Lebouit

TRANSPORTATION SYSTEMS FOR PLUG PLANTS GROWN FOR TRANSPLANTING PROCESSING TOMATOES

G.B. Hergert
Engineering & Statistical
Research Centre
Research Branch, Agriculture Canada
OTTAWA, ONTARIO
K1A OC6

E.J. Tomecek
Horticultural Crops Advisor
Plant Industry Branch
Ontario Ministry of Agriculture
& Food
RIDGETOWN, ONTARIO
NOP 2CO

INTRODUCTION

An opportunity exists for Ontario greenhouse growers to export tray-grown plug plants to other parts of the province, and to Michigan, Ohio and Indiana. Markets could also be available in Quebec and the Maritimes, particularly for cole crops to be planted later in the season. The purpose of this report is to suggest a plug plant transportation system and evaluation of such a system.

Export markets depend on an efficient method of transporting the tray-grown plug plants on trucks, which must include maximizing payloads and reducing loading times. Special requirements for transportation are required to protect the growing plants and to allow multi-tiered stacking. Three methods of handling plug plants for long distance transport exist as listed below.

EXISTING PLANT HANDLING METHODS FOR TRANSPORTATION

The most common tray used in Ontario for tomato transplants is the Blackmore 288 (or equivalent) tray which holds 288 plants in

individual cells and measures 11 x 22 in. (28 x 56 cm) and has a plant density of 170 plants/ft^2 (1830 plants/m^2). These trays are sold as being disposable after one season but most growers re-use the trays 2 or 3 times. Alternate trays have similar plant densities and are made of more durable materials for longer life. Re-useable trays usually have larger exterior dimensions. This report assumes the use of Blackmore 288 (or equivalent) trays.

1. **Waxed Cardboard Boxes.** Plants are removed from the trays and placed in cardboard boxes for delivery. This method is used for plants delivered from Florida.

   Advantages
   - compact packing to maximize payload;
   - little investment in transportation racks;
   - no need for rack return;
   - boxed plants are easily loaded onto transplanters;
   - boxes may be handled on standard pallets.

   Disadvantages
   - plants can deteriorate quickly in the boxes causing problems if transplanting is postponed because of weather;
   - plants require individual handling at the greenhouse for placement in the boxes;
   - plants require individual handling during transplanting and may have tangling problems;
   - system is not suitable for automatic transplanting.

2. **Heinz USA Transportation Boxes.** Plants still in the trays are placed into large three-sided boxes about 44 in. wide x 96 in. high and either 44 or 55 in. deep (1120 x 2400 x either 1120 or 1400 mm), having shelves to support the trays. The boxes are

handled by fork-lift trucks for loading and unloading. When placed onto a flat bed truck, with open sides to the centre, the boxes create a closed environment for the plants.

Advantages
- easily handled with fork-lift trucks;
- plants remain in trays.

Disadvantages
- trays must be handled individually during loading and unloading;
- high initial cost;
- boxes must be returned to owner;
- plants must be unloaded from boxes if transplanting is postponed to allow watering and exposure to sunlight (trays handled individually);
- requires individual tray handling to load onto transplanter unless the transplanter has facilities to accept the box;
- would require a fork-lift in the field if boxes were loaded onto the transplanter;
- lower density for shipping than using cardboard boxes.

3. **Trays on Racks.** Trays are held on racks with from 14 to 16 trays each, from the time they are placed in the greenhouse to until they are transplanted. The racks are carried by two people. Transportation from the greenhouse to the fields is accomplished by using special trailers with supports to hold the racks.

Advantages
- trays are handled on racks holding 16 trays each;
- plants easily unloaded, 16 trays at a time to place in a holding area should transplanting be postponed;
- racks suit an already developed seedling production and delivery system from greenhouse to transplanter;
- cost savings for all segments of seedling production and transplanting.

Disadvantages - high initial cost;
- trailers do not have capacity for long distance delivery of larger orders.

PROPOSAL: BOXES TO SUIT THE RACKS USED IN ONTARIO

The rack system already developed in Ontario has shown its advantages for reducing labour for both the greenhouse operator and the tomato grower. By making slight modifications to the trays and by providing suitable boxes to hold 11 or 12 tiers of racks, an efficient long distance delivery system can be developed.

Box Design Strategy

1. **Assumptions**

Tray size - Blackmore 288 (or equivalent)

Rack size - Present racks were designed to hold either 14 or 16 trays. The loaded dimension is 44 in. wide by either 77 or 88 in. long.

Highway Trailer Size - Flat Bed: 8' x 45' (legal width limit is 102" wide)

- Van: 8' x 45' inside.

Plant Height - 6 in. (150 mm) from top of tray.

2. **Design Considerations**

If a box is 90 in. wide, 44 1/4 in. deep and 96 in. high, and uses 2 x 4 skids, a 5/8 in. floor and 1/4 in. cladding, the useable inside dimensions would be:

inside height = 91 7/8

inside width = 89 1/2

inside depth = 44

A rack, 88 in. long, and 44 in. wide will hold 16 trays.

For trailer loading, 6 boxes 90 in. wide will fit a 45 ft (540 in.) length. A box depth of 44 in. leaves 11 in. of waste space available on the width of the trailer. If one-half of the boxes were made 11 inches wider, loading efficiency is increased by 11%.

A rack, 88 in. long and 55 in. wide will hold 20 trays. (A narrow rack 88 x 11 could be used with a 16 tray rack.)

