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PHYSICAL REQUIREMENTS AND CAPITAL COSTS FOR ESTABLISHING CONTAINER NURSERIES FOR U.S.D.A. PLANT HARDINESS ZONE SIX

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INTRODUCTION

Cost models for two sizes of nurseries producing crops representing five categories of container-grown production schemes in U.S.D.A. Plant Hardiness Zone Six were developed. Physical coefficients are included so the information can be readily updated and so individual nurserymen can use the model as a standard against which to compare their own opertions or planned operations. Information derived should provide a basis for decision making for those evaluating the necessary physical and capital requirements in either establishing a new container nursery, expanding an existing container nursery or phasing out of container production.

Comprehensive cost models have recently been developed for both container and field grown crops in U.S.D.A. Plant Hardiness Zones 5 and 6 (2,3) and for field grown crops in U.S.D.A. Plant Hardiness Zones 7 and 8 (1). This paper presents a small portion of the information on physical requirements and capital expenditures to be found in the publication on containers (3).

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OBJECTIVES

The general objective of this paper was to develop the physical and capital requirements model container production facilities. Specific objectives were to:

1. Design physical facilities including land areas, land improvements, irrigation ystems, buildings, machine and equipment components for a small and large commercial container nursery based on model production systems delineated in a companion article entitled "Container Nursery Overview - Size, Systems and Enterprise Mix in U.S.D.A. Plant Hardiness Zone Six".
2. Determine capital costs for the above physcial facilities.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model. They were synthesized based on the Columbus, Ohio area. The complete synthesis included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with the purchase of plant liners and ending with loading the finished product for wholesale

distribution; and budgets for fixed and variable costs (9).

Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1982. The basic goals in synthesizing the production facilities (see Figures 1 and 2) were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and allow future expansion.

Physical Plant and Equipment

Assumptions

Assumptions about the physical facilities and equipment can greatly affect its cost and thereby cost per annual salable plant. The authors included all items a nursery would typically require, thus the physical plant is probably more elaborate than many nurserymen would require. A nurseryman can easily eliminate or reduce items as required. However, it would require substantial effort to do the analysis on his own if they were not included.

Components

Land Improvement. For full utilization of the growing and shipping area; extensive grading, graveling, surface and underground drainage tiles were provided. The growing area was graded to allow a gradual slope from a high point at the shipping area to lower points on the edges of the growing area. In addition, every two rows of polyhouses were sloped

toward each other to utilize a common buried 30-inch water tile that attaches to the open grassy waterways at the perimeter of the container operation. For any area that heavy equipment may run over (roadways, shipping area and machine storage shed), #4 grade gravel was used. In other graveled areas, #8 grade was utilized. Although the cost of this graveling operation is high, it is offset by greater efficiencies and dependability in the handling of plants, ability to reenter the growing areas after natural or artificial irrigation and reduction in soil erosion.

A pond was included even though it was assumed a well could be dug with sufficient regenerative water capacity. This was done to reduce the risk to plants in containers in case of disruptions caused by repairs or electrical failure. An auxiliary take-off drive from the pump could be powered by a large 60 HP tractor for temporary irrigation.

Buildings. Each nursery was assumed to require similar sized permanent buildings for the receiving of nursery stock/storage (50' x 40'), machinery repair/storage (50' x 40'), office space (20' x 20'), and restroom facilities (20' x 20').

Overwintering facilities. The need for overwintering structures (polyhouses) was an integral part of the production operation. Individual crop storage spacing needs can be a limiting factor in the number of units a given production acreage is able to produce. Polyhouse structures measuring 20' x 200' were choosen for the nurseries.

Irrigation system. Irrigation systems were designed to minimize labor efforts, yet provide sufficient irrigation capabilities to meet present and future water needs even under the most unlikely situations. The basic irrigation system was composed of four parts: water source, pumping equipment, inground irrigation pipe, and above ground irrigation pipe.

The water source must have adequate reserves to meet maximum water needs and sufficient purity to meet cultural requirements. Because municipal water is expensive, especially if the production site is located far from a center of population; a well in conjunction with a constructed lake or a site situated near an open water source of high quality water would be desirable. Our models assumed an adequate water source found approximately 40-60 feet below ground. The well was dug to a depth of 80 feet to ensure adequate recharging capacity. In many areas of USDA region six, wells would have to be drilled to much greater depths which would result in higher costs.

Selection of a well pump is crucial to the nursery operation. An electric motor was chosen because of reliability of performance, low maintenance cost and close availability of three-phase electrical power.

The third part of the irrigation system is the inground irrigation pipe. The advantages of inground water mains are:

labor costs for pipe movement is eliminated, breakage due to equipment running over above ground pipe is eliminated, and lower initial cost of P.V.C. pipe compared to portable above ground aluminum.

The fourth part of the irrigation system would be above ground and would include 1" frost free water hydrants, 200 feet of 1" P.V.C. pipe per polyhouse or growing space, riser pipe and sprinkler heads. One inch P.V.C. pipe would hang from the ridge of each polyhouse. Between polyhouses 1" P.V.C. pipe would lay on the ground with sprinklers on risers steadied by stakes. Sprinkler heads spaced at 20 foot intervals would release 1.05 gallons per minute per head and each would cover a maximum 64 foot diameter circle area.

RESULTS AND DISCUSSION

Capital Investment Requirements

Capital investment requirements for establishing container nurseries were itemized under three broad divisions: land and improvements, buildings, and machinery and equipment (Tables 1,2). Each was further divided into several components. The small nursery required $592,921 in investment. Land and land improvements represented 34% or $202,941 of the investment, buildings 35% or $206,243, and machinery and equipment 31% or $183,737. The large nursery had an initial investment requirement of $964,574. Land and land improvements represented 40% or $387,428 of the

investment, buildings 33% or $318,108, and machinery and equipment 27% or $259,038. The difference in the percent of total investment between the various components of the two nurseries was primarily caused by the larger nursery being able to make more efficient use of buildings, machinery, and equipment than the smaller nursery. Both nurseries were about equally efficient in the use of growing space.

