SUMMARY

A split-plot experiment was set up March 15, 1961, to determine effects of 4 lighting treatments on growth and flowering of 9 varieties of *Chrysanthemum morifolium*.

Under conditions of this experiment plants receiving 2 spm of 'flashlight' grew as tall as plants receiving 4 hours of continuous light.

The pompon varieties produced more flowers under 2 spm of 'flashlight,' than any other treatment.

There were no differences in flower diameter of standard varieties.

LITERATURE CITED

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EFFECTS OF NITROGEN AND POTASSIUM LEVELS AND TWO APPLICATION INTERVALS ON GROWTH AND CHEMICAL COMPOSITION OF RHODODENDRON INDICUM AND VIBURNUM SUSPENSUM

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Little research has been undertaken on many cultural problems associated with growing woody ornamental plants in containers. The experiments reported here deal with certain cultural factors affecting growth of container-grown woody ornamental stock.

Some effects of varying levels of nitrogen and potassium and 2 fertilizer application intervals on the growth of *Rhododendron indicum* 'Formosa' and *Viburnum suspensum* in gallon cans have previously been reported by Poole and Dickey (2). Terminal growth measurements and chemical analyses are given in this report.

MATERIALS AND METHODS

Two experiments were established to test effects of 2 fertilizer application intervals and 3 levels each of nitrogen and potassium in factorial combination on growth and chemical composition of 'Formosa' azalea and *Viburnum suspensum*. The experiments were set up in randomized block design. There were 3 replications and the experimental unit was 4 plants. Both experiments were initiated May 5, 1959, and terminated September 1960.

Rooted cuttings, obtained from a commercial source, were potted, one plant to a can, in gallon cans (No. 10 food cans—185 cu. in.) in a soil mixture of $\frac{1}{3}$ imported peat, $\frac{1}{3}$ No. 30 perlite and $\frac{1}{3}$ fine sand and placed under a half-lath shade for the experiment's duration. Before potting, one pound of superphosphate and 5 pounds of dolomite were added per cubic yard and the mixture sterilized with methyl bromide. A soil analysis made after addition of these fertilizers gave the following concentration of these elements: calcium oxide—2168 pounds per acre (ppa), magnesium oxide—1119 ppa, phosphate (P_2O_5)—150 ppa, potash (K_2O)—165 ppa, and nitrate (NO_3)—low. The pH was 5.9.

The variables were nitrogen and potassium (as K_2O) at the rates of 60, 120 and 240 pounds per acre per year and interval of application—half the plants were fertilized every 2 weeks, the other half every 8 weeks. Ammonium nitrate and potassium sulfate were the sources of nitrogen and potassium, respectively. The fertilizer was applied in solution. Plants were pruned regularly to prevent development of extremely long laterals, sprayed as needed for insect control and watered twice weekly throughout the experiment.

Terminal growth measurements taken September 1960, were growth index (height plus spread—in inches—divided by 2), grid system (number of 4 inch squares wholly or partially covered by any part of plant) fresh weight in grams and visual grade. The visual grade was determined by 4 members of the Ornamental Horticulture Department who individually gave

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each plant a grade of from 1 to 4, using as standards the grades set forth in the Nursery Grades and Standards Handbook of the State Plant Board. For these experiments, No. 1 is equivalent to a cull, No. 2 to Florida No. 2, No. 3 to Florida No. 1 and No. 4 to Florida Fancy.

At the experiment's termination in September 1960, recently matured leaves from all plants of 'Formosa' azalea and viburnum were selected for chemical analyses. These leaves were dried at 65°C for 48 hours in paper bags, and ground in a Wiley Mill to pass through a 40 mesh screen.

Total nitrogen was determined by the Kjeldahl procedure (1). For chemical analyses one-gram samples of the dried tissue were ashed in a muffle furnace at 450°C, dissolved in 40 percent HCl and evaporated to dryness on a hot plate. The silicates were removed by filtration and the extract brought to volume in 0.1 normal HCl.