3. **Theoretical Capacity of a Typical Truck Load**

Each box would hold 11 tiers of plants.

Six boxes 90 x 44 1/4 in would hold 16 trays/tier.

Six boxes 90 x 55 1/4 in. would hold 20 trays/tier.

Each pair of boxes would hold:

288 x 36 trays x 11 tiers = 114,048 plants.

A truck with 12 boxes would hold:

114,048 x 6 pairs = 684,288 plants.

Capacity could be increased if one extra tier was added to each box but this would require increasing the box height and piecing of exterior cladding (assuming 8 ft high cladding is used).

Capacity of a single tier of 6 pairs of boxes:

288 x 36 trays x 6 pairs of boxes = 62,208.

Capacity with 12 tiers = 746,496 plants (theoretical).

The above capacities are theoretical. Actual capacity would

depend on average cell fill and would range from 5 to 15% less.

4. Design Considerations

a. Cost - Low cost materials because the boxes will be used for short period each year. Boxes can be used to store normal racks during off-season.

b. Size - To maximize the load that can be carried on a truck and to use existing racks that have developed.

c. Portability - It is assumed that boxes will be handled with fork-lifts, sometimes on front-end loaders of tractors. It would be ideal if boxes would fold but such a design can be considered if tests show the concept for a rigid design is acceptable in principle.

5. Racks

The size of the racks presently used vary from 77 x 44 to 88 x 44 (loaded width) to suit existing greenhouses. Both wooden 2 x 4 and steel 1 x 1 x 1/8 angle iron construction are used. For this design, because of efficiency of loading a 45-ft long truck, the 88 x 44 size rack will be used. Angle iron construction will be chosen as it offers a much more efficient tiering situation to increase the plant capacity of the box.

6. Possible Problems During Transport

Racks bouncing and dislodging from support. Be sure that racks are long enough that they cannot fall if they slide to one side.

Racks slide out of box while in truck. Be sure boxes are pushed against one another and secured with straps.

Racks sliding out of box while on fork-lift. If the fork-lift is sufficiently strong, the operator has to be sure that the boxes are tipped to prevent racks sliding. If the fork-lift is marginal or if being manipulated with a front-end loader without self-levelling devices, sheathing should be strapped to the open side of the box to prevent such accidents.

Trays bouncing from racks. The design of the racks should prevent trays bouncing completely out but as a pre-caution, trays should be watered to their maximum holding capacity to maximize their weight. Driver should be aware that severe bumps can cause problems.

Different length of truck. Boxes can be loaded on different lengths of trucks in 90 in. intervals. If only 45 in. or more (but less than 8 ft) is left, the rear box can be installed across the width. Be sure wind cannot enter the box.

Different width of truck. The design of the boxes are such that almost all of the weight of the racks rest on the end panels so the box can extend over the side of the truck slightly. Legal width of trucks is 102 in.

7. Use of Shorter Racks

For situations where racks are 11 or 22 in. shorter, the box must be redesigned. A stop-gap measure would provide a false wall in the box.

8. Use of existing racks

Angle iron racks can be modified to provide a solid extension beyond the edge of the trays and out to 89 in. total width. Racks made of wood 2 x 4 construction require redesign of both the box and racks but they can never be efficient. If the racks are built 89 in. long, trays would have to be loaded on top. This would result in 3 1/2 in. loss of loading capacity for each tier. If the racks were made to be loaded inside of the 2 x 4 frame, the length and width of the box would have to be increased and would affect the efficient truck loading capacity outlined above.

HOW THE BOXES AND RACKS AFFECT THE PRESENT GROWING SYSTEM

An efficient plant production system for producing tray-grown plug plants is evolving in Ontario, based on handling the growing plants on racks holding 16 trays each. The transportation system described here takes advantage of this technology developed by growers. Changes and their possible effects are listed below:

1. Racks have to be slightly longer than used presently to fit onto the tier shelves on each side of the box. This should have no effect on the present system except that new racks for transport plants and/or modifications to existing racks would be required. The only actual different is that the rack length must extend to the outside dimension of the trays.

2. Single tray width racks are required for loading the wider boxes. These can be handled with trays during the growing process or can be loaded with trays when the boxes are loaded. These trays will account for 11% of the total plants.

3. The requirement for a longer rack will cause problems for growers who already have racks built but as expansion occurs and racks are built to suit the boxes, there will be less management required to ensure export orders are loaded onto the proper trays.

4. Time study of loading the boxes requiring individual handling of

trays versus rack handling of trays is required to fully evaluate the value of each.

5. Costs of boxes for handling the trays individually as opposed to handling the trays on racks are likely to be similar, but a detailed cost analysis would be worthwhile.

The cost of racks for the latter design is much higher but such racks are already in use by most Ontario plant growers. Extra cost involved could be such items as:

a. effect of racks not returned;
b. effect of racks not returned on time for subsequent planting;
c. effect of trucks returning empty and having to return later for box and rack pick-up.

CONCLUSION

The rapid growth of tomato plug plant production in the last three years is providing opportunity for many plant growers. An efficient plant handling system has involved using racks to hold the plant trays. An evaluation of a transport system for out of area sales is important at this time because new customers are available and are looking for the most efficient system. A standardized system developed now, lead to long term export possibilities as the move toward plug plants and improved semi-automatic and automatic transplanters continues.