



*Current Mechanization Systems Among
Nursery-Only and Mixed Operations
in Selected Gulf South States*



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CONTENTS

Introduction	1
Materials and Methods	1
Results and Discussion	2
Substrate Mixing	2
Container Filling	2
Placing Plants in Containers	3
Transporting Containers from Potting Area	3
Transporting Containers to Field	3
Placing Plants in Field	4
Spacing Containers	4
Picking/Pulling and Loading for Transport	4
Unloading Plants from Transport Vehicles	4
Loading Plants onto Delivery Vehicles	5
Jamming Plants in Winter	5
Plant Pruning	5
Fertilizer Application	6
Pesticide Application	6
Irrigation Application	7
Summary and Implications	8
Literature Cited	8

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INTRODUCTION

The nursery and greenhouse industry in the Gulf South provides a significant economic impact in the region. Hall et al. (2008) estimated that the industry's annual economic impact amounted to \$5.182 billion with Alabama contributing \$411 million; Mississippi, \$55.6 million; Louisiana, \$149.3 million; Florida, \$3.006 billion; Tennessee, \$548 million; South Carolina, \$445.2 million; and Georgia, \$566.8 million. In addition, the nursery and greenhouse industry in these states provided 59,903 jobs and generated an estimated \$148 million of indirect business taxes. As horticulture production in the Gulf South states increases in value, it is expected that nursery and greenhouse growers will want to increase production capability and efficiency by adopting mechanized/automated technologies, enhancing markets for horticulture products, and improving working conditions and worker safety.

A survey of nurseries and greenhouses was conducted in selected Gulf South states as part of a research

project undertaken by the Mississippi Agricultural and Forestry Experiment Station and the U.S. Department of Labor, entitled *Enhancing Labor Performance of the Green Industry in the Gulf South*. The overall goal of the survey was to develop a socioeconomic profile of nursery and greenhouse workers and to evaluate the impact of automation on their employment, earnings, safety, skill levels, and retention rates (Posadas et al., 2004). Results from the survey were presented in publications dealing with the socioeconomic characteristics of workers and working conditions (Posadas et al., 2005; Posadas et al., 2010), socioeconomic impact of automation and mechanization (Posadas et al., 2008a), and operational characteristics of nurseries and greenhouses (Posadas et al., 2008b). This bulletin will present an overview of the types and levels of automation/mechanization employed by nurseries and mixed nursery and greenhouse operations. Only nurseries and mixed nursery and greenhouse operations are discussed in this bulletin.

MATERIALS AND METHODS

The socioeconomic survey of wholesale nurseries and greenhouses in seven Gulf South states (Mississippi, Alabama, Louisiana, Florida, Tennessee, South Carolina, and Georgia) was conducted between December 2003 and September 2008. This length of time was required due to the distance traveled to complete the surveys, as well as the availability of growers to meet one-on-one with the research associate who conducted the surveys. Official lists of certified nurseries were retrieved from the Mississippi Department of Agriculture and Commerce (2003), the Alabama Department of Agriculture and Industries (2004), the Louisiana Department of Agriculture and Forestry (2005), the South Carolina Department of Agriculture (2006), the

Florida Department of Agriculture (2005), and the Georgia Department of Agriculture (2007). Additional information about the growers was retrieved from industry buyer's guides (Alabama Nursery and Landscape Association, 2004; Louisiana Nursery and Landscape Association, 2005), an earlier draft of an Extension Service reference guide (Johnson and Wells, 2007), and the Tennessee Nursery and Landscape Association (2006).

Only wholesale growers operating throughout the seven states — except in north Florida — were included in the selection of survey participants. In Florida, nurseries were randomly selected only from Gainesville (Alachua County) and northward. A random sample of

50 growers was generated in each state. These selected growers were contacted via mail and asked for their cooperation and participation in the survey. They were asked to return a postcard indicating their willingness to participate in the survey. Those willing to participate were then contacted by phone to schedule interviews.

