

## Automation of Bedding Plant Production

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### INTRODUCTION

Greenhouse and nursery crop growers are continually faced with increased production costs with little opportunity to raise prices. The small-scale grower must specialize in unique crops or capitalize on individualized service to command top dollar for their products and coexist with large-scale growers who target mass merchants. Many growers, large and small alike, are considering more automation in their daily production operations. Automation often requires a major capital expenditure, but when properly planned, it can offset equipment investment by reducing labor costs and enhancing production efficiency.

### AUTOMATION

**Automation — Setting the Pace to Scale.** Chipsea Greenhouse, Inc. of Colorado has made major investments in automating their bedding plant operation. John Wilson, the Production Manager, has stated that “automation is the number one means to create the process or flow, which sets the pace to scale”. This means that the size and scope of a production system ultimately determines how efficiently production units of plants (plugs) are processed and sold. A need must first be established prior to automating any production process.

**Financial Incentives to Automate.** With the recent increase in federal minimum wage requirements, equipment purchases for automation are becoming more attractive. There are many forms and varying degrees of complexity in automation that a bedding plant grower can employ, which allow for increased production efficiency. When choosing to automate, consider first your most tedious and labor-intensive tasks. These may include mixing media and filling trays, transplanting into trays, moving trays, and irrigation. It is important to evaluate each process completely and determine which process is the most efficient or inefficient under your production conditions.

**Evaluation of Employee Production Efficiency.** After reviewing your production processes — evaluate your single most valuable asset, which is your staff. How your staff interacts with your current production processes requires scrutiny before any automation is incorporated into a new production system. For example, determine how many times an employee touches a plant during cutting production, while transplanting seedlings, or how many trays are moved per employee-hour. Once data are known, one can begin to make changes to increase production efficiency. These changes could be as simple as including an irrigation tunnel on a conveyor to reduce the time to water plugs in a newly transplanted tray, or as complex as a fully automated robotic transplanting line.

**Ease of Automating Media Handling.** One task easily automated is media handling. Most bedding plant growers can adapt some form of automation for

mixing media. This may be as simple as a tractor with a front end loader or as complicated as a drum mixer with continuous feed conveyors. A tractor with a bucket or a drum mixer can yield from 11.5 to 15.3 m<sup>3</sup> (15 to 20 yd<sup>3</sup>) media per employee-hour; whereas, smaller mixers, such as modified mortar mixers, may yield only 1.1 to 3.8 m<sup>3</sup> (1.5 to 5 yd<sup>3</sup>) media per employee-hour (Hamrick and Beytes, 1998). Filling bedding plant trays can also be labor intensive. Anywhere from 60 to 100 trays per employee-hour can be manually hand-filled, whereas machines can fill 150 to 300 trays per employee-hour (Hamrick and Beytes, 1998). By comparing the expense of purchasing equipment designed to mix and fill trays to the labor costs to perform the same tasks — one quickly recognizes that tray filling equipment is essential to a successful bedding plant program, even if pre-mixed media is used.

**Transplanting Systems and Equipment.** No other stage of bedding plant production systems has gone through greater changes in efficiency and technology than transplanting during the past 15 years. Seedling plug production has revolutionized bedding plant production allowing more species diversity in the market at reduced costs. Many growers no longer bother to sow and germinate their own seedlings — opting to purchase plugs from specialty propagators. This single decision alone eliminates the need for sowing equipment, germination chambers, and irrigation equipment specific to seedling production. The availability of high quality seedling plugs also has streamlined the transplanting operation allowing for rapid handling of individual plants.

However, the transplanting of bedding plant plugs is one of the most labor-intensive jobs in the greenhouse. It involves repetitive movements, which may lead to carpal tunnel syndrome and other potential injuries to employees. Transplanting equipment is no longer utilized only by major bedding plant growers. Robotic transplanting equipment is now available that can realistically transplant 240,000 plugs into 5000 trays in a 10-h day. One Colorado greenhouse grower uses equipment that requires one employee for media support, one for moving transplanted trays away from the transplanting line, four for patching missed plugs and tagging, and one crew leader — seven personnel in total. Prior to the use of robotic transplanting equipment, this same greenhouse grower's transplanting line could do no more than 2500 trays in a 10-h day with 20 people, resulting in 12.5 trays per employee-hour for hand-transplanting, compared to 71.4 trays per employee-hour for a robotic transplanting system that costs \$100,000. Amortizing this investment over 3 to 5 years, one quickly realizes that robotic transplanting equipment is cost effective.

**Robotic Transplanters Are Not a Panacea.** Robotic transplanters are not always the perfect solution. They will not operate at maximum capacity if plug trays are not evenly filled with quality plants. Also, not all tagging equipment is compatible with some robotic transplanters or operates as quickly. Finally, a means for moving filled trays to the transplanter, as well as removing transplanted trays away from the work area is important to prevent bottlenecks, which reduce productivity. Robotic transplanters also have a plethora of moving parts and sensors requiring maintenance and adjustment by trained technicians for efficient, continuous operation.

Not all large-scale bedding plant growers use robotic transplanting equipment. Another Colorado greenhouse company manually transplants with 24 people and

transplants 1750 trays in a 10-h day or 7.3 trays per employee-hour. This transplanting rate is considerably less than the previously discussed manual and automated systems of 12.5 and 71.4 trays per employee-hour. The manual greenhouse production system with 12.5 trays per employee-hour transplants into 12-04 trays, while the second transplants into 18-04 trays — which require more plugs and time per individual tray.

Many greenhouse growers find that their current staff are capable of transplanting at satisfactory rates, with more precision and flexibility to tray configuration and handling difficult-to-transplant bedding plant species. Petunias are easily transplanted by hand, whereas marigolds, snapdragons, and impatiens have tender stems and are difficult and slower to transplant by hand. Even hand transplanting lines require some degree of mechanization for efficient operation. Automated equipment may include conveyors, media-filling equipment, and tray-moving equipment. However, as personnel skilled in transplanting bedding plants becomes more difficult to find, many greenhouses are considering robotic transplanters.

**Automation in the Movement of Plants.** Movement of plants away from the transplanting area to the greenhouse or from the greenhouse to the shipping and staging dock is another opportunity for automation increasing production efficiency. Conveyor systems can move 200% more trays per hour compared to carrying trays by hand. Of course this requires a considerable investment in equipment — but is more than offset by labor savings. Monorail trolleys for moving trays can move 150% more trays than by hand, with a minimum of equipment installation in the greenhouse. Other production tasks easily automated include irrigation and pesticide application with appropriate equipment for the greenhouse or production area.

## CONCLUSION

Automation of bedding plant production is not for all greenhouse or nursery crop producers, but some degree of mechanization can probably decrease any operation's labor costs. Consider first the most tedious, labor-intensive task and then compare the current investment in labor to the investment costs and calculate the respective savings in labor costs. Also consider idle time that robotic equipment is not being used. Remember to apply all labor expenses, including fringe benefits, to the cost of producing a bedding plant crop.

## LITERATURE CITED

**Hamrick, D. and C. Beytes.** 1998. Equipment and automation. In: Ball, V. (ed.). Ball Publishing Co., Ball RedBook, 16th ed., Batavia, Illinois