce drudgery
- It retards enzymatic activity
- It reduces disease severity
- The treated mango remains fresh up to 10-12 days and the fruit surface becomes attractive colour

Specifications

- The water tank is made of mild steel or stainless steel materials
- Cork sheet of 25 mm thickness is used between two metal sheet of the tank to prevent heat loss of water.



- The mild steel roller is attached widthwise on the bottom of the tank
- The roller and stirrer are moved by an electric motor of 0.38 kW
- Water is heated by 20 kW electric heaters (2 kW each) for large and 12 kW for small hot water treatment plant
- Mango is treated in hot water at 53-55 °C in 5-7 minutes
- Overall dimension
 - :3110 mm× 1170 mm × 1530 mm (Large)
 - :1620 mm×1180 mm×1530 mm (Small)
- Water holding capacity of tank :1000 L (Large), 450 L (Small)
- Weight: 400 kg (Large), 235 kg (Small)



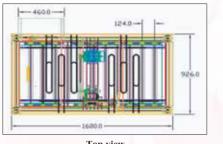
Different parts of BARI hot water treatment plant



Detail specifications of the hot water treatment plant

Name of parts	Specifications				
	Small	Large			
Overall dimension of the plant	1600×926×1566 mm	3130×1170×1530 mm			
Size of water tank	1600×926×697 mm	3020×750×500 mm			
Thickness of MS/SS sheet	1.6 mm	1.6 mm			
Water holding capacity of the water tank	550–600 L	850-1000 L			
Overall dimension of conveyor roller	1460×750×130 mm	3020×750×130 mm			
Size of roller	Length= 620 mm Diameter = 46.8 mm Thickness = 1.5 mm	Length= 620 mm Diameter = 46.8 mm Thickness = 1.5 mm			
Numbers of roller	11 numbers	21 numbers			
Speed of roller	1.6 rpm	3.5 rpm			
Electric motor	0.38 kW, 1480 rpm	0.38 kW, 1380 rpm			
Electric immersion dry heaters	2 kW (1), 6 nos	2 kW(1), 10 nos			
Rotation of stirrer	420 rpm	420 rpm			
Insulation material (cork sheet)	25 mm	25 mm			
Gear box (reducer)	1:78	1:60			
Magnetic contact	100 A	100 A			
Digital temperature controller	0–300 °C	0-300 °C			
Circuit breaker	100 A	100 A			
Sensor (Thermocouple)	300 mm	300 mm			
Panel board	61×46×21 cm	61×46×21 cm			
Treating temperature and time	54–56 °C, 5-6 minute	54-56°C, 5–6 minutes			
Capacity of the plant	500 kg/h	1000 kg/h			
Price a. Made of MS sheet b. Made of SS sheet	Tk 100,000 (US\$ 1300) Tk 170,000 (US\$ 2000)	Tk 140,000 (US\$ 1800) Tk 250,000 (US\$ 2600)			

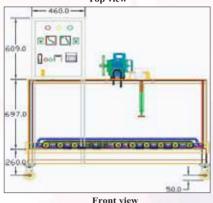


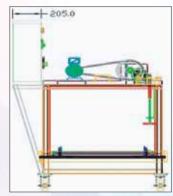


All dimensions are in mm

Scale-20:1







Side view

Different views of hot water treatment plant

Working principle

The plant is placed on a plane, open and shady space which has availability of water and electric grid connection. The water tank is filled with fresh water. The desired temperature of water is fixed in the digital thermometer. The immersion water heaters and stirrer are started through switch on from the electric panel board. When water attains the desired temperature, the heaters are stopped automatically through the thermostat valve. Then the motor is started to run the conveyer roller. Fruits are washed before feeding in the plant. Washed fruits are put inside the plastic crates having capacity of 20-22 kg. The crates of fruits are then submerged on a conveyor roller at 1-2 minutes interval. If mangoes are floated, a mild steel made net of about 2 kg in weight will be placed on the surface of the mangoes of the loaded crate. They move slowly from one end of the hot water tank to the other in 5:30-5:45 minutes. When the alarming bell rang,





treated mangoes crates are picked up from the other end at same intervals. This process is continued until the desired amount of fruits are treated. Finally, the treated fruits are carried to the drying place for surface drying.