Aliquots of the plant extract were analysed for phosphorus, potassium, calcium and magnesium. Calcium and potassium determinations were made with a Model B and magnesium with a Model DU Beckman Flame Spectrophotometer. Phosphorus was determined using the ammonium molybdate-amino-naphthol sulfonic method utilizing the Bausch-Lomb Spectronic 20 Colorimeter. Before the magnesium and calcium determinations were made the extract solution was filtered through a column of Dowex 1-X8 anion exchange resin for the removal of interfering anions.

TABLE 1. EFFECT OF NITROGEN AND POTASSIUM ON GROWTH INDEX (INCHES) 'FORMOSA' AZALEA, 1960.

POTASSIUM LEVEL	NITROGEN LEVEL N1-60ppa	N2-120ppa	N3-240ppa	K LEVEL MEANS
K1 60 ppa	14.4	17.5	19.8	17.2
K2 120 ppa	13.5	16.6	20.5	16.7
K3 240 ppa	13.7	17.2	20.8	17.3
N LEVEL MEANS	13.9	17.1	20.4	
L.S.D.		.05	.01	
N and K_2O Level Means		0.5	0.7	
Means Within Table		0.9	1.2	

TABLE 2. EFFECT OF NITROGEN AND FERTILIZER APPLICATION INTERVAL ON GROWTH INDEX (INCHES) 'FORMOSA' AZALEA, 1960.

INTERVAL OF APPLICATION	NITROGEN LEVEL N1-60ppa	N2-120ppa	N3-240ppa	INTERVAL MEANS
T1 2 wks.	14.0	17.6	21.2	17.6
T2 8 wks.	13.8	16.6	19.5	16.8
N LEVEL MEANS	13.9	17.1	20.4	
L.S.D.		.05	.01	
Between Nitrogen Level Means		0.5	0.7	
Between Interval Means		0.4	0.6	
Between Means Within Table		0.8	1.0	

TABLE 3. EFFECT OF NITROGEN AND FERTILIZER APPLICATION INTERVAL ON GROWTH OF 'FORMOSA' AZALEA AS MEASURED BY THE GRID SYSTEM USING FOUR INCH SQUARES, 1960.

INTERVAL OF APPLICATION	NITROGEN LEVEL N1-60ppa	N2-120ppa	N3-240ppa	INTERVAL MEANS
T1 2 wks.	12.0	18.2	26.2	18.8
T2 8 wks.	11.6	15.5	22.8	16.6
N LEVEL MEANS	11.8	16.9	24.6	
L.S.D.		.05	.01	
Between Nitrogen Level Means		0.9	1.2	
Between Interval Means		0.8	1.0	
Between Means Within Table		1.3	1.7	

TABLE 4. EFFECT OF NITROGEN LEVELS ON FRESH WEIGHT AND VISUAL GRADE OF 'FORMOSA' AZALEA, 1960.

NITROGEN LEVEL	FRESH WEIGHT	VISUAL GRADE
N1 60ppa	108	1.44
N2 120ppa	196	2.17
N3 240ppa	351	3.16
L.S.D. - 1%	17	0.19

TABLE 5. EFFECT OF NITROGEN LEVELS ON GROWTH INDEX, GRID SYSTEM, FRESH WEIGHT AND VISUAL GRADE OF VIBURNUM, 1960.

NITROGEN LEVELS	GROWTH INDEX	GRID SYSTEM	FRESH WEIGHT	VISUAL GRADE
N1 60 ppa	12.0	9.3	124	1.33
N2 120 ppa	14.1	12.0	190	1.96
N3 240 ppa	16.1	15.1	323	2.86
L.S.D. - 1%	1.1	2.7	23	0.21

TABLE 6. CORRELATION COEFFICIENTS (r^2) FOR GROWTH MEASUREMENTS OF 'FORMOSA' AZALEA AND VIBURNUM, 1960.

	Rhododendron indicum 'Formosa' GRID	VISUAL	GROWTH INDEX
FRESH WT.	0.847	0.970	0.940
GRID		0.930	0.962
VISUAL			0.910
	Viburnum suspensum GRID	VISUAL	GROWTH INDEX
FRESH WT.	0.900	0.956	0.904
GRID		0.910	0.930
VISUAL			0.922

RESULTS

Growth Measurements

Rhododendron indicum 'Formosa'—September 1960.

