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Transport systems in glasshouse horticulture*

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Summary

Several transport systems are in use which may be divided into conveyor belts and rail systems. Conveyor belts are used only for single-harvested crops. Conveyor belts should be mobile because of the high annual costs which are the result of the high investment. Part of the savings in labour is lost by the need to move the belt from one place to another. This is why conveyor belts are not economically attractive for use with crops which need to be harvested over a period of time. Rail systems are a better proposition for these crops. The capital and annual costs of rail systems are relatively low. Another advantage of these systems is that they may be used for harvesting as well as cultural operations in the crop. This makes them economically very attractive. Compared with the traditional methods of transport, the systems mentioned offer the following advantages: savings in labour, easier labour, more efficient use of the growing area, less handling and therefore better quality of the produce, possibilities of mechanizing certain operations and of using unskilled and/or female labour.

1 Introduction

Transport operations are an integral part of all human activities. In its most elementary form transport may consist merely of the movements of the hands in the performance of a task. More complicated transport movements are walking and moving goods. The latter is the subject examined in this article.

There have been enormous developments in transport in the glasshouse industry in recent years. The aim of all these developments – or systems – is to increase the efficiency of transport operations. In this context, efficiency may have several meanings, such as:

- quicker transport (savings in time);
- easier transport (less tiring);
- better transport (less damage to the goods transported).

All these factors have in common that they may have a favourable effect on the production process. This is of overriding importance in deciding whether one should change over to a certain transport system.

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2 Transport systems

In the glasshouse industry, the term 'transport systems' covers transport in the growing area by means of more or less permanent equipment, such as rail systems and conveyor belts. This is different from the normal concept of transport which does not necessarily take place via fixed pathways. Because of the fixed installation transport systems are subject to limitations (see Section 3). The nature of the transport system will depend on its purpose (transport of the operator, of the operator and produce, or of produce alone), the nature of the produce and the production methods. Because of these combination of factors, it may happen that several systems are used for one and the same crop. In the harvest of pot chrysanthemums, for instance, both conveyor belts (Anon., 1973b) and rail systems (Anon., 1973c) are used. The various systems available may be classified as follows:
– conveyor belts
– rail systems which travel over the crop, travel alongside or between the crop, or move the whole crop.

2.1 Conveyor belts

A conveyor belt is an installation consisting of rollers or wheels of which one roller or two wheels are driven by a motor. A belt or cords run over the rollers or wheels powered by the driver roller. For economic reasons conveyor belts are used only with crops which are single harvested. They have been constructed in such a way that they are mobile and may be moved within easy reach of the operator (van Mullem, 1972).

The capital cost of conveyor belts is too high to make it economically justified to equip the whole of the production area with more or less permanently fixed belts. On a year-round lettuce nursery producing 7 successive crops at a rate of 18 heads per m², the labour saved by using a permanently fixed conveyor belt would be about 4 h a year per 100 m². In 1974 labour costs were *f* (Dutch guilders) 12.50 per hour which would make up a money saving of *f* 50 per 100 m². However, the annual cost of a conveyor belt for this area would be about *f* 250 (Hendrix, 1973). These figures show clearly that conveyor belts must be mobile to be a viable proposition. Moving the belt on this lettuce nursery takes about 2 h per 100 m² per year (Hendrix, 1972), leaving a saving in labour for transport of 100 minutes per 100 m² per year.

For selectively harvested crops the use of conveyor belts is seldom economically attractive. On the one hand there is the high cost of the system compared with the savings in transport, on the other hand continually moving the belt takes more time than the possible savings in transport obtained from the use of the belt. In the case of harvesting cucumbers or tomatoes, the time taken to move the produce from each picking out of a glasshouse bay is 2 and 2½ minutes, respectively. If one were to use the mobile lettuce belt for this purpose, it would take about 17 minutes to move the belt from one bay to the next. Other transport systems must therefore be used for these crops (see Section 2.2.2).

Apart from lettuce (Fig. 1), conveyor belts are also used for pot chrysanthemums

Fig. 1. Transport of harvested produce by means of mobile conveyor belts.

(Anon., 1973b) and cut flower chrysanthemums (van Gaalen & Hendrix, 1973). Other possible areas of application may be endive, celery and pot plants which are cleared in the lump such as saintpaulias and zygocactus. With cut chrysanthemums the conveyor belt is used for two purposes: saving in labour for transport (van Gaalen & Hendrix, 1973) and the possibility of using machines (Fig. 2) which may speed up certain operations. Bunching is done by machine in this instance. The conveyor belt is necessary to carry the cut crysanthemums to the bunching machine on the main path.

Fig. 2. The conveyor belt with cords enables mechanizing certain operations such as deleafing and bunching.

Fig. 3. Transport of pot chrysanthemums with the aid of a trolley suspended over the crop.

