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One of the most important aspects of running a sustainable business is reducing crop losses. But how do you do it?

Reducing Crop Shrinkage

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NO matter how good we are at growing, we end up losing plants in our operations. Shrinkage, or the gradual loss of plants over time, occurs at every stage of the supply chain, such as in propagation when some seeds fail to germinate, finished material that is unmarketable due to insects or diseases, plants grown on speculation that never get purchased or plants at retail that die from lack of water. The simple truth is that one of the best ways our industry can be sustainable is making sure the time and resources (pots, tags, fertilizers, pesticides, etc.) we spend on our crop aren't lost to plants that must be tossed out.

An easy way to calculate shrink in our industry is to determine the total number of seeds or unrooted cuttings we purchase compared to the total number of plants we sell to the end consumer. Ball Horticultural Co. surveyed a wide range of industry members at every stage in the supply chain to determine such losses.

Results varied widely from operation to operation, but on average, shrink losses were 20 percent during propagation, 11 percent higher during production and 9 percent higher at retail (post harvest). This means that of 100 seeds or unrooted cuttings we buy in, 60 will wind up as plants sold to the consumer.

Shrink impacts your bottom line. Let's examine the hypothetical case of Dick and Jane's independent garden center. Dick and Jane have a contract with Bob's Greenhouse and Nursery to purchase 1,000 containers of 3 1/2-inch geraniums for \$2,500. They know they will be able to sell them for \$3 each. If Dick and Jane were able to sell all 1,000 plants (0 percent shrink), they will realize a gross revenue of \$3,000 – with \$500 profit (Table 1).

At 10 percent shrink (about the average at retail), Dick and Jane will realize a net profit of only \$200. At 20 percent shrink, they will lose money on the crop. Shrink works against us in two ways – it raises the cost that it took to produce each saleable container, and it reduces the number of containers we



Figure 1. Shrinkage may occur when cultivars do not germinate true to type from seed.

had for sale (and hence gross revenue).

One question you may have is: Does it make a difference when crop shrinkage occurs? The answer is yes. Each week the plant has been on the bench means we have more invested in it in terms of overhead and variable costs. The sooner you can toss an unmarketable plant, the less space, heat and fertilizer you will waste on a product that will never see the light of day in a customer's garden.

Seed Propagation

Shrinkage is common, and often difficult to avoid, in seed propagation because no species has a 100 percent germination rate. Empty cells in plug flats due to low germination rates result in higher costs per square foot for each flat. Because shrinkage at this stage will affect every other stage in the cropping cycle, very few growers will accept plug flats in which even 10 percent of the cells are empty. Thus, some plug growers remove empty cells and replace them with live seedlings. This is often done by hand at great expense to the grower.

To prevent low germination, use seed from a high-quality producer that was purchased that year. For species with lower than optimum germination rates, consider purchasing primed or pre-germinated seeds. They are more

Table 1. An example of how shrink affects gross and net revenue at retail.

	0% Shrink	10% Shrink	20% Shrink
Containers sold at \$3 each	1000	900	800
Cost to produce each sold container	\$2.50	\$2.78	\$3.12
Gross revenue	\$3,000	\$2,700	\$2,400
Net revenue	\$500	\$200	(-\$100)

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expensive than standard seeds, but using primed or pre-germinated seeds saves money producing flats and prevents refilling.

Shrinkage may also occur when cultivars do not germinate true to type from seed (Figure 1). For example, when double flowering stock seeds germinate, generally only half the seedlings produce double flowers, and the other half will have single flowers. Ball Holland has used an innovative method for identifying single stock at the cotyledon stage and replacing them with double stock. Single and double stock leaves are slightly different shades of green (Figure 2).

Digital imaging is used to identify single flowering stock. Once they have been identified, a mechanical arm pulls single flowering stock and empty cells out of trays. In a separate area, a mechanical arm pulls double flowering stock from multiple trays to produce a full tray. Technology used in this process makes it expensive.

However, what makes it economically viable is that growers obtain a premium price for double stock. They are able to make enough of a profit to cover the expense of replacing single flowering stock. Because trays are filled with double flowering stock early in the production cycle, they do not waste bench space or time growing single stock beyond seedling emergence.

