RESEARCH RESULTS FOR NURSERYMEN

Tok Furuta

Horticulture Series No. 1

AGRICULTURE EXPERIMENT STATION

AUBURN UNIVERSITY

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PACKING AND SHIPPING OF HORTICULTURAL SPECIALTY CROPS

I. Use of Polyethylene film for LCL shipments of deciduous ornamentals (Furuta, Pate and Perry - Auburn)[1]

The value of Polyethylene film and the kraft papers laminated with Polyethylene in the movement of plants through the mail is well known. Results of a series of experiments over several years duration showed that the same materials can be used with subsequent savings in marketing cost in LCL shipments. The savings in marketing cost resulted from a reduction of transportation cost. In the first of the experiment, a standard bale of 100 plants cost $2.09 to express to Aiburn, Alabama. A similar 100 plants were shipped for $1.37 by the use of plastic film and the elimination of the moist packing around the roots. The cost of the materials for the pack varied. In this test, it was calculated that the cost of the paper in the check treatment was 6.9 cents per bale and the cost of the Polyethylene film was 17.6 cents. The greater material cost only partially offset the savings in transportation cost.

The cost of labor and the time involved in the actual baling of the plants for shipment remained approximately the same regardless of the materials used. Time studies during the experiment revealed that it took one man 15 minutes to bale the 100 plants for shipment.

The regular nursery packing crew handled these materials and prepared the packages. They objected to the use of the film chiefly because they were not accustomed to its feel and use.

Labor required in packing the plants was reduced by the use of a box lined with the plastic film. Use of plastic lining eliminated the need of a moist packing around the roots. The transportation cost of this comparison was for the standard bale, 74 cents, and for the boxed plants, 59 cents. The box and lining cost more than the paper and burlap of the bale.

The use of the plastic film prevented drying out of the roots of the plants during shipment. This was true whether the entire plant or only the roots were enclosed with plastic.

Crushing of the roots, or their breakage during shipment was not severe when only plastic film was used. Bales arrived with some puncture holes. However, this did not influence the survival of the plants after planting. Where it was necessary to use some packing, dry materials were used with success.

The time of harvesting the plants influenced the effectiveness of the packing treatments somewhat. There was evidence that the plastic wrapping was superior probably because of reduced moisture loss from the plants. This was especially important for plants that were dug early in the season.

Earliness of harvest influenced the storage life of the plants and the number of flowers the following year on those plants that initiate flower buds the summer before flowering. The earlier the plants were harvested (from Sept. thru Dec.) the fewer the number of flower on the plants the following year. (This was true with the Pink Almond Cherry, Winter Jasmine, and Flowering Quince.)

[1] Chief personnel concerned and location of experiment.

The early harvested plants were in poorer condition upon removal from storage than the later harvested plants. This was due partially to the length of storage and partially to the condition of the plants when placed into storage. On many plants harvested in September and October, the leaves had to be pulled from the plants before they could be stored.

Late winter and spring shipments of plants responded differently to the use of plastic than did mid-winter shipments. More plant damage was noticed when the plants were in the plastic wrap and subjected to warm temperatures. Cold or freezing did not affect the plants more in plastic than in the standard bale. Late in the shipping season, the use of plastic should probably be avoided due to the danger of greater plant damage.

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II. Studies on shipping broadleaf greens (Furuta and Self - Auburn and Spring Hill)

Similar studies to those reported above were conducted on broadleaf evergreens. Sealing in a plastic bale seemed to be undesirable for these plants. However, using a box lined with plastic did not result in plant damage. Plastic film could be used in place of other paper now being used. However, there is not sufficient reason to change procedures at the present time.

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III. Insulation of shipping container (Furuta - Auburn)

Under certain conditions it is desirable to insulate the shipping container to protect plants from low temperature. Experiments on this problem revealed the following:

1. The temperature along the bottom of the box drops most rapidly and plants here will be the first to show signs of freezing.

2. Added insulation along the bottom of the container will help to retard this temperature drop even without added insulation in the sides or the top of the box.

3. Newspaper was an excellent insulation material.

4. Insulation materials made from cellulose crepe were no better than 10 sheets of newspaper at best.

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IV. Influence of container on sale of nursery stock in Garden Centers (Furuta, Pate and Perry - Auburn)

To date it has not been possible to detect the effect of the container on the sales of plants. Containers used in a study with Roundleaf Japanese Holly were Plastican #170 in red, shades of gray, black and pink colors; Plantainer in silver and green; and Nurserican in silver and green. Azaleas were tested in some of the above containers as well as rusty and black reclaimed No. 10 food cans.