Performance

- Capacity: 1000 kg/h (Large), 500 kg/h (Small)
- Efficiency:98%
- Treatment cost, 0.63 Taka /kg (Large), 0.85 Taka /kg (Small)



Mango is treating by the HWT plant



Kept mango inside the plastic crate



Economic analysis of hot water treatment plant

Cost item	V	alue	Remarks			
	Small unit	Large unit				
Purchase value (P), Tk	170000	250000				
Interest on investment, Tk	15%	15%				
Machine life, years	10	10				
Annual use, h	360	360				
Required labour, nos	3	4	Labour charge, 500Tk/day (8 h)			
Electricity, kWh	12.5	21	Electricity charge, Tk/kWh for commercial (flat rate) = 9.8+5% VAT=10.29 (Ref. REB)			
Water holding capacity of the plant, L	400	800	Water tariff, Tk/1000 L =8.49+15% VAT = 9.45 for domestic (Ref. WASA)			
Water use for treatment of fruits, L/day	400-800	800-1600	It depends on intensity of sap and dirt of mango surface area			
Fixed cost (FC)						
1. Capital consumption (CC), Tk./yr	33000	48500	Salvage price=10% of P			
2. Shelter (T), Tk/yr	850	1250	Shelter=0.5 P			
Sub-total, Tk./yr (Tk./h)	33850 (94)	49750 (138)				
Variable cost (VC)						
Labour, Tk./h	188	250				
Electricity.Tk/h	129	216				
R&M, Tk./h	14	20				
Materials, Tk./h	1	2	Plastic crate, pedestal fan, polythene etc.			
Water tariff, Tk/h	1	2	example, 800Lper day *0.00976Tk perL/day per 8h=0.976 Tk/h=1.0 Tk			
Sub-total	333	490				
Total cost (FC+VC), Tk/h	427	628				
Capacity of the plants, t/h	0.50	1.0				
Treatment cost, Tk./t (Tk./kg)	854 (0.85)	628 (0.63)				





Repair and maintenance

- * Replace sensor that is available in market if needed
- * Greasing in the moving parts such as gear reducer, chain sprocket
- * In off season, clean and dry and store it dry and shady room
- Panel board should be covered with thick polythene from rat attacked, protect from rain water

Limitations

- Electric power supply needs to be ranged from 12 kW to 21 kW 220 or 440 voltage and about 15 ampere lines
- * Due to lack of power consumption line in rural area, optimum power was set in the plant. For this reason, plant is operated after 10 minutes of starting.

Precautions

- Mature mango should be treated by the plant. Ripe (soft) or immature mango should never be treated by the plant.
- * TSS of mature mango should be between 9-10% of Brix or mature mango generally sink into water means specific gravity >1.0
- Don't touch the plant without checking the electricity line with the tester
- Check the electricity connections before starting the plant
- Water level of the tank should not go down below the sensor/thermocouple
- Water temperature should not higher the desired temperature of the water
- * Test whether the roller is running
- Whether temperature of the digital controller is shown correctly then cross check water temperature with the mercury thermometer
- Sometimes measure the water temperature in the tank
- * Check whether stirrer is running correctly?
- * Sometimes check the heaters with tester are workable?
- Stop the auxiliary heaters when water temperature is reached the desired temperature
- * In starting, auxiliary heaters should switch on



Troubles, causes and remedies

Sl. No.	Trouble shootings	Causes	Remedies
1	Display of temperature controller doesn't show accurate reading/ shows various abnormal reading	✓ Connection of electricity doesn't properly correct with the panel board ✓ Sensor /thermocouple doesn't work properly	✓ Check neutral/earthin/phase and connect accurately ✓ Check sensor and replaced it (if needed)
2	Electric motor is not running	✓ Connection with the panel board doesn't correct ✓ Connection with the motor disconnect ✓ Switch is not good	✓ Check connection and connect accurately
3	Roller is not running	✓ Adjustment between motor and roller aren't accurate Jam/loose chain sprocket link	✓ Adjust chain sprocket connection between motor and roller ✓ Clean/tight the chain sprocket linked
4	Loaded plastic crate is moves slowly and suddenly moves zigzag	✓ Stirrer speed is high Bottom of plastic crate ✓ is smooth	 ✓ Reduce the speed of stirrer ✓ Bottom of the plastic crate have to rough ✓ Use appropriate crate
5	Mango is floating on the loaded crate	Mango is immature or over matured	✓ MS net have to place over the loaded crate
6	more or less up to the optimum mark	✓ More electric power is required for more water ✓ Over flow the water surrounding the plant ✓ Fruit is not treated properly due to less water	✓ Carefully maintain the accurate quantity of water
7	More time required for heating of water	✓ Heater is not properly work ✓ Voltage is low	✓ Check heater and if not workable then replaced it ✓ Check voltage with the multi meter ✓ Parallel connection should be followed



Packaging of Mango

Bangladesh is rich in seasonal and year round fruits. Mango, banana, guava, jackfruit are the main fruits of Bangladesh. Most of these fruits are perishable in nature with high nutritional value. Their qualities rapidly deteriorate if not transported safely. Inappropriate or rough handling can damage or injure the fruit surface resulting in reduction of market value. Carton is a box made of high-grade corrugated fiber board (CFB). It is used to carry fruits while transporting through the various marketing channels until consumption. It reduces the postharvest handling losses and damage. It saves the fruits from abrupt shock loads. these facts under consideration. Bangladesh Keeping Agricultural Research Institute has developed CFB carton that can ensure quality fruits for retailing, wholesaling and exporting. Besides, imported/local multipurpose plastic crate can be used by the traders that was introduced in the market level at first by BARI in 2004-05 under the NCDP project.