Vegetative Propagation

In cutting propagation, one key to reducing shrinkage is to keep cuttings cool after they are removed from stock plants. Warm temperatures reduce the post-harvest life and quality of cuttings. As soon as possible, stick cuttings. If they must be held for a short period of time, store them in a cooler at a temperature appropriate for each species – preferably, this should be a floral cooler with ethylene scrubbers. As with seed propagation, purchase high-quality cuttings from reliable growers.

In both seed and vegetative propagation, shrinkage may also occur after germination or during rooting. Temperature and light should be

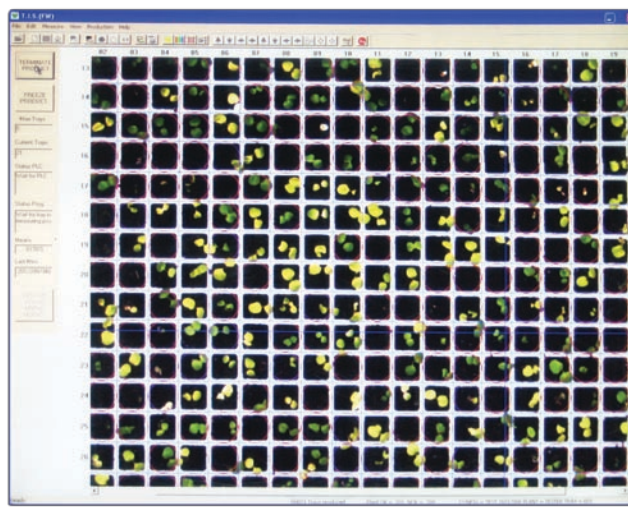


Figure 2. Ball Holland has used an innovative method for identifying single stock at the cotyledon stage and replacing them with double stock. Single and double stock leaves are slightly different shades of green on the monitor.

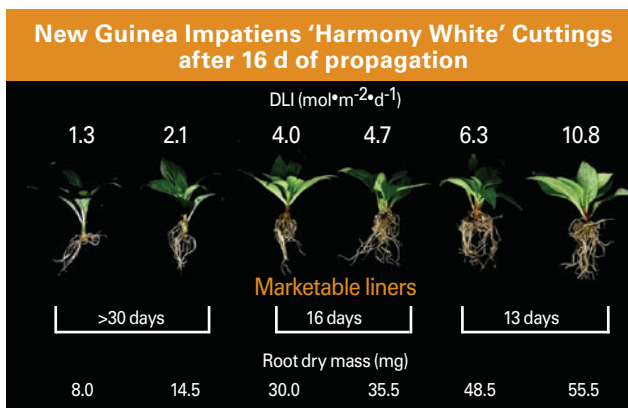


Figure 3. The cumulative amount of light or daily light integral (DLI) that a seedling or cutting receives during a 24-hour period can dramatically improve timing, quality and reduce shrink.

properly managed in a propagation house. The cumulative amount of light or daily light integral (DLI) that a seedling or cutting receives during a 24-hour period can dramatically improve timing, quality and reduce shrink (Figure 3).

Plants are typically grown in small volumes of substrate, which makes water management more difficult than at later stages of development. Young plants should be checked multiple times a day and irrigated with very small volumes of water to replace only the water used by plants.

Shrinkage In Production

The first line of defense to reduce the amount of shrinkage in finished plant production is to plan ahead and properly schedule your crop. If you have been growing the same number of six-packs for the last 15 years, chances are you are throwing more and more away each year. Keeping organized records of each year's crops will give you an idea of year-to-year trends and allow you to adjust production numbers appropriately.

When scheduling each crop, take

time to make your schedule as exact as possible (down to the week is usually close enough for most crops). Schedule only the amount of time it will take to grow the crop. Adding in extra weeks as a "cushion" will cause you to miss your target date or produce plants that will be overgrown and lower quality – both making your compost pile grow (Figure 4).

Be mindful of the temperatures different plants need at different times during production, and plan to group different crops with similar temperature requirements. Stick to the recommended temperatures for your crops. Lowering temperatures to save money will cause you to miss your target date and, in some cases, cost you more in energy usage. Suboptimal temperatures can compromise overall plant health and predispose them to damage from disease and pests.

