REPORT ON STUDY TOUR OF DUTCH FORCING TECHNIQUES IN MECHANISATION AND HANDLING

HORTICULTURAL DEVELOPMENT COUNCIL
BULBS AND FLOWER PANEL
PROJECT B/11

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SUMMARY AND CONCLUSIONS

Dutch forcing techniques did not appear to have any significant benefits in handling and mechanisation over those of the leading UK forcers. The main difference in performance was attributable to management and attention to detail.

Large forcing trays have advantages in handling by reducing labour costs and the number of people involved in handling. There appeared to be no advantage over traditional trays in forcing techniques, or the present system of selective cropping. The report describes an optimum design to suit the UK forcer.

Holding stores in Holland used basically the same techniques for environmental control as in the UK. The report however describes methods for ensuring minimum drying out of rounds held for prolonged periods.

1 CONTAINER SIZING FOR HANDLING

The use of a unit larger than the standard tray purely as a means for saving labour in handling must be balanced against cost and versatility.

1.1 Size of large tray

The width of a tray, is governed by the comfortable reach of the croppers, as set out in the forcing house. This limits one dimension to 1.2 m (4'). Trays in Holland were cited most commonly as 1.2 m x 1.2 m, but some were at 1.8 m x 1.2 m, which are accceptable from the ergonomic point of view provided the trays are placed to from rows 1.2 m wide. The 1.8 m tray entails forklift handling in the "long" direction if the rows are set up along the length of the house (see fig 1), which effectively derates the forklift capacity due to the long load centre created.

Tray depth and leg height are also important. Whilst the standard tray contains about 75 mm of peat, large trays with mechanical handling can accept greater depths if these are needed for cultural reasons. There is evidence that a depth of up to 150 mm of soil has proved beneficial to tulips in Holland. Narcissus, being surface planted, might not need this depth but the large UK tray considered in this report has been designed for 100 mm of soil/peat depth. Dutch trays were, in the most, designed for outdoor plunging so had no need for legs for vertical spacing in a cold store. The model UK large tray (see fig 2) has 125 mm legs to allow 100 mm growing headroom and 25 mm for fork time depth.

Due to the loss of handles, edges etc, the model 1.2 x 1.2 m large tray has the same growing surface area as 5½ small (traditional) trays occupying the same external area.

1.2 Cost Comparison of large and small trays

UK costs for a similarly sized mushroom tray are £20.00, which can be compared with 5½ equivalent small trays at £1.50 each costing £8.25.

Life of either tray depends on the care in its handling, but the traditional tray being flimsier might need more repair, so it is assumed that it has a replacement life of 4 years and the large tray 6 years. This gives a simple annual cost of £2.06 for traditional trays and £3.33 for large trays.

1.3 Handling trays

It is assumed that a pallet load of 40 traditional trays at 20 kg each would weigh 800 kg plus the pallet. This would come within the scope of a 1 tonne forklift.

The large tray, with 100 mm of peat would probably weigh 150 kg. A 1 tonne forklift could thus handle a stack of 6, this being the equivalent of 2/3 of a pallet of traditional trays.

The forklift could place the trays in rows along the house to within 4 m of the door end. Unless the whole end was able to be opened the final 3 trays in each row would have to be placed with a hand truck. This would necessitate a concrete floor.

At 150 kg, the large trays could not be manhandled.

1.4 Handling Costs

Evidence from NIAE work in 1970 suggests a house filling rate of 60 trays.man hr. By comparison, average cycle times for running a large tray into the house and placing it could be 1½ minutes, or 200 traditional trays/man hr equivalent. At £4.00/hr the relative cost would be:-

1 Traditional tray	6.7p
Large tray equivalent in traditional trays	36.9p
1 Large tray	10.0p

It is assumed that emptying would incur the same labour as filling so the costs per round would be:-

Large tray	20p
5.5 traditional trays	74p

On 5 rounds per year, this labour cost saving from using large trays would be £2.70 per large tray unit.

Taking, as an example, a 0.1ha (¼ acre) forcing house holding 1100 traditional trays or 200 large trays, the annual saving in handling labour would be £540.00, against an extra investment in large trays of £254.00.

It is assumed a forklift is also occupied moving pallets of traditional trays so no extra costs have been put in against the large trays.

