

New packaging options for transporting tomatoes in India

In this article the authors describe the results of trials to transport tomatoes in specially designed cardboard cartons, rather than in the traditional wooden crate.

Background

International Development Enterprises (IDE) works in India, mainly in the field of small-scale irrigation. It is involved in a project funded by the DFID Crop Post Harvest Programme that seeks to investigate improved methods of packaging and transporting tomatoes. The tomatoes are produced by small-scale growers in the vicinity of Shargaon in Himachal Pradesh. Growers traditionally use wooden boxes called *peti* to pack and transport their produce. The Himachal government, however, has recently banned the felling of trees to make the boxes in order to reduce deforestation. Neighboring states have not followed suit and wood will continue to be available for some time, but eventually an alternative to wood will be required. Research by IDE identified corrugated fibreboard boxes (CFB's), recently developed for growers in Gujarat, as being a potential replacement for the wooden *peti*. IDE carried out a series of trials of the boxes with the local growers in Solan area. They selected a box with a 15kg capacity (code VC-15) for the initial trials. Core Emballage, a company in Ahmedabad that had previously collaborated with the Indian Institute of Management, Ahmedabad (IIMA), manufactured 2500 boxes for the trials.

Aims of transport trial

- To determine whether VC-15s could withstand the rigours of the 350km, 12 hour road journey from Solan to Delhi
- To compare the degree of protection given to the produce by the VC-15 as compared to the *peti*
- To obtain feedback from growers, traders and others on various features of the boxes such as ease of filling, handling, price etc
- To develop second generation boxes suitable for the Solan area, taking into account the results of the trial and feedback.

Tomato in the Solan area

Farmers in this region grow tomatoes in small fields on terraced slopes. The crop is ready for the market in June and harvesting continues until August. During this period, this region is the only source of supply to Delhi and other markets. Growers therefore get a good price for their crop.

Harvesting

Pickers move along the rows with small basket or plastic crates. When full these are emptied into a larger basket called a *kilta*, which is made of fine bamboo splits and has a capacity of around 30–40kg. The tomatoes are taken to a shed, where they are sorted and packed.

Environment

The region experiences frequent rains from mid-June to August, which coincides with the main harvest period. During this period, the weather is humid and sky is cloudy. The average temperature in June is 33–34°C, falling to 25°C in August. There were concerns that the local damp climate might reduce the strength of the CFB boxes.

Mode of packaging

Wooden boxes (390x280x200mm) called *peti* are the present main mode of packaging. They weigh about 1.5kg, have a capacity of 13–14 kg tomatoes and cost around Rs.18–20 per box. *Petis* are readily available in kit form, which the growers purchase and assemble as required. There is a well-developed and efficient network in the area that supplies the growers with the *peti* kits. Suppliers deliver the kits at a convenient pick-up point and growers need only a hammer and nails to assemble the *peti*.

A *peti* has provision for aeration and a smooth inner finish, though nails may sometimes be protruding.

There are efforts underway to develop alternatives to the *peti*. In the Delhi market there are already 5-ply CFB boxes for tomatoes available. These boxes have the name of the grower, the variety, lot number and 'Himachal Tomato' printed on the side. The boxes are a similar shape and volume as a *peti* with 8 vent holes (25 mm diameter) on both the longer side-walls and on the top and bottom. Oval grips are provided on the smaller walls.



Asia
India

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Conversion

UK £1 = Rs 69.7



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Current packing practice

Tomatoes of a relatively uniform colour and size are selected and packed in layers in a *peti*. Pine needles or dry grass is placed at the bottom and between the layers to provide cushioning and protection for the fruit. A sheet of newspaper is placed on top and the box is closed by nailing. Codes of the grower and the commission agent and the total number of *petis* being sent on that trip are stamped on each *peti*. Growers carry the *petis* on their back or on mules to the road-side, where they remain on damp ground for up to four hours until pick-up by the transporter.