Growth Index—Data for the significant nitrogen-potassium and nitrogen-fertilizer interval interactions are given in Tables 1 and 2.

There was no difference between K_1 and K_2 and K_3 potassium levels at N_1 and N_2 levels, but at N_3, K_3 produced more growth than K_1. There was no difference between plants fertilized every 2 and 8 weeks at N_1, but at medium and high nitrogen levels plants fertilized every 2 weeks grew better than those fertilized every 8 weeks. These interaction differences were not sufficient to be detected visually. Growth increased with

TABLE 7. EFFECT OF NITROGEN, POTASSIUM AND INTERVAL OF FERTILIZER APPLICATION ON PERCENT DRY WEIGHT OF NITROGEN, POTASSIUM, PHOSPHORUS, CALCIUM AND MAGNESIUM IN FOLIAGE OF 'FORMOSA' AZALEA AND VIBURNUM, 1960.

		Viburnum suspensum					Rhododendron indicum 'Formosa'				
NITROGEN LEVELS		N	P	K	Ca	Mg	N	P	K	Ca	Mg
N1 60ppa		1.14	0.10	1.01	0.67	0.28	1.32	0.17	0.60	1.59	0.52
N2 120ppa		1.26	0.08	0.80	0.72	0.30	1.40	0.10	0.55	1.63	0.56
N3 240ppa		1.39	0.08	0.59	0.94	0.40	1.61	0.08	0.45	1.80	0.60
POTASSIUM (K_2O) LEVELS											
K1 60ppa		1.29	0.09	0.59	0.89	0.39	1.45	0.12	0.38	1.86	0.60
K2 120ppa		1.27	0.08	0.80	0.76	0.33	1.44	0.12	0.50	1.65	0.60
K3 240ppa		1.23	0.08	1.01	0.68	0.28	1.44	0.11	0.73	1.51	0.48
L.S.D.	.05	0.07	0.01	0.21	0.08	0.03	0.13	0.02	0.06	0.09	0.03
	.01	0.09	0.01	0.29	0.11	0.05	0.17	0.03	0.08	0.12	0.05
INTERVAL OF APPLICATION											
T1 2 wks.		1.27	0.08	0.84	0.80	0.35	1.46	0.11	0.57	1.74	0.56
T2 8 wks.		1.26	0.09	0.76	0.76	0.31	1.42	0.12	0.50	1.61	0.56
L.S.D.	.05	N.S.	0.01	N.S.	N.S.	0.03	N.S.	N.S.	0.05	0.08	N.S.
	.01	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.10	N.S.

each increase of nitrogen regardless of potassium level or interval of fertilizer application.

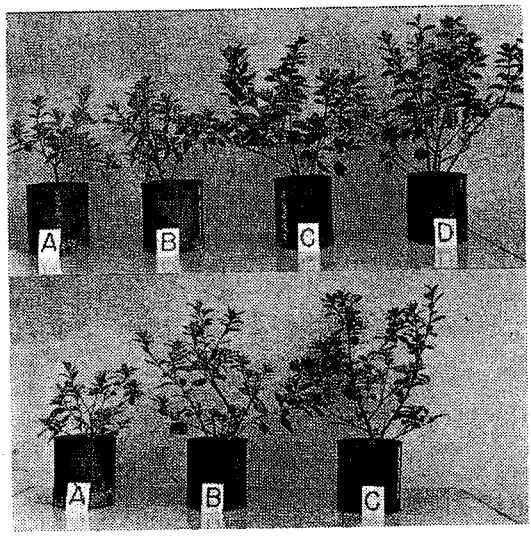

Figure 1. Plants of Rhododendron indicum 'Formosa'. Top: standards used for visual grading system. A-Cull, B-Florida No. 2, C-Florida No. 1, D-Florida Fancy. Bottom: Effect of three nitrogen levels at high potassium level and two week interval of fertilizer application on vegetative growth. A-N_1—60ppa, B-N_2—120ppa, C-N_3—240ppa.