There was a tremendous influence on the appearance of the sales area. However, the customers were interested primarily in the plant. This was especially true with plants that have showy flowers - any plant in flower usually sold first.

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V. Sealing Azaleas in plastic (Furuta and Perry - Auburn)

Azalea plants were wrapped in plastic in various ways so that roots alone, or roots and tops were sealed in the film. This was to study whether there was any merit in sealing Azaleas in bags for better keeping quality in sales areas. It was concluded that it is undesirable to seal Azalea plants in plastic for any extended period of time. Doing so resulted in yellowing and deterioration of the foliage. This detracted from the sales appeal of the plant, although this leaf damage did not result in reduced growth or survival after planting out. Nor did complete enclosure result in better plants or increased survival after the plants were planted out.

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VI. Root wrapping of broadleaf evergreens (Furuta and Perry - Auburn)

In some cases it is desirable or necessary to move broadleaf evergreens bare rooted. Use of moist packing material such as sphagnum moss improved the survival of the plants even when plastic film was used around the roots. However, none of the bare root treatments were as good as the standard B&B method when the growth of the plants was considered. All bare rooted plants deteriorated rapidly. Best results with bare root plants were obtained when moist sphagnum was used around the roots, the roots and sphagum were covered with plastic, and the plants were planted soon after harvesting.

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PROPAGATION OF PLANTS

I. Mist propagation of some Malus species (Furuta - Auburn)

Studies were conducted on the rooting of cuttings of several Malus species. Those cuttings used were: East Malling 7 and 9 rootstock, Anoka, Malus atrosanguinea and Malus halliana parkmanii. The results of this experiment may be summarized as follows:

1. Fewer cuttings died when the beds were open rather than enclosed but more cuttings rooted when the beds were covered in a plastic cover.

2. Fewer cuttings died when the electronic leaf was used rather than the interrupted mist, but the rooting percentage was approximately the same.

3. There was little influence on rooting by hormone and anti-transpirant treatment.

4. Early May cuttings (at Auburn) rooted better than late May cuttings.

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II. Influence of Gibberellin treatment on seed germination (Furuta - Auburn)

Soaking seeds of Camellia sasangus 'Texas Star', Camellia japonica, Quercus alba, and Cornus florida in a Gibberellin solution resulted in faster germination. The optimum concentration for the 24 hour soaking was: Camellia sasangua 'Texas Star' - 100 parts per million; Camellia japonica - 50 to 100 parts per million; White oak - 100 parts per millipn; and the flowering dogwood - 500 parts per million. Note that the flowering dogwood seeds had not been stratified before this treatment. Use of Gibberellin in talc was not effective in the concentration used (0.88%).

III. Propagation of Silver Spreading Redcedar (Orr - Auburn)

Cuttings were made on April 1 and the degree of rooting observed on May 29. These results are of interest:

Type of cutting	Auxin Treatment	Per cent rooting
Tip of shoot	Hormodin No. 3	52.7
Median of shoot	Hormodin No. 3	43.3
Basal portion of shoot	Hormodin No. 3	32.0
Heal cutting	Rainbow, Tender	40.0
	Rainbow, Semi-woody	43.5
	Rainbow, Woody	38.2
	Hormodin No. 3	58.0
	Hormodin No. 1	1.4
	None	0.0

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PRODUCTION OF PLANTS IN CONTAINERS

I. Garden Chrysanthemums in containers (Furuta and Martin - Auburn)

Garden Chrysanthemums are excellent plants to grow in containers for fall sales. They transplant easily even in full flower, and serve as a means of very rapidly adding color to the yard. Container grown plants transplanted better than bed grown plants.

One plant in a container of about 3 quarts capacity was found to be the best. The larger the container used, the larger the plant at the end of the season. Use of more than one plant in a container was not desirable.

All the varieties tested did well in containers. The rooted cuttings or small plants should be planted in the containers in June or early July. Constant attention must be paid to spraying for insect and disease control, pinching of the shoots to develop compact plants (stop on August 1) and to proper fertilization. Any good soil mixture should be satisfactory.

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II. Site preparation for container plants (Furuta and Martin - Auburn)

The following bases for container plants were compared: concrete, asphalt, sawdust, and crushed gravel (road slag).