An important consideration for managers in most industries is determination of investment per unit of production capacity. For container nurseries this indicator would be the capital requirement per-salable-plant capacity. This indicator was determined for each of the five groups of plants (3). These capital costs for the small nursery differentiated by plant group were: $4.63 for Group I (Juniperus), $5.72 for Group II (Cotoneaster), $5.90 for Group III (Taxus), $7.33 for Group IV (Viburnum) and $9.09 for Group V (Rhododendron). The average for all groups was $6.20. For the large nursery the respective figures were: $3.71 for Group I, $4.65 for Group II, $4.80 for Group III, $5.96 for Group IV, and $7.39 for Group V. The average for all groups was $5.02. It was approximately 32% less expensive to provide salable plant capacity in the large nursery than in the small.

SUMMARY

Investment requirements for two different container nurseries for U.S.D.A. Climatic Zone Six conditions were examined. Examination of the data indicate higher investment

costs per unit of salable plant capacity would incur as container nursery size is decreased from the smaller one analyzed. This would be caused by spreading the cost of fixed items such as buildings, equipment, and machinery over fewer units. Conversely, lower costs per unit of salable plant capacity would be realized for container nurseries larger than those analyzed as the costs of fixed items would be spread over more units.

LITERATURE CITED

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TABLE 1.--Capital Requirements for a Small* Commercial Container Nursery U.S.D.A. Climatic Zone Six, 1982

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	Acre		17.04	1,850	31,524	5
+ Improvements	Grading, tiling, graveling, pond		20			171,417	29
Subtotal						202,941	34
Buildings							
Office and restrooms	20′ x 40′ cement block	sq ft	20	800	28	22,400	4
Potting and packing shed	40′ x 50′ steel pole insulated	sq ft	20	2000	18	36,000	6
Machinery storage, shop	40′ x 50′ steel pole insulated	sq ft	20	2000	18	36,000	6
Polyhouse structures	200′ x 20′ pipe frame	each	10	51	2,193	111,843	19
Subtotal						206,243	35
Machinery and Equipment							
Tractor, 60 HP	60 HP, gas fuel with front end loader	each	10	1	16,000	16,000	3
Tractor, 28 HP	28 HP, gas fuel	each	10	2	6,025	12,050	2
Manure spreader	130 bu capacity	each	10	1	2,135	2,135	**

TABLE 1 Cont.

Wagon	4 wheel, self steering	each	10	2	2,300	4,600	1
Irrigation pump/well	75 HP electric pump	each	20	1	40,085	40,085	7
Inground irrigation system	PVC pipe/valves		20		38,801	38,801	7
Above ground irrigation system	PVC pipe/sprinklers		5		19,383	19,383	3
Fertilizer injector	200 gal	each	5	1	6,500	6,500	1
Airblast sprayer	300 gal, on trailer	each	7	1	6,955	6,955	1
Cyclone spreader	Hand operated	each		1	40	40	**
Forklift	3000 lb lift						
	exterior wheels	each	10	1	24,000	24,000	4
Truck	1/2 ton pick-up	each	5	1	8,000	8,000	1
Pallets	Wooden	each	2	349	12	4,188	1
Handtools	Miscellaneous		5		1,000	1,000	**
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Subtotal						183,737	31
TOTAL						592,921	

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.

**Less than half of 1%.

TABLE 2.--Capital Requirements for a Large* Commercial Container Nursery U.S.D.A. Climatic Zone Six, 1982

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land Unimproved	land	Acre		33.04	1,850	61,124	6
+ Improvements	Grading, tiling, graveling, pond		20			326,304	34
Subtotal						387,428	40
Buildings							
Office and restrooms	20′ x 40′ cement block	sq ft	20	800	28	22,400	2
Potting and packing shed	40′ x 50′ steel pole insulated	sq ft	20	2,000	18	36,000	4
Machinery storage, shop	40′ x 50′ steel pole insulated	sq ft	20	2,000	18	36,000	4
Polyhouse structures	200′ x 20′ pipe frame	each	10	102	2,193	223,708	23
Subtotal						318,108	33
Machinery and Equipment							
Tractor, 60 HP	60 HP, gas fuel with front end loader	each	10	1	16,000	16,000	2
Tractor, 28 HP	28 HP, gas fuel	each	10	2	6,025	12,050	1
Manure spreader	130 bu capacity	each	10	1	2,135	2,135	**

TABLE 2 Cont.

Wagon	4 wheel, self steering	each	10	4	2,300	9,200	1
Irrigation pump/well	75 HP electric pump	each	20	1	40,085	40,085	4
Inground irrigation system	PVC pipe/valves		20		77,160	77,160	8
Above ground irrigation system	PVC pipe/sprinklers		5		38,765	38,765	4
Fertilizer injector	200 gal	each	5	1	6,500	6,500	1
Airblast sprayer	300 gal, on trailer	each	7	1	6,955	6,955	1
Cyclone spreader	Hand operated	each		1	40	40	**
Forklift	3000 lb lift						
	exterior wheels	each	10	1	24,000	24,000	2
Truck	1/2 ton pick-up	each	5	2	8,000	16,000	2
Pallets	Wooden	each	2	679	12	8,148	1
Handtools	Miscellaneous		5		2,000	2,000	**
Subtotal						259,038	27
TOTAL						964,574	100

*33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space.

**Less than half of 1%.