A total of 185 nursery automation survey forms were completed through personal interviews with wholesale nurseries (N=66), greenhouses (N=48), and mixed nursery and greenhouse operations (N=71) in

Mississippi (32), Louisiana (29), Alabama (26), Florida (27), Tennessee (17), South Carolina (30), and Georgia (24). Due to differences in types of automation/mechanization, only nurseries and mixed nursery operations (137 growers) are examined in this bulletin. Statistical comparison of automation/mechanization types was performed using Chi-square tests and frequency distributions within each task of container nursery production as described in the survey instrument utilizing SPSS (version 16.0 for Windows, SPSS, Inc., 2008).

RESULTS AND DISCUSSION

Results of this study indicate that, while there is automation/mechanization available to growers, a majority of the growers surveyed still relied on manual labor for many tasks. Mechanization can be defined as “equipping with machinery, especially replacing human or animal labor,” and automation as “automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human labor” (Merriam-Webster, 2009). Frequency distributions were calculated for several nursery tasks by type of operations. Chi-square tests indicated that the differences between the tasks in nursery-only and mixed operations were significant.

Substrate Mixing

Of the growers surveyed, 53% of the nursery-only operations purchased the substrate used in their production practices, while 58% of the mixed operations purchased the material (Table 1). Twenty-seven percent of nursery-only operations are in-ground production only, while none of the mixed operations reported in-ground production. Fourteen percent of the mixed operations reported using front-end loaders, while none of the nursery-only operations employed them. Twelve percent of the nursery-only operations and 7% of the mixed operations either did not mix substrates or did not provide any responses. However, 11% of the mixed operations and 6% of the nursery-only firms manually mixed their substrate.

Container Filling

Fifty-two percent of nursery-only operations and 42% of mixed operations manually filled their containers (Table 2). Among 27% of the nursery-only firms and 11% of the mixed operations, either filling was not done or the filling method was not specified. Twenty-five percent of mixed operations and 20% of the nursery-only firms used some type of pot filler. Approximately 9% of mixed operations used flat fillers, but none of the nursery-only firms reported using this equipment.

Table 1. Percentage distribution of nursery operations by type of substrate-mixing methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Purchased	53.0	57.7	55.5
Manual	6.1	11.3	8.8
In-ground production	27.3	0.0	13.1
Mixer	0.0	4.2	2.2
Pot filler	1.5	5.6	3.6
Front-end loaders	0.0	14.1	7.3
Unspecified	12.1	7.0	9.5
Total	100.0	100.0	100.0

Table 2. Percentage distribution of nursery operations by type of container-filling methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	51.5	42.3	46.7
Flat filler	0.0	8.5	4.4
Front-end loaders	0.0	4.2	2.2
Pot filler	19.7	25.4	22.6
Shovels	1.5	1.4	1.5
Silage wagon	0.0	2.8	1.5
Soil mixer	0.0	4.2	2.2
Unspecified	27.3	11.3	19.0
Total	100.0	100.0	100.0

Placing Plants in Containers

Seventy-three percent of mixed operations and 65% of nursery-only operations placed plants in containers manually (Table 3). Twenty-nine percent of nursery-only firms and 11% of mixed operations did not specify their method of container filling. The rest of the growers used some other method, such as pot fillers, plug poppers, gas-powered drills, or planters.

Transporting Containers from Potting Area

Sixty-one percent of nursery-only growers and 62% of mixed operations moved containers to transport vehicles manually (Table 4). Twenty-seven percent of nursery-only growers and 13% of mixed operations did not specify a transportation method. Nine percent of nursery-only growers and 7% of mixed operations used a conveyor. Nine percent of mixed operations used a rail system, but no nursery-only firms reported using this method. Six percent of mixed operations used pot fillers, but no nursery-only firms reported use of this equipment. Other equipment reported was a silage wagon (mixed operations only) and tractor and trailer or wheelbarrow (nursery only).

