Plug and Liner Production: Are You a Grower or Manufacturer?©

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Profitable production of young plants (seedling plugs and rooted cuttings) requires consistency, efficiency, and tracking of costs and revenue. Uniform quality across a tray, shipment, and over time is demanded by a market place that is characterized by increasing competition and tight profit margins. The artisanal perspective of horticulture has given way to plant factories, as economies of scale push young plant production towards highly specialized and mechanized operations. However, the requirement to minimize waste in terms of crop losses, or inefficient use of labor, space or materials, applies equally to large and small businesses.

Young plant production involves a series of processes in common with manufacturing in other industries, which include inventory control of inputs (trays, substrate, fertilizer, etc.), assembly (filling trays, sticking cuttings, or sowing seed), material transport (placement in the greenhouse), quality control (patching or fixing trays), order pulling, and shipping. Growing (irrigation, climate management, height control, fertilization, etc.) is the least standardized part of young plant production. However, even with growing processes, well-defined and standardized crop plans are more achievable in propagation than with most other horticulture products, because multiple crops are grown each season with short production times.

This paper discusses three areas of important focus to help young plant growers move from art to manufacturing in their production. These are identifying sources of crop losses, understanding costs, and identifying opportunities to increase efficiency in production processes.

SHRINKAGE

Shrinkage refers to any reason a plant product is started but is not successfully sold. During January to June 2010 (spring season in the USA), a survey was conducted of 11 greenhouse operations producing at least $1 million in sales of young plants. After an initial discussion with each grower on how they tracked shrinkage, crop losses were separated into three broad categories. These included:

Internal Production Losses

The product is grown but is not of saleable quality. This may arise because trays are only partially filled (from patching of incomplete trays or having to purchase a minimum unrooted cutting order size that is not divisible into complete trays), poor germination or rooting, disease or insect damage, chemical damage, or other reasons that crops were not to market specification such as excessive height.

Unsold Product

The product is successfully grown but cannot be sold. This may result from cancelled orders, speculation miscues, or planting excess buffer to account for possible crop losses.

Credits on Shipped Product

The product is sold, but the customer demands a credit. This may occur from shipping damage during shipping, heat, or cold; the customer may find the plant quality unacceptable; or the wrong cultivar may have been shipped.

Figures 1 and 2 show the results of the shrinkage survey. Internal production losses contributed the largest category of losses, followed by unsold product and credits or other unspecified losses (Fig. 1). Losses were higher on young plants compared with finished plants, which occurs because seedlings and cuttings are the most vulnerable crop stage,

susceptible to disease and physiological problems. Surveyed growers also indicated that their finished plant customers were tending to order young plants later in the season, based on how their own sales are progressing and to manage their own risk, which increased speculation losses (unsold product) for their supplier of young plants.

Businesses varied widely in the type and level of shrinkage (Fig. 2). Company "1" sold young plants to another profit center of their own business. Therefore, sales forecasting was more reliable, product was not shipped long distances reducing credits, and the speculation loss was passed from the young plants to finished plant sales. Company "2" grew young plants mainly on contract to another grower, thereby passing along speculation costs to their customer. The high level of production losses at Company "3" indicated a need for improved growing practices. Losses at Company "8" were dominated by the unsold product category, indicating over-speculation and the need to better match production levels to the market.

