Overview of the Speedling, Incorporated, Transplant Industry Operation

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Historically, the use of transplants in the production of crops has been used on tobacco, timber, and many vegetables. Transplant use is justified if risk is reduced, yields increase, higher market prices are achieved, or production costs are reduced. If one or more of the above conditions is not satisfied, then direct-seeding in the field generally is selected as the primary method of starting the crop. As demand for greater yield increases to offset higher production costs farmers turn more and more to techniques to provide higher returns.

In the past 20 years, we have witnessed changes in the use of higher-cost production methods, such as plastic mulch, drip irrigation, pesticides, and laser-planing of land. The use of hybrid varieties has increased costs dramatically. When seed cost increases, the farmer no longer can afford to waste seed in direct-seeding; this therefore has spurred the increased use of transplants. All of these new costs place more pressure on the efficient use of seed and/or transplants.

Bare-root seedlings generally were accepted until the mid-1960s. After that time, transplants produced in individual cells were observed to produce higher yields. Other proven advantages included less seedling stress at transplanting, more-uniform growth, and a higher degree of plant survival. All this time, Leisey and Todd Farms in Sun City, Fla. (later to be known as Speedling, Inc.), were working to improve cauliflower production methods with transplants. In 1968, the development of the transplant flats produced superior results, and a patent was granted in 1970 for their unique flat design. From 1968 to 1973, Florida tomato, pepper, and cauliflower growers were changing to this system as fast as Leisey and Todd could build greenhouses. The farmers were seeing

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higher yields, more-uniform product, and earlier maturity than any previous time in their history. By 1973, the conversion to container-grown tomato and pepper transplants was fueled further by the introduction of full-bed plastic mulch by the Univ. of Florida. Full-bed plastic mulch methods were incompatible with bare-root seedlings.

The commercialization of mulch production escalated the conversion from bare-root seedling production to containerized transplant production. Speedling, Inc., was unable to keep up with the demand for new license agreements or additional greenhouses. In Summer 1973, Speedling, Inc., decided to offer the planter flat to other plant producers and growers.

**Greenhouse design**

The Speedling system consisted of a light-weight, multi-celled growing container; soilless mix; a greenhouse structure with 80% space utilization; and a mobile overhead watering system. In 1972, we realized that totally enclosed houses were inappropriate for seedling production in Florida. High temperatures would prevail during seedling production months, and ventilating the house by forced air provided inadequately uniform temperatures for seedling production. In 1973, open-sided greenhouses with free-standing greenhouses were introduced and accepted in most growing areas where mild sub-tropical to tropical climates prevail. Open-sided greenhouses allow for uniform temperature distribution, allowing uniform seedling growth without continuous forced-air circulation. Today, this is the most common greenhouse structure and system in use in the United States. Virtually all the transplant producers from the southeastern United States to California use an open-sided greenhouse with overhead watering trolleys. The use of space with open-sided greenhouses has increased efficiency from 65% to 70% to 90% in contrast to older systems.

**Cell flat systems**

In the United States, there are a multitude of transplant producers—the major factor that differs among them is the type of growing container selected. The most widely used container system is the Speedling system, or close copies of that system. In addition to the Speedling system, there are at least five different flat systems in use in the United States, such as:

1. Sunnyland Nursery system;
2. Plantway system, developed in the United Kingdom;
3. Plantel system;
4. Greenhart Transplant system; and
5. Plastomer tray system, by Bud Antle.

Each of these systems has unique advantages and disadvantages relating to expected tray life, seedling population per square foot, and the ability to be automated for field transplanting.

In general, the transplant tray systems listed can be broken down into three general categories:

1. Expandable polystyrene (EPS) tray system designed for multiple uses at low cost per tray (Speedling system).
2. Injection-molded trays, which provide the longest life and lowest cost per tray use. The initial cost is higher for the capital investment per tray; however, generally these are more compatible in design for automation (Plantway system).
3. Vacuum-formed trays, which have low capital cost with a short lifespan, and thus the highest cost per use. These trays generally cannot be automated without damage to the tray.

The primary disadvantage of vacuum-formed trays, besides inability for automation, is the inefficiency of handling a nesting type tray in the greenhouse.

**Speedling I system**

Speedling containers range in plant density from 29 plants/ft$^2$ to 270 plants/ft$^2$. This versatility permits the transplant industry to provide greater customer flexibility in different geographic areas, weather conditions, and crops. Crops such as fresh-market tomatoes, watermelons, and fresh-market bell peppers, requiring either low plant populations per acre or having very high economic return per plant, are grown in trays with low density per square foot. Field research on tomato showed that the larger cell size and its resultant higher seedling dry weight produced larger crops with larger fruit size. Consequently, this could increase grower profit in the higher market periods. Crops with low economic returns per plant, such as celery, cabbage, broccoli, onion, and forest seedlings, are grown in the high-plant-population trays to achieve crop profitability.

