PVC ROLLER CONVEYOR BENCHES FOR SEEDLING TRAYS

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Abstract. A roller conveyor bench utilizing 10 cm diameter PVC pipes for the rollers is described. The bench is designed to support and transport seedling trays weighing approximately 20 kg/m^2. The economical roller conveyor bench system increases the efficiency of labor and greenhouse space utilization.

Nurseryman with bench-type operations are very interested in improving material handling methods and also in maximizing their greenhouse bench growing area. Conventional bench and aisle greenhouses are inefficient with regards to both labor and space utilization.

Innovations in greenhouse materials transport systems include conveyor belts (2), various rail systems (1,2,5) and movable tables or trays (5,9). Laterally moving bench systems (4,6,8) and complex devices such as the Ferris wheel (6) have been devised to increase greenhouse space utilization. Roller conveyors have long been used to transport materials for numerous industrial and warehousing operations (3) but the corrosive conditions in greenhouses and their high cost have discouraged use in greenhouses.

This paper will describe a simple roller conveyor bench system which is labor and space efficient. It is fabricated from readily available corrosion and decay resistant building materials.

The roller conveyor bench system (7) is illustrated in Figure 1. Seedling trays ('34 x 67 cm) loaded with media and plants (20 kg/m^2) are placed on one end of the roller bench and pushed down the line by each additional row of trays. Trays are then collected at the other end when they are ready for their next growth stage. This allows the nurseryman to load newly planted seedling trays on one end of the bench and remove the trays of finished seedlings from the other end. Thus, the need for aisleways is eliminated since they are no longer needed because th trays are not manually carried to a bench location.

PVC pipe is an ideal roller tube material for a greenhouse environment because it is resistant to corrosion by fertilizers, pesticides and high moisture conditions. Rollers consist of 1.4 m lengths of 10 cm diameter PVC drain pipe (ASTM D-2729). End plugs were fabricated from 1.9 cm thick treated plywood with drilled holes (1.3 cm) as the bearing surface. Plastic end plugs with bushings were commercially available only for schedule 40 pipe with diameters up to 7.5 cm. Rollers were suspended between wooden frame rails with 9.5 mm x 1.5 m long cold rolled steel axles. The 5 x 15 cm treated frame rails were supported by wooden posts at 3 m intervals. To eliminate upsetting of the trays between rollers, the maximum satisfactory spacing between rollers was determined to be 30 cm since this insured that every tray was supported by at least 2 rollers at all times. The maximum uniform load on any individual roller was 13.5 kg. This load caused a mid-point roller deflection of only 1.5 mm and resulted in only a negligible bobbing effect of the trays as they passed over the

rollers. A 30 cm roller spacing and 1.4 m tube length performed acceptably through an overload factor of 4x (80 kg/m^2). A normal load consists of individual trays weighing 5 kg (20 kg/m^2).

The maximum force required to move a bed of trays occurred as the rollers initiated rotation (breakaway force). Breakaway forces decreased as the slope of the bench increased (Table 1). For instance, under laboratory conditions with a bed, 2 m in length, a breakaway force of 3.8 kg was required to move the trays on a flat bench whereas only 1.6 kg was needed to move the same load on a 4 percent downward sloping bench.

In a seedling greenhouse fitted with a prototype roller conveyor on a 2 percent slope, the breakaway force required to move a 10 m long bed of trays was 22 percent greater than in the laboratory. A slight binding of the trays and increased flexing of the rollers due to a higher temperature (30°C) were contributing factors.

Copper bushings consisting of 2 cm lengths of 1.3 cm diameter copper tubing were inserted into the wooden end plugs in an attempt to improve the bearing surface between the axle and the plug. The improved bearing surface reduced breakaway force by 30 percent.

Therefore, the calculated breakaway force for a 30 m long bed of trays at a 2 percent slope with a load of 20 kg/m^2 is 30.7 kg when copper bushings are used. An average nursery worker would be able to push this large load (840 kg).