Air temperature: the base influenced the air temperature among a group of containers. These measurements were made 12" above the surface. During the winter, the lowest temperature was recorded above the sawdust base, with the temperature above the asphalt just about as cold. The temperature above the concrete and gravel was about the same and warmer than the other two. It has been shown a number of times that greater injury to plants occurs during the winter when they are mulched. This is also true with containers set upon mulching material such as sawdust. These materials insulate the surface preventing soil heat to be radiated. The maximum temperatures reached during the winter was the same for all bases.

During the summer, the night temperature above the asphalt base was warmer than the other three. The maximum temperature reached was about the same.

The location of the measurement in a group of containers made a difference in the temperature recorded. Along the western edge was the warmest, both in maximum and minimum temperature recorded. The next warmest was along the southern edge. Along the northern and eastern edge, and among the plants the temperature was about the same, being lower than either the western or southern edges.

The base did not influence the maximum temperature reached by the soil in the containers during the summer.

Plant growth: Nor was there any appreciable influence on plant growth of Roundleaf Japanese Holly. The only difference was the rooting out of the drainage hole of plants on the sawdust base.

Recommendation: Road slag (or other gravel) was the best material in this comparison from the standpoint of cost and useability.

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III. Plant container for woody plants (Furuta and Martin - Auburn)

A number of different types of containers were used to determine their suitability for woody plants. Among those used were: Plastican #170 - red, pink, light grey, dark gray, and black in color; Plantainer - green or silver color; Nursérican #6 - silver or green color; and untreated No. 10 food cans.

Container on soil temperature: Measurements of the maximum soil temperature were made in the containers located in the western row. Against the side of the container, the western side, the two silver containers were the coolest, and the green, red, black and untreated, rusty containers were the warmest. All other colors were intermediate between these two extremes. The type of container, plastic or metal, did not appreciably influence the temperature recorded.

There was a definite relation of the temperature recorded and the presence of roots. Few or no roots were present on the western side of the darker containers exposed to the west. More roots were present in the silver containers. Many were evident on the eastern side. This condition prevailed only on the plants in the western row of the group of plants. On the eastern row, the situation was reversed and was not as severe.

Location of container on soil temperature: After the plants became large enough to shade adjacent containers, the warmest location was on the western side of containers exposed to the west. The next warmest was the eastern side of containers exposed to the east. All other locations measured recorded about the same temperature (the southern and northern sides were not measured) and were cooler than either of the above locations.

Temperature gradient in the soil of one container: The warmest location was the western side of the container next to the container, with the southern edge next. The other two sides were cooler. The temperatures recorded in one test were as follows: western side - 116° F; southern side - 105° F; northern and eastern sides - 103° F. Two inches from the side of the container, the western side was still the warmest, being about as warm as the eastern and northern edge (103° F). All other locations were about the same and cooler, measuring 100 to 101° F. The container color influenced the temperature recorded, but did not influence the pattern of temperatures recorded.

Soil temperature and root growth: Soil temperature has a complex influence on root growth. This has not been studied with the Roundleaf Japanese Holly. Based on research with other plants, however, in general terms, the temperature limits for growth of roots seem to lie between 32° and 122° F. As the temperature increases from 32°, there will be an increase in growth, then a decrease after the optimum temperature range is exceeded. Roots seem to be less resistant to injury by high temperatures than the aerial portions of the plants. In some cases, high nitrogen levels have been shown to result in greater injury due to high soil temperatures. In addition to its influence on growth and survival of the roots, high temperatures influence absorption of fertilizer elements, plant disease organisms, and many other properties of the soil complex. Growth of the plant will be a summation to all these various influences. Since the measurements recorded indicate that the temperature reached is high enough to reduce growth of the roots, or even to kill the roots, every precaution should be taken to maintain as low soil temperature in the container as possible during the summer.

Plant growth: The plants were regularly sheared during the spring and summer. More compact plants developed in the lighter color containers than in the darker containers.

Recommendation: The lighter color containers should be used where-ever practical for the production of woody plants.

Notes on Plastican #170: While excellent for the culture of woody plants, some difficulties were noted by those handling these containers in our experiment.

1. During potting, too much pressure on the soil caused the container to split.

2. During cold weather, the plastic, normally quite flexible, became hard, stiff, and broke rather easily with rough handling.