The large tray system can be handled with only one person. The traditional trays would normally need a gang of two or three at least. This could have implications if other activities such as cropping in another house dictates a shortage of labour.

2.0 FILLING, PLANTING AND EMPTYING

Traditional trays can be filled and planted on an automated line. Such a line could be made for large trays (similar ones exist for mushrooms) but it is doubtful whether the cost could be justified.

The large tray could more simply be filled using a forklift bucket and hand levelling.

The Dutch have tried several methods for automatically planting bulbs the correct way up, but all have failed. This has included robotic methods, which whilst feasible are slow. The fastest cycle time for an intelligent robotic arm is still around 2 seconds, thus taking around 3 minutes to plant a traditional tray, or 16½ minutes for a large one. By comparison a good operator setting out bulbs scattered on the surface should achieve between 40 to 50 bulbs/min, so planting a traditional tray in about 2 minutes.

A simple filling station for large trays could consist of two tray positions and three operators. In one position a forklift could place the tray, fill and the driver level it whilst at the second, the two other operators could plant. The typical turnround on 550 bulb/tray would be 6 minutes.

Watering large trays could be by hand spray, in a similar way to traditional ones. Alternatively, the large tray would fit into a box drencher, similar to those used for apples or white cabbage. Using a recirculation system like the drencher, would enable chemicals to be added without undue wastage.

Emptying large trays would have to mechanised. The simplest system using a rotating head forklift unit tipping directly into a cart, or bulk hopper if reclaiming. This could be done by one operator, as opposed to a gang being needed to clear and tip traditional trays.

If needed to cleanse and disinfect, the large tray would be a simpler item.

3.0 STORAGE ENVIRONMENT

A palletised stack of traditional trays, 40 per pallet, 2 pallets high would occupy a floor area of 1.35 m^2 and be 3.2 m high. The equivalent number of large trays would occupy an area 1.44 m^2 but need to be 15 trays or 4.6 m high, needing an internal store headroom of 5 m. This could preclude some stores from holding the equivalent number of large trays.

3.1 Air Circulation

Air movement within traditional tray stores is sometimes less than desirable, with freely blowing cooler units directly discharging onto certain tray stacks, causing localised drying out.

Most tray stores are solidly stacked, with no access gangways to allow good circulation. However, the construction of most trays with handles automatcially leaves vertical air passages in even the most solidly stacked store. For cooling purposes use has to made of these small gaps by distributing air evenly throughout the roof headspace. This would require the use of a ducted system with correctly designed distribution holes such as a perforated polythene system.

A more sophisticated system is offered by a Dutch manufacturer, consisting of an overhead duct system with vertical ducts dropping from it. These vertical ducts fit into passageways between the tray stacks and have distribution holes to coincide with each tray layer. This system has the fundamental requirement of needing gangways between rows of pallets.

Large trays, as in the proposed design, could stack very tightly together and thus make any vertical penetration of air impossible. There are two solutions, redesigning the trays with spacers to make vertical gaps or using horizontal ventilation. Tray spacers would be vulnerable to damage and would waste space in the forcing house. Horizontal ventilation is possible by modifying one wall, say the rear wall, to form a supply plenum when the trays are stacked against it. The airflows to maintain a maximum differential of 1 deg C across a 10 m wide store would be 250 m^3/h per large tray.

This would however produce a very low airspeed which would not carry across the width. It is therefore better to increase this to 1500 m^3/h per tray and to ventilate intermittently, for example 10 minutes per hour. This would have the additional advantage of reducing moisture loss because during the remaining 50 minutes a microclimate would develop which would quickly saturate to prevent further drying.

Small tray stores could in theory be ventilated in this way, but irregularities in the stacking would disrupt the airflow and preclude the intermittent high speed purging.

3.2 Humidity

The best way to prevent drying out in store is to install refrigeration of the correct specification and ensure that the air distribution avoids certain trays being subjected to a constant, drying airstream.

Refridgeration plant specification to ensure high rh can prove expensive. It is also possible to consider artificial humidification of the store air, both to cheapen a new store or to upgrade an existing, problematical one.

Humidifiers using hydraulic spray jets, compressed air/water (ultrasonic) nozzles or spinning discs are all suitable. Complete evaporation of their discharge is not as important as in other crop stores because any free water droplets not vaporised can be absorbed by the compost. Output of the humidifier will depend entirely on the refrigerator specification but a useful guide is 0.5 litres/hr per ton of boxed bulbs. Artificial humidification will increase the rate of ice buildup on the evaporator coils, leading to more frequent defrosting.