Grid System—There was a significant nitrogen-interval of fertilizer application interaction. Plants fertilized every 2 weeks grew better than those fertilized every 8 weeks at the medium and high nitrogen levels but not at N_1 (Table 3). Increasing nitrogen increased growth regardless of application interval.

Visual Grade and Fresh Weight — These growth measurements indicated only a significant nitrogen main effect with each increase in nitrogen producing a decided increase in growth and/or weight (Table 4). 'Formosa' azalea plants representative of the visual grades and the effect of nitrogen levels on growth are shown in Fig. 1.

Viburnum suspensum—September 1960.

Growth Index—Grid System—Fresh Weight—Visual Grade—These growth measurements indicated a significant main effect of nitrogen and of potassium on fresh weight only. Each increase in nitrogen produced a decided increase in growth and/or weight (Table 5). However, the lower level of potassium produced slightly more fresh weight than the high level of potassium. Interval of fertilizer application did not affect vegetative growth in 1959 or 1960. Vi-

burnum plants representative of the visual grades and the effect of nitrogen levels on growth are shown in Fig. 2.

Correlations

Each growth measurement system resulted in a high correlation coefficient when compared with the other (Table 6). For each species the grid-fresh weight comparison gave the lowest index number, the visual-fresh weight combination indicated the highest correlation.

Chemical Composition

The chemical composition data for both species showing simple effects of nitrogen and potassium levels and application intervals on the percent (dry weight) nitrogen, phosphorus, potassium, calcium and magnesium in the foliage are given in Table 7.

Rhododendron indicum 'Formosa'

As nitrogen increased in the substrate, nitrogen, calcium and magnesium increased in the leaf tissue, while phosphorus and potassium decreased.

As potassium increased in the substrate, potassium increased, calcium and magnesium decreased and nitrogen and phosphorus showed no change in the leaf tissue.

More calcium and potassium was found in leaf tissue of plants fertilized every 2 weeks than ones fertilized every 8 weeks, while leaf nitrogen, phosphorus and magnesium remained unchanged,

Viburnum suspensum

As nitrogen was increased in the substrate, nitrogen, calcium and magnesium increased while phosphorus and potassium decreased in the leaf tissue.

As potassium was increased in the substrate, potassium increased in the leaf tissue while phosphorus, calcium and magnesium decreased and nitrogen remained unchanged.

There was more magnesium and less phosphorus, and nitrogen, potassium and calcium remained unchanged in the leaves of plants fertilized every 2 and 8 weeks, respectively.

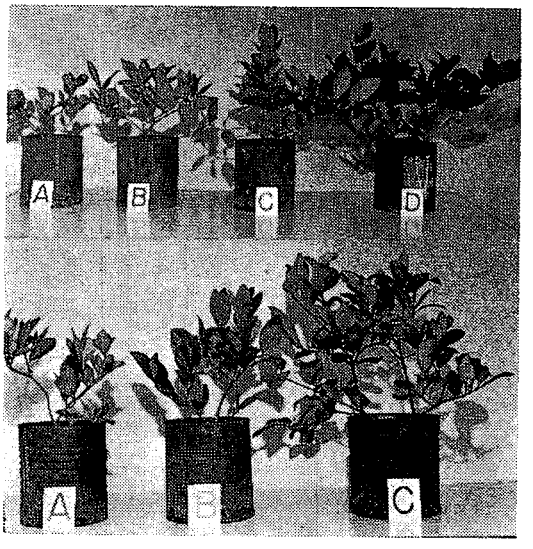

Figure 2. Plants of Viburnum suspensum. Top: standards used for visual grading system. A-Cull, B-Florida No. 2, C-Florida No. 1, D-Florida Fancy. Bottom: Effect of three nitrogen levels at high potassium level and two week interval of fertilizer application on vegetative growth. A-N_1—60ppa, B-N_2—120 ppa, C-N_3—240ppa.

Discussion

Nitrogen was the major factor limiting growth for each species. There was a linear response to nitrogen in these experiments indicating that higher nitrogen levels should be investigated. Growth differences, other than response to nitrogen, could not be detected visually.