Sharan and Rawale

Figure 2. Unloading the truck in Delhi

Vehicle, load and road

Five tonne single axle trucks, with leaf springs and no dampers are used to transport the boxes of tomatoes to market in Delhi. Each truck can hold around 600 *petis*, which are stacked in columns of up to 8 tiers. A tarpaulin covering is placed on top to protect the cargo from rain (Figure 1).

Hill roads are narrow, have numerous hairpin bends and gradients with many potholes. Journeys along such roads expose the load to vertical, lateral and forward and backward sway of the columns.



Sharan and Rawale

Figure 1. Truck transporting the tomatoes.

Unloading at the market in Delhi

Two workers typically unload each truck – one in the truck handing boxes to another worker on the unloading platform where they are stacked. Initially the two workers are close enough for the boxes to be handed down (figure 2). As unloading proceeds the boxes begin to be thrown across large distances. Being experienced, the boxes are expertly tossed and caught, but occasionally there is a miss and the box falls onto the hard floor.

Some of the produce reaching Delhi market may terminate its journey here. Some may be loaded onto another truck to be taken to other terminal markets in the country. For produce ending its journey in Delhi, the transport distance (from Solan) is about 350 km. For that going onward to other destinations it could be twice as much.

Trial procedure

Several small-scale growers were involved with the initial trials. The new cartons (250 in total) were taken to Shargaon and the farmers were shown how to assemble and use them. Tomatoes that were in the 'breaker' stage, i.e. the blossom end had just started to turn pink, were selected for the trial. The cartons were placed on level ground and carefully filled with tomatoes. The box was shaken once or twice during filling to ensure proper settling. Cartons were secured with straps



(those on the floor of the truck which is considered to be the most vulnerable position) were opened to check for damage to the produce.

Results of the trial

Damage to containers

There was no damage (burst boxes or irreversible bulges) to any of the boxes. All VC-15's and the wooden *petis* retained their structural integrity. This

before loading on to the trucks. Tomatoes were also packaged in the traditional *petis* to compare the efficacy of the new box. A few sample boxes were weighed after filling and the gross weight was found to be 15kg in both cases.

Loading the truck

The truck used was one that regularly transports produce to Delhi. The VC-15's were stacked in columns of four and the *petis* in columns of seven. The overall column heights were almost the same. The truck held 187 VC-15's and 247 wood *petis*. The placement plan is shown in figures 3 and 4.

The truck left Shargaon at 9.30pm and reached Azadpur market (Delhi) the next day at 8.00am, having travelled about 350 km.

Upon arrival in Delhi, the truck was unloaded and the boxes and their contents inspected for damage. All of the VC-15s were checked for damage to the packaging. Only a sample of the cartons

is despite the fact that some VC-15s were initially exposed to a slight wetting due to a leaky tarpaulin.

Damage to Produce

Table 1. Damage to the produce during transport

| Position in truck | % damage | |
|-------------------|----------|-------------|
| | VC-15 | <i>Peti</i> |
| Front | 4.6 | 2.3 |
| Centre | 0 | 0 |
| Back | 0 | 4.1 |
| Overall | 1.5 | 2.1 |

Damage to the produce is summarised in table 1. Overall damage to the produce was 1.5% in VC's and 2.1% in the *petis*. We conclude that this low level of damage is acceptable and is similar for both forms of packaging. The damage to produce is lower than that observed in trials in Gujarat that involved a 250km road journey. This is not surprising since the transport trial in Gujarat was carried out in March when temperatures were 40°C. Higher temperatures increase the rate of respiration and accordingly the ripening. Also, growers in Gujarat usually pack nearly red ripe tomatoes rather than the under ripe ones. These external factors increase the susceptibility of tomatoes to damage in transit.

