Mature hen debeaked by precision debeaking as a chick.

ence between methods 2 and 3 was not significant.

During the first period of 60 days, the average difference due to density was not significant, but production started to diverge near the end of the period (graph 3). During the last 169 days (graph 4), birds in the three-bird cages laid 70.9% while those in the four-bird cages laid 65.4%. This difference was highly significant.

There was no significant interaction between debeaking and density during either period. The production over the entire laying period for the six treatment combinations is summarized in the table.

EFFECTS OF DEBEAKING METHODS* AND CAGE DENSITY ON EGG PRODUCTION

Birds/Cage	(1) Early precision	(2) Late precision	(3) Late non-precision	Average
3	68.6%	64.9%	62.9%	65.4%
4	63.7%	58.9%	58.9%	60.5%
Av.	66.1%	61.9%	60.9%	

* See text for explanation.

There was a highly significant difference between densities in number of birds that died from causes other than cannibalism. The four-bird cages had a death rate of 11.7% while the three-bird cages showed only 5.6%. There was no significant difference related to debeaking method. The mortality from vent picking (cannibalism) showed no significant difference either due to cage density or method of debeaking. The percentage of pick-outs was low in all cases—about 5%.

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SULFUR-COATED for controlled- of container-

TOKUJI FURUTA

R. H. SCIARONI · J. R. BREECE

Controlled-release fertilizers have been used in the production of ornamental plants for a number of years. This slow release of elements from fertilizer particles has been achieved by one of three methods: (1) coating fertilizer particle with a membrane to regulate availability; (2) using minerals or compounds which are slightly soluble; and (3) using compounds which are slow to mineralize.

Coating

Coating particles or granules of urea with sulfur and a sealant results in the formation of a membrane that regulates the availability of nitrogen for plant growth. The rate of nitrogen availability is determined by the thickness of the coating. Several experiments were conducted during 1966 in nurseries throughout California to determine the value and use of sulfur-coated urea for the growth of ornamental plants. The results (with woody plants in containers) are reported here.

Sulfur-coated urea with various dissolution rates was used in two ornamental nurseries on container-grown woody plants. The rate of dissolution was determined by measuring the amount of substrate that would dissolve in water at 100° F in a 24-hour period, and was expressed as a percentage of the original weight. Fertilizers with dissolution rates of six, five, and one per cent were used. The dissolution rate is influenced by the thickness of the sulfur coating.

Controlled-release urea was incorporated into the soil mixture immediately before the small plants (liners) were planted. During the growing season, some of the plants in the experiments were given additional amounts of fertilizer.

Toxicity

Symptoms of toxicity due to overfertilization were evident in many of the urea incorporation treatments. Injury to plants of wax-leaf privet (*Ligustrum japonicum*) and dwarf Chinese holly (*Ilex cornuta* "Rotunda") occurred when sulfur-coated urea with a dissolution rate of six per cent was incorporated at 40 and 80 grams of nitrogen per cubic foot of soil mixture. Injury occurred to dwarf Chinese holly plants at rates of 20 grams of nitrogen. Injury was also noted on English laurel plants (*Prunus lauro-*

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UREA FERTILIZER

release nutrition

grown ornamentals

Nursery experiments have shown that sulfur-coated urea was excellent as a slowly available form of nitrogen for ornamental plants in containers. Best plant growth resulted when the sulfur-coated urea was incorporated in the potting mix and the plants received fertilizer applications during the growing season. Even without additional fertilization, the controlled-release urea was able to supply adequate amounts of nitrogen for several months' growth. Excessively heavy applications resulted in plant injury and death.

cerasus) when the fertilizer was incorporated at a rate of 2.5 grams of nitrogen. At the high rates of 20, 40, and 80 grams of nitrogen per cubic foot of soil moisture, plants were killed. Plants injured at the lower rate survived and developed into excellent plants.