Potash was high (165 ppa K_2O) in the unfertilized medium which probably explains why there was no response of viburnum and slight response of 'Formosa' azalea to added potash (Table 1). The slight growth increase of 'Formosa' azalea obtained from high nitrogen-high potassium treatment was measured only by growth index and could not be determined visually.

There was no difference in growth of viburnum plants fertilized every 2 and every 8 weeks during this experiment. 'Formosa' azalea plants fertilized every 2 weeks grew better than those fertilized every 8 weeks as measured by growth index and square grid in 1959 and 1960 and fresh weight in 1960. However, these differences could not be detected by the visual grading system. To the nurseryman this means that, under conditions of these experiments, no increase in plant quality was obtained with either species by using the more costly practice of more frequent fertilization.

The high correlation between the growth measurement systems suggests that each can be used as a reliable measurement of the other.

Summary

Two experiments, initiated May 5, 1959, and terminated September, 1960, evaluated the effects of 3 levels each of nitrogen and K_2O and 2 intervals of fertilizer application in factorial combination, on growth and chemical composition of *Rhododendron indicum* 'Formosa'

and *Viburnum suspensum* in gallon cans under half-lath shade. Data used are those taken at termination of these experiments.

Growth measurements were growth index (height plus spread divided by 2), square grid, fresh weight and visual grade. Foliage samples were analysed for total nitrogen, potassium, phosphorus, calcium and magnesium.

Nitrogen produced a linear response and was the major factor limiting growth for each species. Growth index of 'Formosa' azalea measured significant nitrogen-potassium and nitrogen-interval of fertilizer application interactions. The slight increase in growth of high potash at the high nitrogen level, and 2 weeks over 8 weeks interval of fertilization application at medium and high nitrogen levels, though statistically significant, could not be detected visually.

Terminal measurements for *Viburnum suspensum* for growth index, square grid, fresh weight and visual grade indicate a significant main effect of nitrogen. The lower level of potassium produced slightly more fresh weight than the high level of potassium.

LITERATURE CITED

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MARKETING NURSERY PRODUCTS IN PINELLAS COUNTY

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As the initial phase of a study concerned with the scope and marketing practices of the nursery industry in Florida, a pilot survey was done in Pinellas County last year. A sample of nurserymen was interviewed to obtain data on market outlets, total sales, purchases of other nursery stock, amount of nursery stock sold in containers, pricing policies and other factors. Results of the survey have been analyzed and experience gained in the conduct of the study was utilized in planning a similar study for the entire state. Nearly half of the growers selected for interviewing in the statewide study have already been interviewed. The remaining nurserymen will be contacted during the coming winter and spring.

Pinellas County was selected as the pilot area because nurseries of many different types were located there. Both sub-tropical stock and hardier nursery products were grown in Pinellas County. The county is bounded on two sides by water and on another with a large metropolitan area which has many producers and sellers of nursery stock in its environs. It was felt that much of the trade done by nursery operators in Pinellas would be with local persons or businesses; results of the study bore out this hypothesis.

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INDUSTRY CHARACTERISTICS

The nursery industry is probably more heterogeneous than any other segment of agriculture. Individual growers usually produce a wide variety of products and sell them through many different channels of distribution. Some products are propagated and cultivated entirely by the nurserymen and then sold by them to final consumers. In other instances liners are propagated by nursery operators who then sell them to nurserymen for further growing on. A number of nurserymen buy fully developed stock to fulfill their growing and selling requirements; some of the stock may be resold immediately while certain portions may be held for further growing on and later sale.

The complexity of the nursery organization makes it difficult to acquire data which is useful in making a complete analysis of the business operations involved in nursery production and marketing. As a consequence, it was necessary in conducting this study to design a questionnaire which would enable the nurserymen interviewed to furnish information relative to various general classifications of nursery stock rather than data on individual nursery crops.

A thorough analysis of the marketing and other economic aspects of the nursery industry would require a case study of the records of a group of nurserymen who kept adequate accounts on their operations. There are few guide lines in the literature on the economics of the nursery industry which have been help-