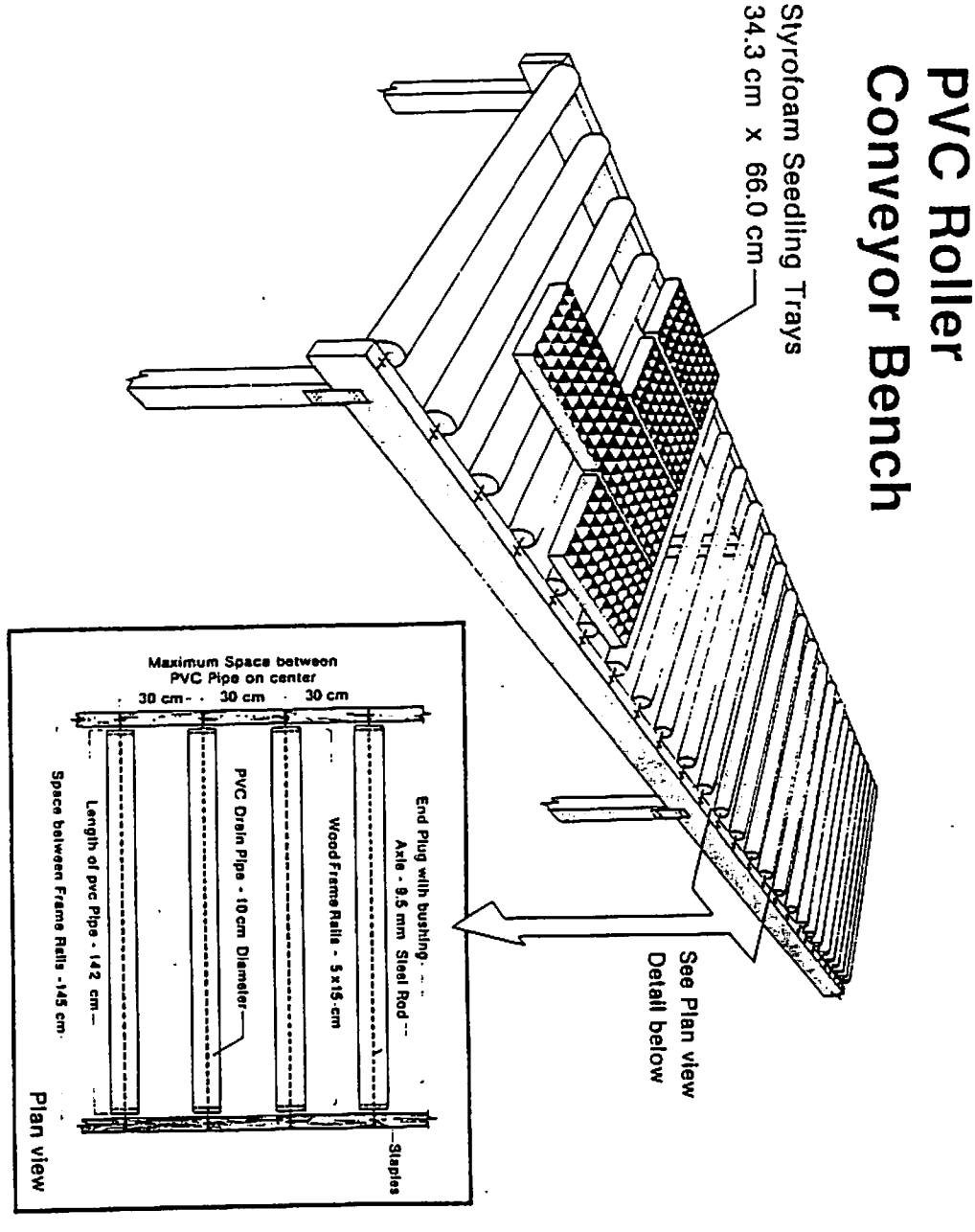
A PVC roller conveyor bench is relatively inexpensive especially when one considers the increased efficiency of greenhouse space utilization. Roller conveyor benches can be fabricated with readily available materials by nursery workers.

Table 1. Breakaway force (push_ required to move a bed of trays 1.4 m wide by 1 m long for a normal load of 20 kg/m^2 at 4 different bench slopes as tested in the laboratory.

Bench slope (per cent)	Kg of pushing force/m of bed length
0	1.90
1	1.65
2	1.20
4	0.80

Figure Caption

Figure 1. An illustration of a roller conveyor bench.



Literature Cited

1. Damen, P. C. 1979. A new internal transport system in spray carnation growing. Vakblad Voor De Bloemisterij 34:26-27.

2. Hendrix, A.T.M. 1975. Transport systems in glasshouse horticulture. Netherlands Journal of Agricultural Science 23(3):231-237.

3. Kulevie, R. 1974. Package and unit handling conveyors. Plant Engineering 28(12):122-128.

4. Labowsky, H. J. 1977. Mobile glasshouse benches. Deutscher Gartenbau 31:1372-1373.

5. Onstenk, R. 1979. Internal glasshouse transport need not always be expensive. Vakblad Voor De Bloemisterij 34:68-73.

6. Poole, H. A. and P. C. Badger. 1980. Management practices to conserve energy in Ohio greenhouses. Ohio Agric. Research and Development Center. Special Circular 104.

7. Sletteland, N. T. and B. A. Kratky. 1984. A PVC roller conveyor bench designed for greenhouses. ASAE Paper No. 84-1089, ASAE, St. Joseph, MI. 49085.

8. Wlowski, J. 1978. A mobile greenhouse bench. Ogrodnictwo 15(7):181-183.

9. Young, R. E. and D. D. Murphy. 1982. Centralized shipping for an ornamental greenhouse. Transactions of the ASAE 25:872-875.