3. Picking up the plant by the rim of the container would result in a broken container. Employee training should eliminate these difficulties.

The plastic container maintained the original appearance better than the painted metal container in the open exposed to full sun. In some cases, drainage from the plastic container was better because: 1. The container is constructed so that the center portion of the bottom is slightly higher than the sides. 2. The drainage holes were not stopped with rust or other debris during the test.

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IV. Methods of fertilizing container grown plants (Furuta and Martin - Auburn)

Studies were conducted on methods and materials for the fertilization of woody plants growing in metal containers. The cultivars used were: Ilex aquipernyi 'Brilliant', Ilex cornuta 'Burford', Ilex cornuta rotunda, Ilex cornuta femina, Ilex crenata 'Convexleaf', Ilex crenata 'Hellers', Ilex crenata 'Roundleaf', Ilex opaca 'Howard', Ilex vomitoria, Ilex vomitoria nana Pittosporum tobira, Pyracantha crenata-serrata, Teucrium chamaedrys, Juniperus conferta, Juniperus horixontalis 'Waukegan', Thuja occidentalis 'Tom Thumb', and Thuja orientalis 'Berckmanns Golden'.

One teaspoonful of 8-0-8 per can per month was used as the standard treatment. Plants died from overfertilization when one teaspoonful of 8-0-8 was applied each week. Overfertilization also resulted when approximately one teaspoonful of urea was applied once a month to the soil.

Ureaformalhyde nitrogen was not as long lasting as desired in these studies. Monthly applications at the rate of one teaspoonful per can was better than applying two teaspoonful every other month. These treatments did result in the largest plants of all the treatments.

All plants used absorbed nitrogen from foliar applications of urea. Except when a concentration of two ounces per gallon of water was applied each week, growth was less than the check plants.

The costs of application of the differential fertilizer treatments were calculated and are presented in the following table:

TREATMENT				COST FOR SEASON MAY 1 to OCT 1				
						Cost per 1000 Containers		
Fert. Material	Place of Appli-cation	Rate of Appli-cation	Frequency	No. of Appli-cations	Fert. Cost per Ton	Fert.	Labor*	Total
						dollars	dollars	dollars
8-0-8	Soil	1tsp/can	Monthly	6	40	1.32	24.00	25.32
8-0-8	Soil	1tsp/can	Weekly	23	40	6.04	92.00	98.04
Ureaform	Soil	1 tsp/can	Monthly	6	440	14.52	24.00	38.52
Ureaform	Soil	2 tsp/can	Bi-Monthly	3	440	14.52	12.00	26.52
Urea	Soil	1 tsp/can	Monthly	6	135	4.05	24.00	28.05
Urea	Foliar	1 oz/gal	Weekly	23	135	5.55	15.41	20.96
Urea	Foliar	1 oz/gal	Bi-Weekly	12	135	4.19	8.04	12.23
Urea	Foliar	1 oz/gal	Monthly	6	135	2.21	4.02	6.23
Urea	Foliar	2 oz/gal	Weekly	23	135	9.58	15.41	24.99
Urea	Foliar	2 oz/gal	Bi-Weekly	12	135	5.70	8.04	13.74
20-10-15	Foliar	2 tbsp/gal	Bi-Weekly	12	680	14.28	8.04	22.32

*Based on one dollar per hour

Notice that high material cost does not necessarily mean that the total cost would be correspondingly higher because labor cost may be lower. Net profit calculations based on the income due to growth and size of plants were not made. This would be necessary before the final decision of the alternative fertilization method to select can be made.

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FERTILITY STUDIES WITH ORNAMENTAL PLANTS

I. Influence of N-P-K levels on growth of Ilex crenata 'Roundleaf' (Orr and Furuta - Auburn)

Various fertilizer analyses were applied to plants in No. 10 food cans at the rate of one teaspoonful once every two weeks. Preliminary analysis of the results indicates a reduction in the growth of plants when over 5% potash was applied. The most dense, heaviest, best-shaped plants were in plots receiving 5-5-5, 5-10-5, and 10-10-5 formulations. Decrease in growth resulted when any fertilizer formula higher than 10-10-5 was used.

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II. Influence of N-P-K levels on growth of Magnolia grandflora (Orr and Furuta - Auburn)

Various fertilizer analyses were applied to plants at the rate of one teaspoonful every two weeks to each two gallons of soil. Preliminary analysis of results indicates that increasing the nitrogen supply from 5% to 10% resulted in increased growth.

