

Review Article

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Cost Benefit Analysis of Grading and Packaging of Mandarins – A Review

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ABSTRACT

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Grading is one of the most important procedures to be followed in post harvest handling, as it determines the quality, shelf life and price of the fruit. During grading, the produce is sorted according to the fixed grade standard, taking into consideration various quality factors to make a homogenous lot. Post-harvest grading of Mandarin is rarely practiced at the producer's level. This paper studies the various methods of grading and packaging of mandarins

Introduction

Grading of agricultural produce especially the fruits and vegetables has become a perquisite of trading across borders. In India mostly fruit growers grade the fruit manually. Manual grading is costly, time-consuming and inefficient. Sometimes grading are carried out by trained operators who considered a number of grading factors and fruit are separated according to their physical quality. Manually grading is time consuming and grading operations are affected due to shortage of labor in peak seasons. Human operations may be inconsistent, less efficient and time consuming.

New trends in marketing as specified by World Trade Organization (WTO) demand high quality graded products. Farmers are looking forward to having an appropriate agricultural produce-grading machine in order to alleviate the labor shortage, save time and improve graded product's quality.

Grading of fruits is a very important operation as it fetches high price to the grower and improves packaging, handling and brings an overall improvement in marketing system. The fruits are generally graded on basis of size and graded fruits are more welcome in export market. Grading could reduce handling

losses during transportation. Grading of fruits and vegetables is an important operation affecting the quality, handling and storage of produce. Grading systems give us many kinds of information such as size, color, shape, defect, and internal quality. Among these color and size are the most important features for accurate classification and/or sorting of citrus such as oranges, lemons and tangerines.

Grading based on size consists of divergent roller type principle having inclination, expanding pitch type, inclined vibrating plate and counter rotating roller having inclination type graders. Weight grading based on density and specific gravity of agricultural commodities. The need to be responsive to market demand places a greater emphasis on quality assessment, resulting in the greater need for improved and more accurate grading and sorting practices. Size variation in vegetables like potatoes, onions provides a base for grading them in different categories. Every vegetable producing country had made their own standards of different grades keeping in view the market requirements.

A rotating screen grader is suitable for fruits like lemon, ber, aonla etc. Citrus grading is normally achieved based on external visible criteria including size, shape, and color of the fruits. Grading based on size is easy and less expensive according to other methods of grading and used for grading of potato, onion, tomato, apple etc. Weight grading of fruits and vegetables based on its density and specific gravity. Electronic color grading is done for highly perishable fruits and vegetables. This method is costly but higher accuracy of grading. Electronic color grading and reflecting color grading is used for apples, tomatoes, papayas, pineapples grading.

Grading is one of the most important procedures to be followed in post harvest

handling, as it determines the quality, shelf life and price of the fruit. During grading, the produce is sorted according to the fixed grade standard, taking into consideration various quality factors to make a homogenous lot. Post-harvest grading of Mandarin is rarely practiced at the producer's level. At the most, the fruits are sorted out, based on physical characteristics like weight, size, colour, shape and degree of damage on fruits. This type of grading is done by hand in small operations. In pack houses handling large volume of the produce, semi- automatic grading machines are also used, wherein the fruits are passed down on a slow moving conveyor. This semi automatically grading is very efficient with respect to time, space and quantity.

The N.R.C.C., Nagpur has developed a machine for mechanical sorting, washing, waxing and sizing operations. Sometimes, hand-held rings called "Fruit Sizer" of different diameters are used to check the different size categories and help in packing of same size fruits in the one container. It is a common experience, the traders generally place best quality fruits at the top of containers, but this practice neither helps the growers nor traders. Therefore, the grading of fruits as per accepted quality standards helps farmers, marketing functionaries, processors, traders and consumers in efficient marketing. The state-wise grading parameters used for grading of Mandarin and percentage share graded by different agencies are given in table No 1.

From the above table No. 1, it is observed that practice of grading, based on scientific grade standards is not being followed by any of the agency engaged in marketing of Mandarins, in the country. At the best, the growers do sorting out to remove immature, rotten or diseased fruits from the bulk and grade according to colour, shape and size.