Advantages

- The carton is made with corrugated fiber board
- It is light in weight for easy handling
- * It saves the fruits from internal and external injury
- * Use of quality carton enhances commercial marketing
- * It helps to maintain the quality of fruits until consumption
- Holes on the carton provide sufficient aeration to keep the fruits healthy
- It helps transportation of fruits to consumer in fresh condition

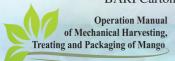






BARI Carton

Multipurpose plastic crate



Specification of CFB carton and multipurpose plastic crate for mango

Dimensions:300mm×200mm×180 mm, 5 ply recycled CFB for 5 kg

400mm×250mm×180 mm, 5 ply recycled CFB for 10 kg

542 mm×360mm×300 mm, plastic crate for 20-22 kg

Static load bearing capacity: 70-80 kg

Price: Taka 45 (US\$ 0.60) for 10 kg CFB

Taka 30 (US\$ 0.38) for 5 kg CFB

Taka 300 (US\$ 4) for plastic crate

Wrapping materials

Foam net, napkin paper, cling paper and news print paper for wrapping of fruit for prevention of friction between fruits surface and mechanical shock. Nontoxic materials should be used.

Working principle

Package have to gather near the heap of mangoes. Before packaging, CFB and plastic crate have to clean and dry. Dry and graded mangoes are took and wrapped with napkin/foam net/ cling paper/news print paper Later, they are kept inside the package layer by layer up to top of the package keeping 12 mm gap.

Limitation

CFB carton is one time used and damage from water or moist condition.

It cannot withstand more than 70-80 kg of vertical load

Repair maintenance

No repair is needed

After completion of work, multipurpose plastic crate should be cleaned with water, dried and later kept it a dry place

Protect it from rat attack





Precautions

Newspaper should not be used as wrapping materials due to source of carbon availability that is absorbed by the fruits.

Chula for Hot Water Treatment Plant

BARI hot water treatment plant for fruits was operated mainly by electric power of 12.5 to 21 kW. Conveyer rollers and stirrer were rotated by a single phase electric motor and water was warmed by single phase electric immersion heaters. In rural areas, 12.5-21 kW single phase electric line is not available but also load shading is occurred. Traders/farmers want to connect said power electric line for any plant; authority of REB does not agree to install another new transformer. If authority agrees to install the line, trader and farmers need lot of money that is not afford for all farmers and traders. Three alternative heating sources would be such as chula for fire wood, LP gas burner, and kerosene chula for heating of water upto desired level of temperature and fruit treatment. This plant can be used where electricity is not available and also be used as alternative energy to electricity for heating water and treating of mango.







Kerosene chula

LP gas burner

Fire wood chula



Advantages

Chula (burner) are made with locally available material in local workshop

It has high efficiency

Less fuel required

Specification and comparison of different heating sources for heating of water of 354 litre

Sl.	Energy sources	Parameter							
No.		Temperature	Amount of	Cost of	Time required,				
		ranged from	energy/fuel	energy, Tk	minutes				
1	Electricity 6 dry heaters of 2 kW	31 to 55°C	11.2 kW	67	105				
2	LP gas (burner size:City75, 30 cm dia,6 rows, 18 holes/row Nozzle size:4)	31 to 55°C	1.30 kg	114	65				
3	Kerosene (Burner:10 Nozzle size: 4)	31 to 55°C	1.6 kg	112	46				
4	Fire wood	31 to 55°C	10.5 kg	63	50				

Working principle

Hot water treatment machine has to be placed in a plain and shady space. Chula/burner have to be placed below the bottom of the machine that is called firing, chamber. Before firing, chula /burner have to be started firing, when firing, is fully okay, then it placed in the chamber. Heat of the chula /burner have to be controlled by hand, regulator or adding/removing fire wood from the chula.