**Speedling II system**

In general, the system described up to this point is referred to as the Speedling I system, using overhead watering. In 1982, Speedling began research and development on an alternative system, Speedling II, to reduce disease pressure caused or influenced by the use of overhead watering. This system involved the use of recycled sub-irrigation in seedling production. The first production facility using this concept was constructed and used by Speedling in 1984 in Bushnell, Fla., with further expansion in 1989. This nursery has 0.5-million ft$^2$ of production area. The second nursery construction began in 1991 in Nipomo, Calif.; it has 0.5-million ft$^2$ of production area. Speedling II is designed to flood beds with a nutrient-fortified water for plant growth. The only water applied above the flat is that supplying supplemental fertilizer or pesticide applications. Speedling II has virtually eliminated foliar disease problems encountered with the Speedling I system, such as seed-borne diseases in which leaf wetness encourages foliar diseases in specific crops or seasons. Advantages of sub-irrigation of transplants include the 50% to 65% reduction of pesticide use, 85% reduction of water use, 50% reduction of fertilizer use, elimination of groundwater contamination, and infrequent occurrence of foliar and soil-borne diseases. With >10 years of R&D and production experience in this growing system, we have found that seed-borne pathogens did not contaminate other seedlings, compared to overhead systems, which may spread pathogens from one plant to another. The California sub-irrigation greenhouse, in addition to the above advantages, has a rain water collection system to collect and store all rain water for use in transplant production.

**Speedling tobacco flat system**

In addition to Speedling I and II systems, the third system being used by Speedling, Inc., is the tobacco float system. In this system, the flats are floated continuously during their entire production cycle. Today, both plug-and-transfer or direct-seeding methods are used for tobacco.

In the plug-and-transfer method, seedlings are produced in a high-population plug tray of 350 plants/ft$^2$. After these seedlings are germinated and well-developed, they are sent to tobacco farmers, who transfer the tobacco plug to a finished flat of 80 to 100 plants/ft$^2$. These plants are finished on a constant-float bed until they are ready to be transplanted into the field. In the direct-seeding method, the finished flat is direct-seeded and floated continuously during its entire production cycle. Today, research indicates that the plug-and-transfer system for tobacco has an advantage over direct-seeded flat systems in yield, transplant shock, and premature flowering. The difference between plug-and-transfer and direct-seeding methods is presumed to be related to the number of feeder roots available to support the plant at field planting. The direct-seeding method produces fewer roots, resulting in more transplant shock at the time of transplanting.

**Transplant delivery**

Transplants produced with any of the three Speedling transplant production systems may be transported to the grower’s field by two delivery methods. One method involves a pull-and-pack method, in which plants are removed from the growing flat, placed in corrugated shipping cartons, and transported to the grower for transplanting. The second method uses shipment of the flats containing plants in rack trailers and transported to the grower’s field. With this method, there is less...
transplant shock and generally superior plant performance. However, due to shipping costs and grower location, shipment in the flat is not always cost-efficient from the grower's viewpoint. Additional research is needed to compare differences in yield and length of time plants are in darkness during shipment for these two methods of shipping.

Summary

In conclusion, the primary reason for the development of a transplant industry was to improve plant performance, yields, and grower profits by reducing growers' risks. Prior to the development of containerized systems, uniformity of plants in the field from bare-root seedlings, as well as survival, was less favorable than with the containerized systems in use today. A properly grown seedling in a containerized system will result in superior survivability in the field, improved uniformity, and higher yields. Today, major changes have occurred with growers using containerized rather than bare-root transplants. Bare-root production in many crops has lost favor, and is used only when the crop requires the lowest cost input, such as with onion, celery, or cabbage.

Future trends

Speedling will be moving in the future to greater use of sub-irrigation methods of plant production to reduce ground water contamination and produce plants with less disease.

Systems improvements needed for the future include:

Seed research for high germination, high vigor, and pathogen-free seed.
Research on the effects of shipping conditions, such as temperature, duration of shipment, pre-conditioning of plants for shipping, and the relationship of climatic conditions prevailing between the seedling production site and the geographic area where seedlings are used.

There are many improvements yet to be discovered if the transplant industry is to continue to meet the needs of the industry. The future is very strong due to research supported by the industry and many universities.