Table.1 Grading Parameters used for grading of Mandarins

Sl.No.	State	Agency	Parameters used for grading	Quantity Graded (%)
1	Assam	All functionaries	Size and colour	N.A
2	Haryana	All functionaries	Size and colour	NIL
3	Karnataka	Producers	Size and colour	15
		Wholesalers	Size and colour	30
		Commission agents	Size and colour	46
		Cooperatives,Processors	Size and colour	1
		Retailers	Size and colour	22
4	Madhya Pradesh	All functionaries	Size and colour	N.A
5	Maharashtra	Producers	Size and colour	-
		Wholesalers	Size and colour	80-85
		Commission agents	Size and colour	80
		Exporters	Size and colour	100
6	Meghalaya	Retailers	Size and colour	N.A
7	Mizoram	Producers	Size and colour	N.A
8	Nagaland	Producers	Size and colour	20
		Wholesalers	Size and colour	50
		Retailers	Size and colour	30
9	Punjab	Wholesalers	N.A	60-65
		Cooperatives		4-5
		Processors		N.A
		Exporters		100
		Others	NO	NIL
10	Rajasthan	Producers	Size and colour	10
		Wholesalers	Size and colour	40
		Commission agents	Size and colour	60
		Cooperatives	Size and colour	40
		Retailers	Size and colour	25
11	Tamil Nadu	Producers	Shape, Size and colour	100
		Commission agents	Shape, Size and colour	0
		Wholesalers	Shape, Size and colour	100
		Retailers	Shape, Size and colour	100
12	Tripura	Retailers	Size and colour	25
13	West Bengal	Producers	Shape, Size and colour	100

It is common practice in almost all the Mandarin producing states that the producers sell the orchards to the pre harvest contractors before commencement of the harvesting season. These merchants harvest the fruits and carry them to different 21 markets without undertaking any grading, for sale. In the markets, the grading is generally done on the basis of colour, shape and size.

Advantages of Grading and standardization

- i) Grading is beneficial to the farmers, traders as well as to the consumers, as it provides common standard to all.
- ii) Grading of the produce before sale enables farmers to get better price for their produce.
- iii) Grading assists the producers and other intermediaries in preparing fresh produce for market with appropriate labeling.
- iv) Grading helps the consumers to get standard quality produce at fair price.
- v) It facilitates the consumer to compare the prices of different qualities of a produce in the market.
- vi) It assures the quality of the produce and also reduces the cost of the marketing and transportation.
- vii) Produce of similar grade can be stored in bulk.
- viii) Market values are better understood.
- ix) Commodities can be bought and sold without inspection, through e-trading.
- x) Grading provides an authentic and scientific basis in promoting and managing the marketing system.
- xi) It serves as a realistic and common basis for market intelligence and reporting.
- xii) It facilitates the settlement of quality disputes between buyers and sellers.

Grading at producers' level

Though there is no grading of Mandarin at producers level, but there is an increasing recognition to the fact that producers need to be assisted in grading their produce before sale so that they may get better price. For securing adequate returns to the producer/seller, the scheme of "Grading at Producers' Level" was introduced in 1962-63 by Directorate of Marketing and Inspection. The main objective of this scheme is to subject the produce to simple test and assign a grade before it is offered for sale. After grading, the producers get prices commensurate with the quality of the produce.

The programme is being implemented by the States/Union Territories. At present, some fruits are graded at producer's level, mainly in the regulated markets of Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal etc. Up to 31-03-2006, 2051 grading units have been set up in the country. The total number of producers' level grading units, as on 31-03-07 are 2143.

Benefits of Grading at producers' level

1. Grading of the produce at producers' level enable farmers to get higher price for their produce as well as it helps the consumers to get standard quality produce at fair price.
2. Grading not only facilitates the dissemination of prices and market information but also assist the machinery of distribution at all stages.
3. Grading at producers level helps them to develop suitable marketing strategy.