The loss of plants due to diseases, insects, nutritional deficiencies (Figure 5) or toxicities and ethylene also contribute to shrink. Be sure that at the beginning of each production cycle you properly disinfect benches, floors, walkways and greenhouse walls to

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reduce your risk of disease carryover from previous crops. Remove weeds growing in the greenhouse that may harbor insect pests that will quickly move to your crop.

Inspecting plant material when it arrives at your greenhouse is important. Be sure to do so in a quarantine area. This protects the plants that are already in your greenhouse from being infected with any potential pests from outside sources.

Keep "pet plants" out of production areas, as they may harbor pests and diseases. Scout your crop and monitor water and media pH and EC at least on a weekly basis. Use sticky cards to monitor pest populations, but don't rely on them completely. Not all pests will be found on sticky cards.

Look at the plants themselves to identify insects, mites and the damage they cause. Record observations and review these regularly to identify any trends in infestations. Don't get tunnel vision when scouting for insect pests, look for disease and nutritional



Figure 4. Adding in extra weeks as a "cushion" will cause you to miss your target date or produce plants that will be overgrown and lower quality – both making your compost pile grow.

problems as well. Check your heaters frequently as faulty heaters can release ethylene and damage sensitive crops such as geranium (Figure 6). Catching a problem early will make treatment much easier and will reduce the number of plants affected.

Post-Harvest Shrinkage

Assuming you have minimized your propagation and production



Figure 5. The loss of plants due to diseases, insects, nutritional deficiencies or toxicities and ethylene also contribute to shrink.

shrinkage, you are now two-thirds of the way to hopefully making a profit. Traditionally, wholesale growers did not have to worry about their plants once they were delivered to the garden center or mass merchandiser. Pay-by-scan merchandising has dramatically shifted this accountability to wholesale growers. Today, whether you are a wholesale or retail grower, once your plants leave the production area, they



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are more than likely in someone else's hands. The likelihood of shrinkage will then increase.

Post-harvest plant losses are typically observed due to improper plant development or poor packaging, shipping, handling and display in the retail environment. As your crop reaches the market date, it is important to harden the crop off by reducing the night time temperature by 5°F to enhance flower color and increase longevity.

Research at the University of Florida suggests post-harvest longevity of flowering potted plants is significantly increased when fertilization is terminated between two to four weeks prior to flowering. Easter lilies are one exception to this guideline, and fertilization of this crop should not be terminated. As with any recommendation, be sure to conduct your own trials with a small number of plants the first time you try a new growing technique.

It is important to only ship plants that are at the correct developmental stage. For example, chrysanthemums are ready for sale when the flowers are 50 percent open and the remaining buds are well developed. As you prepare to ship your crops a long distance or to the garden center next door, make sure the crop is well watered, but not dry or saturated. Ensure that the foliage is dry to prevent botrytis on leaves or flowers. If your crop is sensitive to ethylene (i.e. orchids, euphorbia, schlumbergia, etc.) and you frequently experience losses, consider trying an ethylene action inhibitor. Another way to prevent the buildup of ethylene when shipping sensitive potted flowering plants is to use packages that allow air movement.

Once your plants reach the retail environment, it is essential they are provided with adequate environmental conditions to sustain photosynthesis. Low light levels and warm temperatures in post harvest will lead to leaf and flower senescence and overall poor quality. Likewise, low light levels and excessively cold temperatures are detrimental for crops such as poinsettias, orchids, and tropical plants. Ethylene is also a factor that



Figure 6. Check your heaters frequently as faulty heaters can release ethylene and damage sensitive crops such as geraniums. Catching a problem early will make treatment much easier and will reduce the number of plants affected.

contributes to postharvest shrinkage at the retail display level. If possible, do not display flowering plants and cut flowers near fruits and vegetables. Ethylene is released as fruits ripen and flowers senesce.

As mentioned before, keeping good records is key for reducing shrinkage. Implement a method of recording when plants are thrown away. Employees should be encouraged to report plant loss. They should feel confident that accurately reporting loss will not directly lead to blame. It doesn't matter if they were thrown away because of disease, insects, missing the target sale date or a dropped tray – you need accurate information to make adjustments for the following year.

We hope we have pointed out a few specific ideas your own operation can focus on to reduce shrinkage. By reducing wasted materials and labor, you will be on your way to becoming more sustainable and more profitable. **GG**

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