Without additional applications of nitrogen, excellent plants resulted from the preplant incorporation of controlled-release urea: wax-leaf privet plant tops had an average fresh weight of 60 grams in the fall, six and one-half months after planting (with the preplant incorporation of 20 grams of nitrogen). Plants fertilized by the usual methods employed at this nursery had an average top weight of 40 grams.

Growth

More growth and better plants resulted when the initial application of fertilizer was supplemented during the growing season with regular applications of fertilizer. Plants of ceanothus (*Ceanothus cyaneus* "Sierra Blue"), camellia (*Camellia japonica* "Covina"), and English laurel (*Prunus laurocerasus*) were grown with and without controlled-release urea —and with and without additional fertilizer applied in the irrigation water. In all cases, the plants receiving controlled-release urea in the planting mixture were better than those without. The best plants, in terms of color and amount of growth, resulted from both controlled-release urea and additional fertilization. Liquid fertilization alone was not as good as controlled-release urea alone.

Controlled-release urea with a fairly high (5%) dissolution rate was better during the initial growth period of the experiment. The plants were darker in color and seemed to be growing better. However, toward the end of the study, seven and one-half months after planting, the plants that had received the fertilizer with a slower (1%) dissolution rate were superior, even when supplemental fertilization was used. Best results were obtained when the dissolution rate was 1%, the amount incorporated was equal to 2.5 grams of nitrogen per cubic foot of soil mixture, and when the plants received fertilizer during the growing period.

Safe rate

These experiments showed that this form of controlled-release fertilizer should not be used in as high a concentration as other and older forms. The safe rate appears to be about two to three ounces of nitrogen per cubic yard of soil mix. The suggested rate of incorporation of urea-formaldehyde is one pound of nitrogen per cubic yard.

Results of the study also demonstrated the advantages of incorporation of controlled-release nitrogen in the potting mixture before planting—even when the fertilization program consisted of applying a dilute solution of fertilizer at every irrigation. The controlled-release nitrogen served as a basic supply of small and continuous fertilization to insure good plant growth.

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GROWTH AND INJURY TO WOODY PLANTS POTTED MAY 31, 1966, AND GROWN WITH CONTROLLED RELEASE FERTILIZER AT PONTO NURSERY, VISTA, CALIFORNIA

TREATMENTS	AUGUST 10, 1966				NOVEMBER 9, 1966			
	Holly[1]		Privet[2]		Holly[1]		Privet[2]	
	Growth[3]	Injury[3]	Growth[3]	Injury[3]	Growth[4] Grams	Injury[3]	Growth[4] Grams	Injury[3]
Control	6.2	0.0	8.0	0.0	14.2	0.0	40.2	2.0
TVAC[5]—20g N per cu ft	7.2	0.0	8.8	0.0	10.6	6.8(20)	60.0	0.0
—40g N per cu ft	3.2	3.4(20)	4.6	3.8(20)	5.7	6.0(60)	34.0	6.0(40)
—80g N per cu ft	0.0	10.0(100)	0.0	10.0(100)	0.0	10.0(100)	0.0	10.0(100)
IBDU[6]—10g N per cu ft	7.6	0.0	9.6	0.0	16.8	2.4	62.2	0.0
—20g N per cu ft	6.0	3.4	10.0	1.2	12.7	5.8(40)	58.4	4.0
—40g N per cu ft	0.8	5.0(40)	4.8	4.6	0.0	10.0(100)	17.8	2.8
Usual Nursery Practice					24.9	0.0	40.0	0.0

[1] Variety of holly was Ilex cornuta "rotunda"—Dwarf Chinese Holly
[2] Variety of privet was Ligustrum japonicum—Japanese Privet
[3] Scored as follows: Growth—0 = No growth, 10 = Excellent; Injury—0 = No visible symptoms, 10 = Plants killed. Number in ( ) indicates percentage of plants killed.
[4] Fresh weight of tops in grams
[5] Sulfur-coated urea—26.8% N, dissolution rate, 6%
[6] 1,1-diureidoisobutane applied as a complete fertilizer with analysis of 14.1—14.0—14.3