Transporting Containers to Field

Participating growers reported using a variety of transportation methods (Table 5). Thirty-nine percent of nursery-only growers transported containers manually, while 32% of mixed operations transported manually. Twenty-six percent of nursery-only firms and 20% of mixed operations did not specify a transportation method. Thirteen percent of mixed operations and 6% of nursery-only firms used carts. Twelve percent of nursery-only growers used tractors and carts, but no mixed operations reported using them. Six percent of nursery-only firms used planters, but no mixed operations used them. Six percent of mixed operations used

Table 3. Percentage distribution of nursery operations by type of planting methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	65.2	73.2	69.3
Gas-powered drill	0.0	2.8	1.5
Planter	1.5	0.0	0.7
Plug poppers	0.0	4.2	2.2
Pot filler	4.5	8.5	6.6
Unspecified	28.8	11.3	19.7
Total	100.0	100.0	100.0

Table 4. Percentage distribution of nursery operations by type of movement from potting area to transport vehicle.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	60.6	62.0	61.3
4-wheeler and trailer	0.0	1.4	0.7
Conveyor	9.1	7.0	8.0
Pot filler	0.0	5.6	2.9
Rail system	0.0	8.5	4.4
Silage wagon	0.0	2.8	1.5
Tractor and trailer	1.5	0.0	0.7
Wheel barrow	1.5	0.0	0.7
Unspecified	27.3	12.7	19.7
Total	100.0	100.0	100.0

Table 5. Percentage distribution of nursery operations by type of transport vehicle.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	39.4	32.4	35.8
4-wheeler with trailers	1.5	2.8	2.2
ATV	0.0	2.8	1.5
Carts	6.1	12.7	9.5
Carts and cushman	1.5	0.0	0.7
Carts and golf cart	0.0	4.2	2.2
Golf cart and trailers	0.0	5.6	2.9
Planter	6.1	0.0	2.9
Pot filler	0.0	5.6	2.9
Rail system	0.0	1.4	0.7
Silage wagon	0.0	2.8	1.5
Tractor and carts	12.1	0.0	5.8
Tractor and trailers	6.1	8.5	7.3
Tractor, carts, and trailers	1.5	0.0	0.7
Truck and trailers	0.0	1.4	0.7
Unspecified	25.8	19.7	22.6
Total	100.0	100.0	100.0

pot fillers or golf carts and trailers, while nursery-only operations did not report using this machinery. Growers also reported using equipment such as ATVs, four-wheelers, golf carts and carts, tractors and trailers, and trucks and trailers.

Placing Plants in Field

Eighty-two percent of mixed operations and 67% of nursery-only firms placed containers in the field manually (Table 6). Twenty-six percent of nursery-only growers and 18% of mixed operations did not specify or indicate any method. The remaining 8% of nursery-only firms reported using equipment such as tobacco setters, conveyors, planters, and tractors and planters.

Spacing Containers

Eighty-six percent of mixed operations and 73% of nursery-only growers spaced containers manually (Table 7). Fourteen percent of mixed operations and nursery-only firms did not specify or indicate any method. The remaining 13% of nursery-only firms reported specialized equipment such as planters or tractors and planters.

Picking/Pulling and Loading for Transport

Eighty-two percent of mixed operations and 62% of nursery-only firms picked/pulled plants and loaded them on transport vehicles manually at the time of sale (Table 8). Thirteen percent of mixed operations and 9% of nursery-only firms did not specify or indicate any method. Among nursery-only firms, 8% used bobcats and tree spades, 6% used bobcats or front-end loaders with booms, and 5% used bobcats and shovels. Mixed operations did not report use of any of this equipment.