When the amount of nitrogen supplied was 5%, greater increase in growth resulted from increasing the potassium supply than from increasing the phosphorus supply. Increasing both phosphorus and potassium did not result in as much increase in growth as increasing either alone. Apparently nitrogen was limiting.

At the higher rate of nitrogen, the same pattern was true except when both phosphorus and potassium were increased. Here greatest growth resulted.

The largest plants resulted from the use of a 10-10-10 fertilizer.

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III. Phosphorus and lime rates (Orr - Auburn, in cooperation with Self at Spring Hill and Adams, Rouse, and Wear at Auburn) (This project is being conducted at both Auburn and Spring Hill. An integrated report will be released when the work is completed)

Using a soil consisting of one part clay loam and one part German peat moss, studies were conducted on the influence of lime and phosphorus incorporation before planting. Fertilizer treatments also varied but were essentially dry applications to the soil. No. 8 Nursericans were used.

Plant species differed in their response to the fertilizer treatments. The following gives the best plants and the treatment.

Treatment consisting of two tablespoonsful of cottonseed meal and two tablespoonsful of 0-14-14 mixed into the soil of each container before planting, and a 13-26-13 applied bi-weekly at the rate of one teaspoonful per container resulted in the heaviest plants for the following: Camellia japonica, Ilex crenata 'Roundleaf', Magnolia grandiflora, and Azalea 'Hexe'.

Treatment consisting of mixing 9.3 lbs of dolomite and 2.5 lbs of 20% superphosphate per cubic yard of soil mixture, and fertilizing bi-weekly with an 8-0-8 at the rate of 1/2 teaspoonful per container resulted in the heaviest plants of Gardenia radicans and Pittosporum tobira.

The heaviest plants of Magnolia soulangeana and Camellia sasanqua were in the following treatment: Mix 6.2 lbs of dolomite and 2.5 lbs of 20% superphosphate per cubic yard before planting and fertilize with 1/2 teaspoonful of 8-8-8 bi-weekly with added minor elements.

Increased growth as rated by fresh weight resulted from increased calcium rates applied to Magnolia grandiflora, Magnolia soulangeana, Pittosporum tobira, Azalea 'Hexe'.

High phosphorus rates were detrimental to the growth of Pittosporum tobira.

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IV. N-P-K on growth of Lyonia lucida (Furuta, Orr and Martin - Auburn)

Plants of Lyonia lucida growing in a medium of one part sand and one part peat by volume and fertilized with an inorganic 5-10-10 were more outstanding visually and according to fresh and dry weight determinations than similar plants growing in the same, medium to which other fertilizer analyses were applied.

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LIGHT AND CHEMICAL CONTROL OF GROWTH

I. Light intensity studies (Furuta - Auburn)

Azalea plants, varieties Hino, Coral Bells, Hexe, and Red Wing budded better and forced into flower more evenly when grown in green saran cloth houses with 22 to 46% reduction of sunlight during the summer than in full sunlight or heavier shading. Cloth house plants were superior to those grown in a lath house in this study.

More flowers were produced when Hydrangea plants were grown in a cloth house having about 22% light reduction.

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II. Daylength on growth of some plants (Furuta - Auburn)

Increasing the daylength with low intensity electric light (Incandescent bulbs; minimum of 10 foot candles of light) resulted in greater growth of Ilex crenanta 'Convexleaf' and Ilex crenata 'Roundleaf'.

Interrupting the night with light of four hours duration was as effective as continual sixteen hour daylengths.

This effect of daylength is more noticeable when the days are short than when the days are naturally long.

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III. Container size and lighting (Furuta - Auburn)

Ilex crenata 'Roundleaf' were grown outdoors. Plants were grown in one and two gallon containers, both under normal daylength and increased daylength (light from sundown to midnight) by the use of electric lights. A minimum of 10 foot candles of light was used. Increasing the size of the container resulted in larger plants at the end of one season. Increasing the daylength resulted in larger plants and was additive to the size of the container. These results are typical:

Daylength	Can size	Plant height inches	Plant spread inches	Fresh weight grams
Normal	1 gallon	9.3	8.0	42.7
Normal	2 gallon	9.7	8.7	67.0
Increased[1]	1 gallon	11.7	10.3	71.7
Increased[1]	2 gallon	13.7	11.3	89.7

[1]Lighted from sundown to midnight.