Modification required

Following the initial trials and taking into account the feedback from the users of the



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Figure 3: Stacking the VC-15s and *petis* in the truck

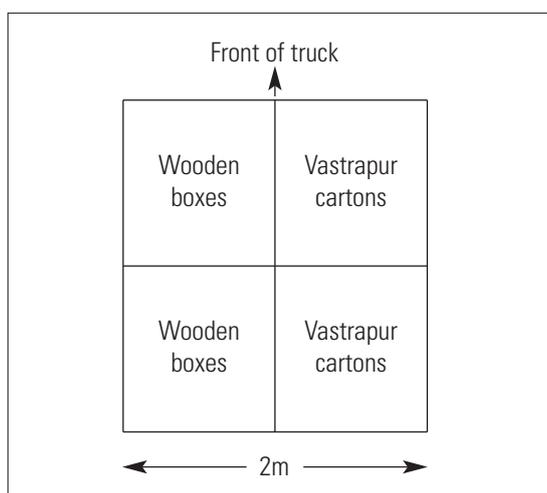


Figure 4: Plan view of the placement of VC-15 and *petis* in truck



cartons, several changes are now being considered:

- *Reduction in volume of box.* On arrival in Delhi it was observed that a gap of about 3–5 cm had developed in the carton, due to settlement during the journey. This suggests that a VC-15 can actually accommodate about 1.5–2 kg more tomatoes. However, rather than increase the quantity of tomatoes per box, a decision was made to reduce the volume of the crate
- *Placement of ventilation holes.* The 8 ventilation holes (four each on the longer side-walls) are clustered close together around the centre of the long walls. This weakens the area near the holes. The holes can be positioned further apart without affecting aeration of the carton
- *Side grip.* To improve handling, the side grip of the carton can be provided.
- *Barrier to moisture intrusion.* In view of the local climate the boxes need to be made more impervious to moisture
- *Feedback from growers and traders.* Growers in Shargaon and traders in Delhi suggested that the dimensions of the box be kept close to that of the *peti*. They also insisted that the price should be kept close to that of the *peti*

In considering the question of volume of the new boxes and the need for them to match as far as possible the size of the *petis*, the researchers made an assessment of the bulk density of the tomatoes.

Current practice is not to segregate the tomatoes according to size. However, as the table below illustrates, tomatoes of varying sizes have very different bulk densities.

Volume

The bulk density of tomatoes was measured at Ahmedabad and Shargaon by sorting tomatoes in different sizes—small, medium, large and also for the mixed lots. A template with holes of varying diameter was used to determine size. A CFB box was filled by hand, shaken 5–6 times to ensure uniform settlement after which the tomatoes were weighed. The measurements for each size were replicated four times. Table 2 shows the mean values.

Table 2: Bulk density of tomato arriving at Ahmedabad APMC market (July)

| Size | Bulk density (kg/m ³) |
|----------------------|-----------------------------------|
| Small (below 5 cm) | 681 |
| Medium (5–5.5 cm) | 638 |
| Large (above 5.5 cm) | 617 |
| Mixed (as in lot) | 642 |

Table 3: Bulk density of tomato at Shargaon

| Size | Bulk density (kg/m ³) |
|--------|-----------------------------------|
| Small | 681 |
| Medium | 687 |
| Large | 619 |
| Mixed | 694 |

Dimensions of small, medium and large are not stated and may not be same as in Ahmedabad

The bulk density has clear implications on the weight of tomatoes per box and is an area that needs more study. In addition, there may be a premium price for larger tomatoes.

Based on the results of the trial, prototypes of new boxes are being fabricated with the following features:

- Volume as near as possible to 21.6 litres
- Outer surface treated with varnish to reduce moisture intrusion. Lamination with plastic film is also being considered
- Side grips to be included
- Maintaining the volume and price as close to the *peti* as feasible.

Conclusions

In terms of protection afforded to the produce, these transport trials were considered to be a success. CFB cartons offer a viable alternative to the traditional wooden boxes. It is a technology that can be replicated throughout India and other countries for the transport of horticultural produce and therefore have a massive impact on the felling of trees.

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