Unloading Plants from Transport Vehicles

Seventy-five percent of mixed operations and 67% of nursery-only growers manually unloaded plants from transport vehicles in holding areas (Table 9). Twenty percent of mixed operations and 17% of nursery-only firms did not spec-

Table 6. Percentage distribution of nursery operations by type of plant-placing methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	66.7	81.7	74.5
Conveyor	1.5	0.0	0.7
Planter	1.5	0.0	0.7
Tobacco setter	3.0	0.0	1.5
Tractor and planter	1.5	0.0	0.7
Unspecified	25.8	18.3	21.9
Total	100.0	100.0	100.0

Table 7. Percentage distribution of nursery operations by type of container-spacing methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	72.7	85.9	79.6
Planter	9.1	0.0	4.4
Tractor and planter	4.5	0.0	2.2
Unspecified	13.6	14.1	13.9
Total	100.0	100.0	100.0

Table 8. Percentage distribution of nursery operations by type of transport-vehicle-loading methods used when picking/pulling plants.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	62.1	81.7	72.3
Bobcat	6.1	0.0	2.9
Bobcat and shovels	4.5	0.0	2.2
Bobcat and tree spade	7.6	0.0	3.6
Carts	0.0	1.4	0.7
Conveyer	0.0	2.8	1.5
Front end loader and boom	6.1	0.0	2.9
Monorail and carts	0.0	1.4	0.7
Shovel	3.0	0.0	1.5
Tree spade	1.5	0.0	0.7
Unspecified	9.1	12.7	10.9
Total	100.0	100.0	100.0

Table 9. Percentage distribution of nursery operations by type of unloading methods in holding areas.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	66.7	74.6	70.8
Bobcat	7.6	0.0	3.6
Bobcat and tree spade	3.0	0.0	1.5
Carts	0.0	1.4	0.7
Conveyor	0.0	4.2	2.2
Front end loader and boom	6.1	0.0	2.9
Unspecified	16.7	19.7	18.2
Total	100.0	100.0	100.0

ify or indicate any method. Among nursery-only growers, 8% used bobcats and 6% used front-end loaders and booms. No mixed operations reported using this equipment. Four percent mixed operations used conveyors, but no nursery-only firms reported using them.

Loading Plants onto Delivery Vehicles

Seventy-three percent of mixed operations and 61% of nursery-only growers manually loaded plants (Table 10). Twenty-one percent of the nursery-only growers and 17% of the mixed operations did not specify or indicate any method. Eleven percent of nursery-only firms and 1% of mixed operations used bobcats. Three percent of nursery-only firms used tractors and booms, but no mixed operations reported using them. Three percent of mixed operations used conveyors, forklifts, and hook systems, but nursery-only firms reported no use of such equipment.

Jamming Plants in Winter

Participating firms indicated no use of automation/mechanization for jamming plants for winter (Table 11). Fifty-two percent of nursery-only firms and 42% of mixed operations jammed plants manually. The rest did not specify or indicate any method.

Plant Pruning

Fifty-one percent of mixed operations and 36% of nursery-only firms pruned plants manually (Table 12). Twenty-eight percent of mixed operations and 17% of nursery-only firms did not specify or indicate any method. Eleven percent of mixed operations and 5% of nursery-only firms used gas trimmers. Eleven percent of nursery-only growers and 1% of mixed operations used hand pruners. Eight percent of nursery-only firms used pruners, but mixed operations did not report use of this equipment. Six percent of both

nursery-only and mixed operations used power shears. Six percent of nursery-only firms and 1% of mixed operations used shears. Other reported forms of mechanization included hand shears, pruners and power shears, pruners and shears, shears and scissors, tractor, trailer with platform and power shears, trailer and shears, and tree saws, lift truck, pruners, and scissors.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	60.6	73.2	67.2
Bobcat	10.6	1.4	5.8
Bobcat and forklift	1.5	0.0	0.7
Carts	1.5	0.0	0.7
Conveyor	0.0	2.8	1.5
Forklift	0.0	2.8	1.5
Hook system	0.0	2.8	1.5
Tractor and boom	3.0	0.0	1.5
Tractor and carts	1.5	0.0	0.7
Unspecified	21.2	16.9	19.0
Total	100.0	100.0	100.0

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	51.5	42.3	46.7
Unspecified	48.5	57.7	53.3
Total	100.0	100.0	100.0