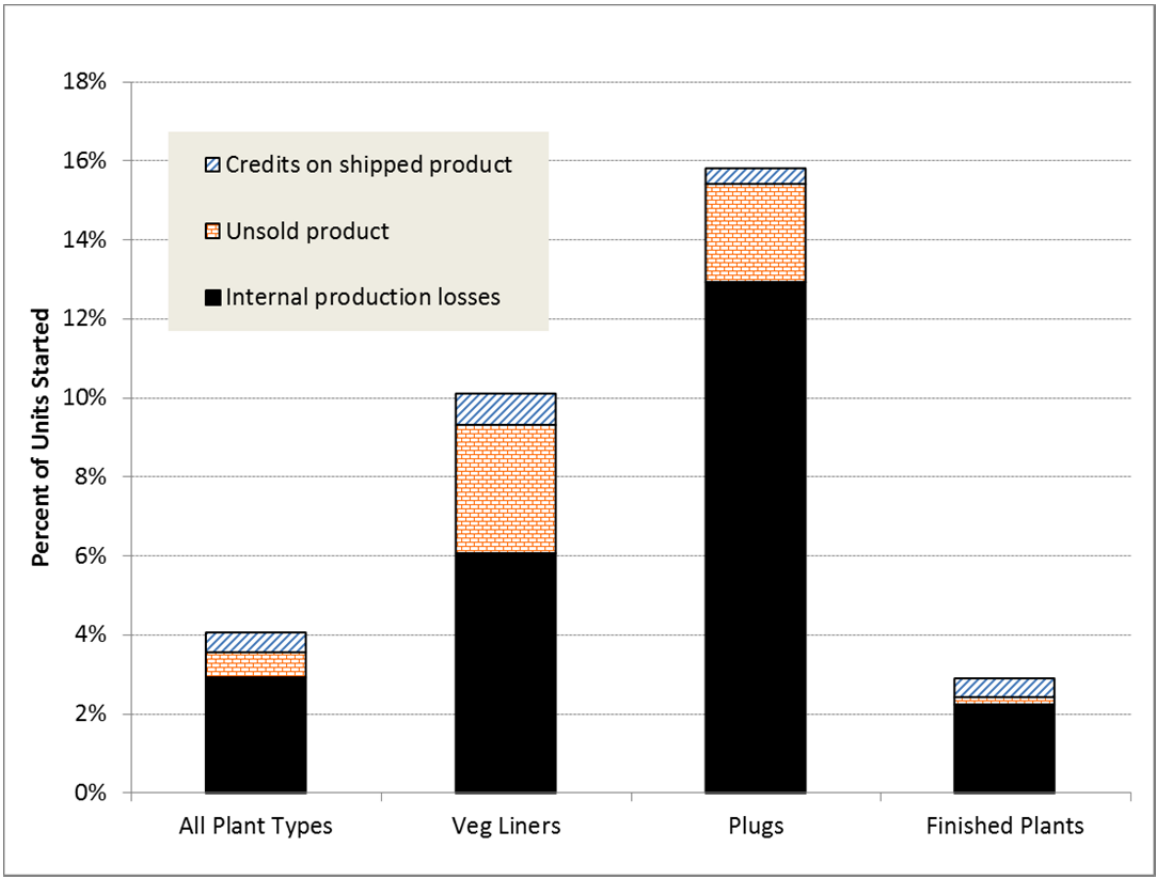

Fig. 1. Results of a survey of 11 young plant growers on the value of several categories of shrinkage in their young plant and finished plant products during 2010.

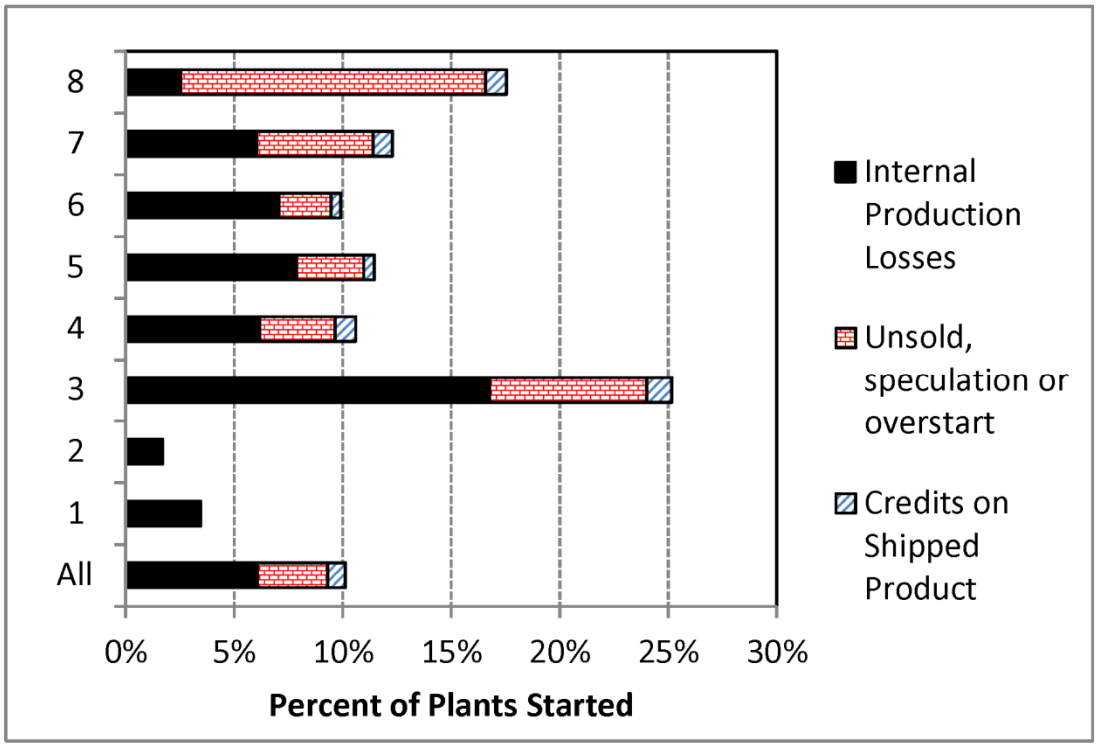

Fig. 2. Individual results for crop losses for eight growers producing rooted cuttings surveyed during 2010.

The observed variation between companies in Figure 2 emphasizes that each business needs to track its own shrinkage in order to provide the management team with a clear focus for areas of improvement. In some successful businesses in the survey group, the grower and sales management staff collectively identified annual target levels of shrinkage and required actions for the coming season.