Packaging

The packaging of fruits is required for efficient handling and marketing, better eye appeal and better shelf life by reducing mechanical damage and water loss. The proper packaging protects the fruits from pilferage, dirt, physiological and pathological deterioration during further handling. Efficient packaging of horticultural produce in uniform size reduces the need for repeated weighing and can facilitate handling, stacking, loading, unloading, better storage, long transportation, transshipment and marketing.

The use of traditional baskets, sacks, boxes and trays to carry the produce to the market is very much common, as a packaging material. These are locally fabricated, low cost and made out of cane and bamboo, dried grass, palm leaves and teak leaves. Though, they serve the purpose of carrying fresh produce to short distances, they can not be used for long distance transportation. Large quantities of produce need better packaging to minimize the losses and achieve the most economical use of conveyance.

During the packing, the immature, overripe, damaged and diseased fruits should be sorted out only sound fruits should be packed. While selecting and opting out for specific packaging material for a particular produce, precaution should be taken to prevent transit hazards caused by the packaging material. Nature of such damages is cut or punctures, shock/impact, compression, vibration, heat damage, chilling or freezing damage and chemical contamination.

The different types of packaging material that can be used for packing fresh horticultural produce comprises of -

i) Natural materials (traditional containers made of cane and bamboo, straw, and palm

leaves etc.),

ii) Wooden boxes,

iii) Corrugated fiber board boxes,

iv) Molded plastics sacks or bags made out of natural or synthetic fibers (e.g. jute, sisal, polypropylene polyethylene) and

v) Paper or plastic films.

Recyclable boxes molded from Higher Density Polythene (HDP) are widely used for transporting of produce. These can be specially designed and fabricated to meet the specific requirements of transport. They are strong, rigid, smooth, easily cleaned and stacked to conserve space. Paper or plastic films is often used for lining of packing boxes in order to reduce transportation loss and prevent friction damage.

Plastic-film bags or wraps are widely used in marketing of fruit, especially in consumer size packs. Packaging operations may be done manually or mechanically using various methods viz; loose-fill jumble packing, multilayer pattern pack with size grading, multilayer size graded pack using separator trays and single layer pack for high value produce. The state-wise packaging material used, mode of packaging and their capacity, are furnished in table No 2.

Losses during grading

Scientific grading of Mandarins is not done by any of the functionaries. At the most, the fruits are cleaned and then sorted out according to size, shape and colour. There are hardly any losses in the process of grading, but due to improper handling of the fruits or due to over ripened fruits, there are likely losses of the fruits at the time of grading. Sometimes, fruits also get infected due to injuries and resulting in huge losses during grading.

Table.2 Mode of packaging of Mandarins

Sl.No.	State	Agency	Mode of Packing	
			Type	Capacity (Kg)
1	Assam	All functionaries	No packing	Loose
2	Haryana	All functionaries	Size and colour	NIL
3	Karnataka	Producers	Size and colour	15
		Wholesalers	Size and colour	30
		Commission agents	Size and colour	46
		Cooperatives,Processors	Size and colour	1
		Retailers	Size and colour	22
4	Madhya Pradesh	All functionaries	Size and colour	N.A
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9	Punjab	Wholesalers	N.A	60-65
		Cooperatives		4-5
		Processors		N.A
		Exporters		100
		Others	NO	NIL
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		Cooperatives	Size and colour	40
		Retailers	Size and colour	25
11	Tamil Nadu	Producers	Shape, Size and colour	100
		Commission agents	Shape, Size and colour	0
		Wholesalers	Shape, Size and colour	100
		Retailers	Shape, Size and colour	100
12	Tripura	Retailers	Size and colour	25
13	West Bengal	Producers	Shape, Size and colour	100

Percentage of losses during grading

In Madhya Pradesh, the losses during the grading are reported 5-8 per cent and are maximum.