2.2 Rail system

All the rail systems mentioned here have in common that transport takes place via a permanent installation. The installation consists of rails or pipes over which wheeled trolleys can run. Rails are usually installed in the central roadway, whilst transport in the glasshouse bays takes place via pipes (Anon., 1973a).

Fig. 4. Transport system amongst the crop. The platform on the trolley makes work easier.

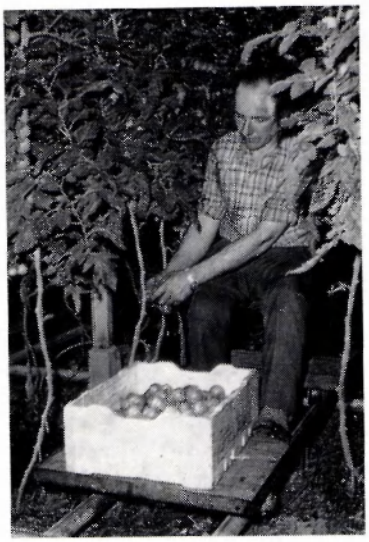

Fig. 5. Transport system amongst the crop. Picking tomatoes in a sitting position. No more moving of the picking baskets and/or the picking trolley is required.

2.2.1 Rail systems over the crop. With these systems the trolleys run on pipes suspended over the crop. Generally, the heating pipes are used for the purpose, but it is also possible to construct a separate rail system. The system is used with crops like pot chrysanthemums (Fig. 3).

2.2.2 Rail-systems alongside or between the crop. With this system the trolleys are moved or driven over pipes near the ground and the heating pipes are also often used for this purpose. The trolleys are often adjustable in height, depending on their purpose and the crop, so that they can be used as a working platform. This system is found particularly in crops like tomatoes, cucumbers and pot chrysanthemums (Fig. 4 and 5).

2.2.3 Rail systems which move the whole crop. This system is used only with crops produced in light-weight growing media (peat compost or rock wool) in containers which makes it possible to move the crop without affecting growth. To facilitate handling, the containers are often stood in racks which may be mobile or which are stood on mobile staging. However, mobile staging is very expensive and this system is gradually falling into disuse. Another point is that, compared with racks, mobile staging is difficult to handle. As far as is known there is only one nursery in Holland using mobile staging. This nursery produces cress (*Lepidium sativum* L.). The system of mobile racks, or transport grids, is still being developed. At the Institute of Agricultural Engineering (IMAG) at Wageningen, a glasshouse has been fitted out with such a system (Anon., 1973d). The transport grids can be moved on specially designed rails in the growing area, as well as over the main paths and in the packing shed (Fig. 6 and 7). Pot chrysanthemums are used as the test crop.

Fig. 6. Transport grids with pot chrysanthemums in the glasshouse. No loss of growing space through paths.

3 Advantages and disadvantages of transport systems

The magnitude of the advantages which may be gained by the use of a transport system depends on the system and the manner in which it is used. The cost of a transport system (see Sections 2.2.1 and 2.2.2) in which the heating pipes are used as rails, is relatively low compared with the system in which the whole crop is made mobile (see Section 2.2.3).

The disadvantages of transport systems are:
– extra capital investment;
– relatively many operators – 3 to 5 persons – are required to achieve the correct distribution – and therefore savings – of labour;

Fig. 7. Transport grid on the operating line. Better working position and the elimination of unnecessary handling may be achieved.

– the work becomes more monotonous as each worker is allowed to do only one operation in the chain.

The advantages of transport systems are:

– labour savings because:

• larger quantities of produce can be transported and handled at the same time (rail systems);

• manual transport of produce can be eliminated entirely (conveyor belt);

• the system may be combined with certain machines, such as a bunching machine at the end of a conveyor belt for chrysanthemums;

• a better work posture may be created; the system described in Section 2.2.2 gives a labour saving of 15 % in the harvest of tomatoes and a 20 % saving in the side-shooting and trimming of the crop;

– less tiring work as there is less lifting to do and because transport over rails is easier than over paths or the soil states that transport over a good path and over an uneven path is 1.2 and 5.7 times as heavy as transport on rails, respectively (Grandjean, 1965);

– greater possibilities of using unskilled labour as operations may be divided; in harvesting chrysanthemums, for instance, the only skilled operation is the shaping of the bunch;

– greater possibilities of employing female labour as the work becomes lighter;

– less risk of damage as there is less handling of produce;

– the use of conveyor belts with lettuce makes it possible to use lighter grade cardboard boxes as they are handled less and they remain dry (van Esch, 1973);

– with certain systems (see Sections 2.2.1 and 2.2.3) a higher degree of glasshouse utilisation may be achieved by the elimination of paths. In some cases, such as with pot chrysanthemums, the cultivated area may be increased by more than 10 %.

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