With the economic recession since 2007, young plant growers have reduced speculation planting, and provided incentives for customers to place orders early in order to reduce risk. Product assortment is also important to reduce speculation losses and production cost per unit, although many growers find it difficult to drop minor value crops to allow production of fewer, more profitable products. As Healy (2012) states, "By aggressively dropping low performing varieties, you create space for new varieties to grow your business."

EFFICIENCY ANALYSIS

On the production side, tightening up monitoring and control of production procedures allows the grower to reduce shrinkage. For example, improved germination or rooting percentage decreases the required buffer of extra plants that must be started to cover future losses. The steps to improve efficiency in any process such as sowing are to monitor the activity using a quantitative measure such as trays sown per hour or germination percentage, identify target levels, investigate root causes when targets are not met, and then take appropriate actions (Healy, 2012). Benchmarks are not widely available or shared across businesses, but can be developed as internal targets within a company over time. Efficiency measurements may include shrinkage percentage, or units processed per worker hour, per machine, per square meter, per square meter week, or direct and total production cost per unit.

Increasing numbers of USA growers are incorporating manufacturing concepts such as lean flow into production processes, particularly the initial stages up to moving plants into

the greenhouse or germination room (stage 0), and shipping. “Lean” considers that resources expended for any goal other than the creation of value for the end customer is wasteful, and thus a target for elimination. “Flow” refers to a smooth progression through stages in the production process. An internet search on lean flow manufacturing is an excellent starting point, followed by hiring of a specialized consultant if major changes are considered (Eddy, 2012).

Although repetitive tasks often undertaken by a supervisor and team of workers, such as fixing trays or pulling orders lends itself to standardization, growing itself will always have a subjective (art) component. For growing tasks, efficiencies can be gained from educating production and growing staff, and documenting crop plans. The most critical aspect of growing is irrigation, and training on a five-point plug-tray moisture scale has been very successful to standardize irrigation practices (Healy, 2008).

COSTING

We developed a series of articles (Fisher et al., 2012a, b, 2013a, b) to help young plant growers calculate production costs and profitability. A first step is to evaluate the annual income statement to differentiate between (1) direct input costs (pot, cutting, label, sleeve, etc.) that increase with every additional unit produced, (2) labor costs (production, shipping, sales, and management), and (3) overhead costs such as marketing, insurance and utilities that are difficult to assign on a per unit basis. In our survey of eight young plant growers in 2006, costs were evenly divided between these three cost categories (direct, labor, and overhead).

In an enterprise budget, such as shown in Table 1, it is easy to calculate direct costs that increase with each additional container produced. It is more challenging to allocate overhead costs, which is usually done on a square meter weeks basis for greenhouse production. An example calculation for overhead cost per square meter week is shown in Table 2, where the annual overhead cost (from the income statement) is divided by the number of square meters used in production throughout the year. Labor costs can be included with overhead costs and allocated on a square meter week basis, particularly for labor categories such as management, facility maintenance, growing, and sales. Alternatively, a more detailed analysis of the production labor required for processes such as filling pots, planting, moving, pinching can be quantified and treated as a direct cost.

There are many ways to develop budgets and allocate overhead, and it is not essential that all growers use the same procedure. However, the key point is that growers must calculate their production costs in order to make informed management decisions. For example, the comparison of two plug sizes in Table 1 shows that although the direct costs are lower when transplanting from a small plug size (392 plugs per tray), the larger 128-count plugs have lower total cost and higher profitability for finished production because of a shorter time after transplant. Because space and time are limiting resources during peak spring production, a trend in young plants in the USA has accordingly been towards production of larger plug sizes, allowing multiple turns of short term crops, and greater net revenue per square meter week.

Table 1. Enterprise budget for an 11-cm-diameter container of Wave® petunia grown from two plug sizes.

Plug size	392-count tray	128-count tray
Plug cost	$0.15	$0.26
Media, pot, tag	$0.10	$0.10
Total direct cost	$0.25	$0.36
Sales price	$1.25	$1.25
Profit/pot	$1.00	$0.89
Spacing between pots (cm)	20	20
Area/pot (m^2)	0.04	0.04
Weeks	6	4
Square meter weeks (smw)	0.24	0.16
Overhead cost per smw	$3.30	$3.30
Overhead cost	$0.79	$0.53
Profit/pot	$0.55	$0.59
Profit/smw	$2.29	$3.69

Table 2. Calculation of overhead costs per square meter week.

Factor	Calculated amount
Salaried staff…	$3,300,000
Fuel, electrical, water…	
Depreciation, interest, insurance...	
Greenhouse bench space (m^2)	20,000
Weeks per year in production	50
Total square meter weeks	1,000,000 (=20,000 * 50)
Overhead cost $/square meter week	$3.30 (=$3,300,000/1,000,000)

CONCLUSION

This paper described several areas of potential improvement in tracking losses, increasing efficiency and uniformity, and tracking costs. When evaluating adopting new management procedures, although it is not possible for everything to be done at once, something can be done at once. Growers are encouraged to choose at least one action that helps move the production philosophy from growing to manufacturing.

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