Losses during packaging

Improper handling, overloading and dropping of the fruits during weighing are the main factors of losses during packaging. The producers generally sell the produce before commencement of the harvesting season and do not undertake the packaging of the fruits. If necessary, they either carry the Mandarins in loose or at the most they carry the fruits in baskets and sometimes in gunny bags. The losses during packaging in states and their causes are given in **table No 19**.

Comparison of estimated costs and expected benefits of sorting/sizing/grading/packing operations

Costs:

Equipments

Labor

Packages

Benefits

Reduced losses due to decay, less spread of infection

Improved overall quality, less damaged produce

Higher market price for highest graded produce

Example: unsorted 20 kg /crates of mandarins have a market value of Rs 40/kg in the wholesale mandi in MP. 20,000 kg / ha. are harvested and 15% postharvest losses are due to water loss transport to market.

Cost

Grader of Rs.5000, usable over many seasons
15 Labor for sorting and packing 3 quality

grades (one day @ Rs. 200/day)

Total labor = 200 X 15 = Rs. 3000

1000 fiberboard boxes cost Rs.130 each (= Rs.13,00,00) vs 500 sacks which cost Rs 15 each (= Rs 7500)

Total Costs (unsorted) = Rs 7500 vs

Total costs (sorted/packed) Rs 5000 + Rs.3000 + Rs13,00,00 (5 Years) = Rs 13,80,00

(Total recurring costs for sorting/packing = Rs. 3000 + Rs. 27,600 = Rs 30,600)

Benefits:

Unsorted/unpacked market price=20,000 sacks of Rs.30 / kg. Total = Rs 60,00,00

Sorted/packed market price: Highest

grade = Rs. 45/kg

Medium grade = Rs. 35/kg

Lowest grade = Rs. 20/kg

If 50% of the produce is of highest grade (10,000 kg) = 10,000 X Rs 45 = Rs 45,00,00

If 30% is of medium grade (6000 kg) = 6000 X Rs 35 = Rs 21,00,00

If the remainder are of lowest quality (4000 kg) = 4000 X Rs 20 = Rs 80,000

Total = Rs 45,00,00 + Rs 21,00,00 + Rs 80,000 = Rs 74,00,00

Expected profits from grading/packing: this example demonstrates an immediate recovery of invested capital. The first 1000 kg of produce sorted and packed pays for the capital outlay (the grader), after this each 1000 kg packed results in a return of an additional Rs 405000 (Rs 74,00,00 - Rs 30,600 in cost) = Rs 709400 in comparison to mandarins sold unsorted in crates (Rs 60,00,00 - Rs 7500 in cost) = Rs. 59,25,00

Keeping this example in view a success story was studied by the KVK Neemuch scientist guiding them as per the recommended package of practices for not only increasing the production but also to get better returns

through proper grading and packaging.

Success story

TITLE : "Profit through Grading and Packaging of Mandarin"

Name : **Pradeep Patidar**

Father's name : Shri Shriram Patidar

Postal address : village : Jaisinghpura , P.O. : Jaisinghpura, Block and district : Neemuch (M.P.)

Cast : Patidar

Religion : Hindu

Education : B.A.

No of family members : 10

Land holding : 5.0 ha.

Introduction

Neemuch district produces a large number of crops which includes oilseeds, cereals, pulses, spices, medicinal, vegetables and fruit crops. Mandarin is one of the major fruit crops of the district having an area of 3000 ha. Farmers get good production but they are unable to get good price due to various sizes of fruits. There is wide scope of grading and packaging to get higher return. Therefore it was decided

to study the success story of the above farmer of village Jaisinghpura. Pradeep Patidar has 5.0 ha. land out of which he grows mandarin in 1.0 ha. area. Earlier the farmer used to sell the ungraded produce in local market and get the lower price. During the year 2010 he came into contact with KVK Neemuch. KVK scientists advised him to follow the recommended package of practices to get higher yield. They also suggested for gradation and packaging before selling in the market to get more price. The farmer was agreed and he purchased a locally made mandarin grader.



Table.3 Intervention / methodology / process
The intervention by KVK was improved package of practices.