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	36.4	50.7	43.8
Gas trimmers	4.5	11.3	8.0
Hand pruners	10.6	1.4	5.8
Hand shears	3.0	0.0	1.5
Power shears	6.1	5.6	5.8
Pruners	7.6	0.0	3.6
Pruners and power shears	1.5	0.0	0.7
Pruners and shears	3.0	0.0	1.5
Shears	6.1	1.4	3.6
Shears and scissors	0.0	1.4	0.7
Tractor-trailer with platform and power pruners	1.5	0.0	0.7
Trailer and shears	1.5	0.0	0.7
Tree saws, lift truck, pruners and scissors	1.5	0.0	0.7
Unspecified	16.7	28.2	31.0
Total	100.0	100.0	100.0

Fertilizer Application

Seventy percent of nursery-only growers and 69% of mixed operations indicated that they manually applied fertilizer at their nurseries (Table 13). Eleven percent of mixed operations used injectors, but no nursery-only firms reported using them. Nine percent of nursery-only firms and 1% of mixed operations used a bucket and spoon. Six percent of nursery-only and mixed operations did not specify or indicate any method. Six percent of nursery-only firms used tractors and spreaders, but no mixed operations reported using this equipment. Six percent of nursery-only firms used belly grinders and spreaders, but mixed operations did not report using this equipment. Six percent of mixed operations incorporated fertilizer at potting, but no nursery-only operations used this practice.

Pesticide Application

Forty-four percent of nursery-only operations and 37% of mixed firms manually applied pesticides (Table 14). Sixteen percent of mixed operations used backpack sprayers, as did 14% of nursery-only firms. Fifteen percent of nursery-only firms and 4% of mixed operations used hand sprayers. Nine percent of mixed operations used sprayers, but no nursery-only operations reported using them. Eight percent of nursery-only operations and 7% of mixed firms did not specify or indicate any method. Six percent of nursery-only firms used a combination of boom sprayers and mist blowers, but no mixed operations reported using this equipment. Five percent of nursery-only firms and 1% of mixed operations used buckets and scoops. Four percent of mixed operations used electric sprayers or air blowers, while nursery-only firms reported no use of

Table 13. Percentage distribution of nursery operations by type of fertilizer-application methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	69.7	69.0	69.3
Batchfeed CLF	0.0	2.8	1.5
Belly grinders and spreader	6.1	0.0	2.9
Bucket and spoon	9.1	1.4	5.1
DOR	0.0	1.4	0.7
Drip tape	3.0	0.0	1.5
Incorporated at potting	0.0	5.6	2.9
Injector	0.0	11.3	5.8
Selectafeed	0.0	2.8	1.5
Tractor and spreader	6.1	0.0	2.9
Unspecified	6.1	5.6	5.8
Total	100.0	100.0	100.0

Table 14. Percentage distribution of nursery operations by type of pesticide-application methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	43.9	36.6	40.1
Air blast sprayer	3.0	0.0	1.5
Air blower	0.0	4.2	2.2
Backpack and hand sprayer	1.5	0.0	0.7
Backpack and air blast sprayer	0.0	1.4	0.7
Backpack and boom sprayers	1.5	0.0	0.7
Backpack sprayer	13.6	15.5	14.6
Boom sprayer and hand sprayer	1.5	0.0	0.7
Boom sprayer and mist blower	6.1	0.0	2.9
Boom sprayer, 4-wheeler and backpack sprayer	1.5	0.0	0.7
Bucket and scoop	4.5	1.4	2.9
Electric pump	0.0	2.8	1.5
Electric sprayer	0.0	4.2	2.2
Electric sprayer and chemigation	0.0	1.4	0.7
Hand sprayer	15.2	4.2	9.5
Injector	0.0	2.8	1.5
Mister, hand sprayer and granular	0.0	2.8	1.5
Pump sprayer	0.0	1.4	0.7
Sprayer	0.0	8.5	4.4
Tractor and hand sprayer	0.0	2.8	1.5
Tractor and sprayer	0.0	2.8	1.5
Unspecified	7.6	7.0	7.3
Total	100.0	100.0	100.0

this equipment. Three percent of nursery-only firms used air blast sprayers, but mixed operations did not report using them. Table 14 also indicates various other types of automation, each of which was used by less than 3% of respondents.