High humidity systems (ice bank or polacell) used in crop stores are ideally suited to prevent drying out, but will not be able to hold the store below about 1 °C.

Pallet wrapping, as used for "ice tulips" should prevent dehydration in problem areas close to the cooler discharge. However, wrapping must not be so complete as to prevent exchange of air and lead to ethylene or other gas problems.

If the above steps can be taken the complex methods of in store rewatering are not necessary.

4 FORCING HOUSE LAYOUT

4.1 Large Trays

Figure 1 shows large trays in 3.2 m x 6.4 m span greenhouses. For cropping it is essential to have access to both sides of the tray, necessitating a pathway along each side wall.

In both cases a single span would be difficult to work, as the pathways could only be 260 mm (10") wide. However multiple spans could be worked easily without having to fit a line of trays between stanchions.

Whilst forklift access requires a height clearance at least 2 m, older, lower houses could be filled using a hand pallet truck, provided the floor was flat concrete.

Large trays could be placed on stands, as seen in Holland, to raise them to a height which best suits cropping. If all rows can be filled from one end it is theoretically possible to have permanent raised walls to sit the trays on. These would be an encumbrance to other uses, and would not allow the forklift or pallet truck to approach from the sides. Because of forklift access it is not possible to place further large trays on top of those from earlier rounds, so each round has to be cleared before refilling.

4.2 Benching Traditional Trays

Several tulip growers in Holland used mobile benches. These had an advantage in increasing the house area used for cropping by up to 30%, but this has to be set against an extra cost of at least £25/m^2 for the benching. Also the number of croppers can be limited by the number of operable pathways.

Mobile benching precludes forklifting pallet loads of trays into the house unless the main paths are 1.5 m or more wide. In most Dutch tulip houses trays had to be conveyed the full length of bays using roller conveyors.

In theory, roll in/roll out benching, as used for crops like pot chrysanthemums, could help filling but it is doubtful whether the cost could be recovered in the man hours saved.

5 CROPPING

The slightly raised level of the proposed model large tray should be an advantage to the posture and comfort of croppers. Otherwise, the large tray appears to offer no advantage over a block of small trays forming the same width of crop.

5.1 Once Over Cropping

The major advantage will only come when selective cropping is no longer needed and, for example 70% or 80% can be cropped at once. Then, the tray can be carried by forklift to a cropping station. Schemes have been mooted to convey trays, on a merry go round principle past the croppers and thence back to the forcing position. This is in theory possible and equipment already exists in industrial handling to do it, but costs could well be ten times the cost of the house, or five times that of mobile benching.

5.2 Crop Density

One narcissus forcer in Holland remarked that cropping was faster in a thin crop to the extent that croppers could take 60 bundles/hr compared with 40/hr from a lush crop. This was reckoned to be due to the ease of locating the stem base of an identified bud.

According to some UK workrates, an average cropping rate is 60/70 bunches/hr, already higher than the Dutch situation. If the UK forcers could increase cropping rate by 10 bunches/hr there could be a saving on cropping of 1p per bunch at current labour costs.

Thinner cropping could be achieved by reducing the number of bulbs/tray or by cultural practices which would reduce leaf growth without affecting flower quality. Reducing the number of bulbs/tray would reduce bulb and planting costs also but the increase in fixed costs per bunch would negate any savings. Treatments to reduce foliage density without affecting the yield of flowers/tonne could however show direct benefit from picking cost reduction.

5.3 Flower handling

Flower handling might be improved marginally using large trays, using a simple push along carrier over the path, running on top of the tray sides. All the operations: bunching, trimming, sleeving and boxing, could be done by one operator on this carrier without having to rehandle the bunches as done at present. Traditional trays do not lend themselves to using this type of carriage.