Operation	Farmer practice	Recommended practise
1. Fertiliser	Use of under dose fertilization.	Use of recommended dose of fertilisation. 20 kg FYM, 1 Kg NPK mixture per plant.
2. Irrigation	Unscheduled irrigation through drip.	Scheduled irrigation through drip.
3. Insect- pest management	Injudicious use of pesticides.	Need based plant protection measures were done.
4. Marketing	Sold in local market without grading and packaging.	Sold in local market along with Udaipur and Jaipur after grading and packaging.

Farmer participated in the training programmes organised by KVK Neemuch regularly and developed knowledge and skill.

Table.4 Output - Rabi season (before adopting the technology)

S. N.	Crop	Variety	Area(ha)	Yield(ctl.)	Gross cost (Rs.)	Gross income (Rs.)	Net income (Rs.)
1.	Mandarin	Nagpur	1.0 ha. (277plants)	277	100000	360100	260100

Sale rate @ Rs. 13/- per kg.

Table.5 Rabi season (after adopting the technology)

S. N.	Crop	Variety	Area (ha)	Yield (ctl.)	Gross cost (Rs.)	Gross income (Rs.)	Net income (Rs.)
1.	Mandarin	Nagpur	1.0 ha. (277plants)	304	125000	Grade A – 182000 Grade B – 243200 Grade C - 61000	361200

Sale rate of grade A@ Rs. 20/- per kg.

Sale rate of grade B@ Rs. 16/- per kg

Sale rate of grade C@ Rs. 10/- per kg

Economical Analysis of Ungraded mandarins

Cost

Yield = 27700 Kg

700 sacks which cost Rs 15 each (= Rs 10,500)

Unsorted/unpacked market price=27700 kg sacks of Rs.13 / kg. Total = Rs 360100

Total Costs (unsorted) = Rs 10,500 + Rs 360100 = Rs 370600

Economical Analysis of graded and packed mandarins

Cost

Yield = 30400 Kg

Grader of Rs.5000, usable over many seasons

15 Labor for sorting and packing 3 quality grades (one day @ Rs. 200/day)

Total labor = 200 X 15 = Rs. 3000

1520 fiberboard boxes cost Rs.130 each (= Rs.197600)

Total costs (sorted/packed) Rs 5000 +

Rs.3000 + Rs197600 (5 Years)

Total costs (sorted/packed) Rs 5000 + Rs.3000 + Rs 39520 (1 Year) = Rs 47520

(Total recurring costs for sorting/packing = Rs. 3000 + Rs. 39520 = Rs 42520)

Benefits

Unsorted/unpacked market price=27700 kg sacks of Rs.13 / kg. Total = Rs 360100

Sorted/packed market price:

Highest grade = Rs. 20/kg

Medium grade = Rs. 16/kg

Lowest grade = Rs. 10/kg

If 50% of the produce is of highest grade (13850 kg) = 13850 X Rs 20 = Rs 277000

If 30% is of medium grade (8310 kg) = 8310 X Rs 16 = Rs 132960

If the remainder are of lowest quality (5540 kg) = 5540 X Rs 10 = Rs 55400

Total = Rs 277000 + Rs 132960 + Rs 55400 = Rs 465360

Expected profits from grading/packing: this example demonstrates an immediate recovery

of invested capital. The first 1000 kg of produce sorted and packed pays for the capital outlay (the grader), after this each 1000 kg packed results in a return of an additional Rs 257000 (Rs 465360 - Rs 42520 in cost) = Rs 422840 in comparison to mandarins sold unsorted in crates (Rs 360100 - Rs 10,500 in cost) = Rs. 349600



Shri Pradeep Kumar Patidar got net returns rupees Rs 465360 /- by following recommended package of practices in mandarin under the technical guidance of KVK Neemuch scientists as compared to earlier net income from mandarin i.e. 360100/- it helped him to improve his socio economic status. Thus the net profit turned out to be of Rs. 105260.

Better income may be obtained by the farmers from the cultivation of mandarin with recommended package of practices along with sale of produce in the market after grading and packaging.

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