Repair maintenance

- Received the checked conduction with the checked and clean sometimes, if necessary replace them
- Regulator of gas burner should be checked and as requirement replace it
- Rubber gasket of the gas cylinder should be checked and replace it
- Any other problems, it have to be brought in a mechanic

Precautions

Operator should be taken careful always from fire Operator should be put on apron





Maturity characters of mango

Variety	Harve period From	То	Thickne ss of peel	Sp. gravit y, g/cc	TSS, %	Skin colou r	Weight / mango, g	Treating temperatu re and time (Azad, 2001)	Shel f- life, days	Treatin g temper ature and time (Hassa n et al 1998)	Sh elf - lif e, da ys	Treat ing temp eratu re and time (Hass an et al 1998)
Gopalbh og	25 May	1 week of June	medium	1.03	22.6	yello w	208	55°C at 5 min	16.7			
Khirsap at	1 June	20 June	medium		21.8	green	276	55-57° C up to 10 min	16.6 2			
Langra	2 nd week of June	4th week of June	thin		20.2	green yello w	315	55° C at 5 min	15.3			
BARI Aom-2 (lakhan boug)												
Fazli	3 week of June	4th week of July	thin		17.49	green	650	55° C at 5 min	14.9	52° C±2°	16. 33	52° to 54° C



Procedure of harvesting and hot water treatment of mango

harvest mango with mango harvester
place the harvested mango to remove sap
· · ·
place mango inside the plastic crate
Bring the harvested mango inside the packhouse
Triming pedicle with 1 cm
Sorting (selected matured fruits, discard injured, riped, disease infected fruits etc)
Washing
work the Hot water treatment plant
Pour water in the tank upto particular level (upto handle of plastic crate)
V
Before starting, check electric connection such earthing, neutral and phase line even
sink sensor have to sink inthe water
connection of electric line
connection of electric line
Set desired temperature on the digital temperature controller
Check the heaters line whether workable or not
Start all heaters
Start roller when desired temperature reach
Start offer when desired temperature reach
check travelling period within 5. 45 minutes for small plant puttting on empty crate
₹ <i>5</i>
check the water temperature with the mercury thermometer
Pickup the treated mango crate within 5.45 minutes
Pickup the crate after 90 second
Flexib the clair after 50 second
When water temparature down upto 54-53 then treatment work stopped. Wait 10 minutes, water temparature regain upto 55 °C. Again, start the treatment process
7 7
Lack of higher ampre electricity of desired voltage in the rural area, minimum electric
heater will be set therefore wait some times.
Drying by padstal fan
Wrapping with napkin/foam net / news print/cling paper
Packing in crate/carton
Toward by took
Transport by track

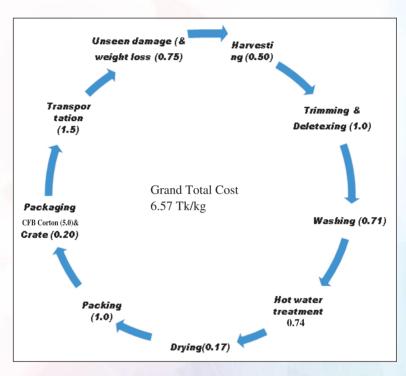


Present status of "BARI Hot water treatment plant for mango"

	Name of Manufacturers'	Manufacturing year	Number of plant (machine)	Unit price of the plant, Tk.	Users address
1	FMPE Division, BARI, Gazipur	2012	Large (MS)-1	100,000	FRESH and SAFE Agro Ltd (FASAL), Gabtali, Dhaka
2	FMPE Division, BARI, Gazipur	2014	Small (MS)-1	100,000	Kansat Bazer, Shibganj, ChapaiNawabganj
3	Chuadanga	2015	Large (MS)-1	130,000	Link Road, Shamally, Dhaka
4	Chuadanga	2015	Small (SS)-1	150,000	Fal-bithi Horticulture Centre, Asad Gate, Mohammadpur, Dhaka
4	Janata Eng. Workshop, Chuadanga	2015	Small (SS)-1	155,000	Mango Foundation, Bholahat
	Workshop, Murapara Bazer, Murapara, Rupganj, Narayangonj	2016	Small (SS)-10 Large (SS)-1	145,000 200,000	Hortex, Dhaka-1 In DAE Office Satkhirasadar upzila-2 Ishwardi upazila-1 Bagha upazila- 1,Charghat upazila-1 ChapaiNawabga njSadar upazila- 1 Bholahat upazila-1 Khagrachharisad ar upzila-1 Rangamatisadar upazila-1 Bandarbansadar upazila-1
7	Station Road Tongi, Dhaka, 01819-892165	2016	Small (SS)-4	160,000	Postharvest Technology Division, Gazipur
8	Station Road Tongi, Dhaka	2016	Small (SS)-1	160,000	Boalia, Rajshahi
Ģ	Expert Engineering, Station Road Tongi, Dhaka,	2016	Small (SS)-1	160,000	Dhanmondi, Dhaka

Total= 4 large models and 20 small models =24 unit sincluding FMPE samples (2) upto February, 2017





Cost flow diagram from harvesting to transportation (Tk/kg)



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