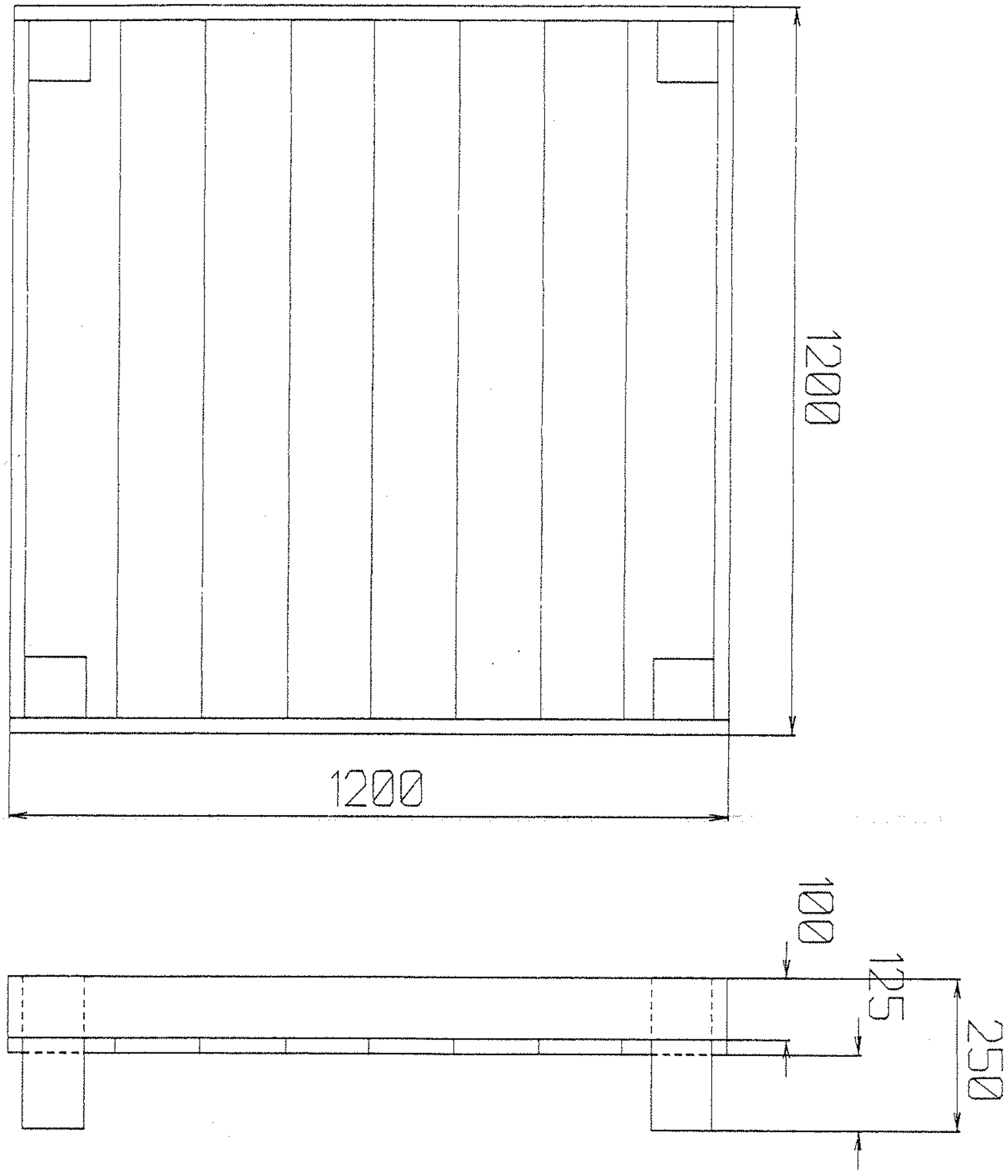
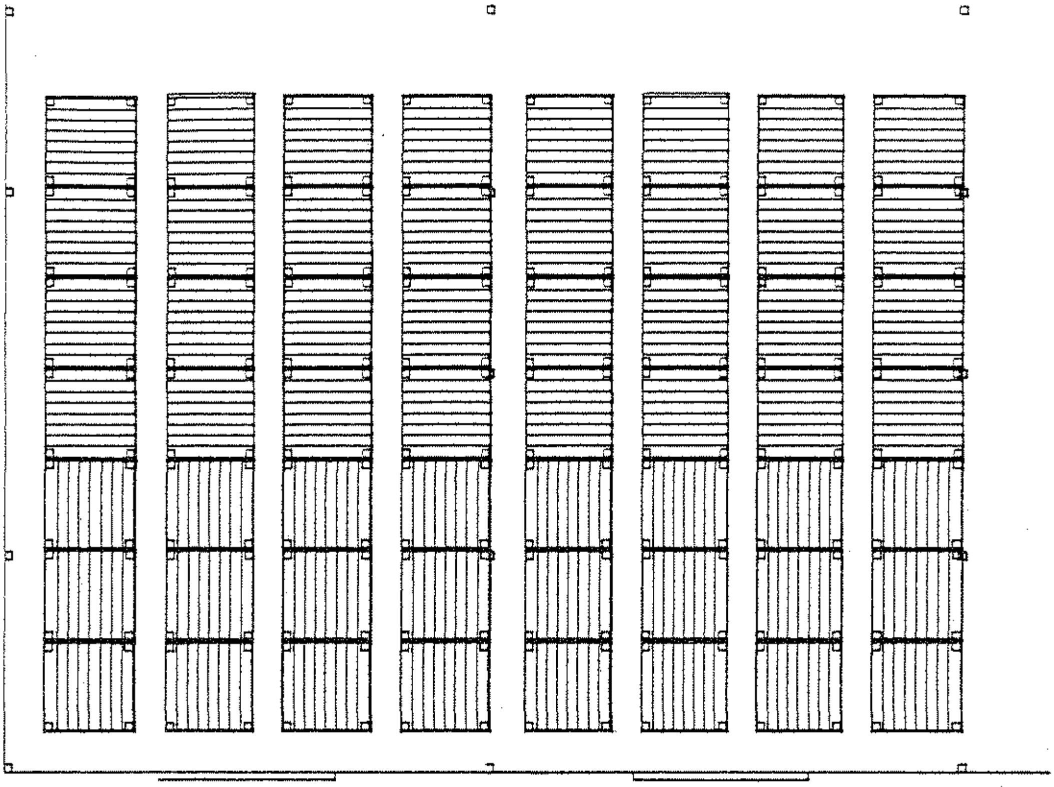
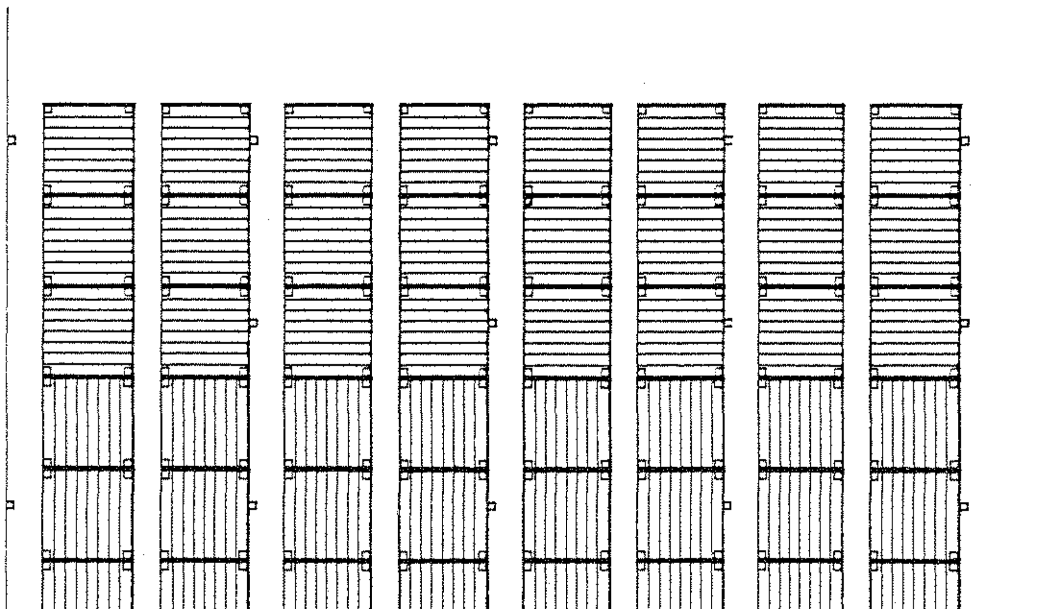


FIG.1 PROPOSED LARGE FORCING TRAY



Double Venlo, 4 rows per span, 400mm paths



Single Venlo, 2rows per span, 400mm paths

FIGURE 2 - FORCING HOUSE LAYOUT