Irrigation Application

Twenty-six percent of the nursery-only growers and 18% of mixed operations indicated that they irrigated manually at their nurseries (Table 15). Four percent of mixed operations used 24V controllers, and 3% used electric valves with golf course controllers with computers. Nursery-only firms did not use this equipment. Twenty-four percent of nursery-only growers and 13% of mixed operations used a combination of drip with timers and controllers and valves. Twenty-one percent of mixed operations and 20% of nursery-only growers used some configuration of overhead irrigation. Eight percent of nursery-only operations and 1% of mixed firms used some combination of hose and sprinkler. Twenty-three percent of mixed operations and 14% of nursery-only growers used some combination of all the equipment listed previously. The remaining 17% of mixed operations and 9% of nursery-only growers did not specify or indicate any method.

Table 15. Percentage distribution of nursery operations by type of irrigation methods.

Method	Nursery only (N=66)	Mixed operations (N=71)	Total (N=137)
Manual	25.8	18.3	21.9
Electric valves, golf course controllers and computer	0.0	2.8	1.5
24v controllers	0.0	4.2	2.2
Drip	12.1	0.0	5.8
Drip and manual valves	6.1	0.0	2.9
Drip, emitters, timers and pumps	1.5	0.0	0.7
Drip, hose, sprinklers, and controller	0.0	7.0	3.6
Drip, overhead, risers, valves and computer	1.5	0.0	0.7
Drip, overhead, pumps and valves	1.5	0.0	0.7
Drip, risers, overhead, manual valves and well	1.5	0.0	0.7
Drip, sprinklers and timers	0.0	2.8	1.5
Drip stake and fogging	0.0	2.8	1.5
Hose	0.0	1.4	0.7
Hose and sprinkler	4.5	0.0	2.2
Hose riser and sprinkler	3.0	0.0	1.5
Hose, valve and overhead	1.5	0.0	0.7
Overhead	1.5	1.4	1.5
Overhead and drip	0.0	1.4	.7
Overhead and manual valves	6.1	5.6	5.8
Overhead and misters	3.0	0.0	1.5
Overhead and timers	0.0	7.0	3.6
Overhead, pumps and PVC	1.5	0.0	0.7
Overhead, risers, manual valves and well	1.5	0.0	0.7
Phytotonic Saturn 6 controllers and overhead	0.0	4.2	2.2
Risers, impact heads and valve	3.0	0.0	1.5
Risers, overhead and computer valves	0.0	1.4	0.7
Risers, overhead and sprinklers	1.5	0.0	0.7
Risers, sprinklers and timers	1.5	1.4	1.5
Risers, sprinklers and manual valves	4.5	0.0	2.2
Risers, sprinklers, solenoid and timers	1.5	0.0	0.7
Risers, sprinklers, valves and computer	1.5	0.0	0.7
Sprinklers	3.0	8.5	5.8
Sprinklers and manual valves	0.0	5.6	2.9
Sprinklers and timers	0.0	1.4	0.7
Timer	0.0	4.2	2.2
Timer and clock	1.5	0.0	0.7
Water wand and sprinkler	0.0	1.4	0.7
Unspecified	9.1	16.9	13.1
Total	100.0	100.0	100.0

SUMMARY AND IMPLICATIONS

While irrigation management, chemical application, and plant pruning are somewhat automated/mechanized, growers have opportunities to apply new or different technology. For instance, plant transportation throughout the nursery and plant placement in the field utilize little mechanization. Therefore, new or existing technology may be applied. Substrate mixing, container filling, and planting are also areas where automation/mechanization might be implemented or modified to help increase production.

With the development or modification of current equipment and technology, growers may be able to lower production costs and, in turn, increase worker efficiency and safety, as well as potential profits. As worker safety and efficiency are increased through mechanization or automation, production costs may in turn be lowered, which will allow for increased profit potential or reallocation of profits or assets to better aide in production or worker morale and safety.

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