Table 2. Hunter color values of petals of 'Cara Mia' and 'Forever Yours' roses held for 3 days in water and floral preservatives.

Treatments	Hunter color values L	a	b
		Cara Mia	
Initial	17.1a[z]	+68.5a	+6.4a
After 3 days in:			
Water	16.3a	+67.7a	+4.9a
Preservative[y]	21.0b	+71.4b	+8.4b
		Forever Yours	
Initial	28.8a[z]	+37.6a	+5.7a
After 3 days in:			
Water	29.1a	+38.6a	+5.0a
Preservative[y]	34.3b	+44.3b	+4.4a

[z]Mean separation within columns and cultivar by Duncan's multiple range test, 5% level.
[y]200 mg 8-hydroxyquinoline citrate plus 20 mg sucrose/liter.

'Cara Mia' rose petals were intensely dark red compared to 'Better Times' (Table 1, 2) and did not have the initial bluish caste or turn blue as did 'Better Times.' Petals from 'Cara Mia' roses held in water did not change color but did if held in preservative. Red saturation increased (a value) and became brighter (L value).

'Forever Yours' rose petals were not as dark as those of 'Cara Mia' (Table 1, 2). The petal color of 'Forever Yours' was close to 'Better Times,' but did not have a bluish caste. Petals from 'Forever Yours' held in water did not change color while petals from those held in preservative increased in redness (a value) and became lighter (L value)

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INFLUENCE OF COMPRESSED FERTILIZER TABLETS CONTAINING SULFUR AND GROWTH MEDIUM AMENDMENTS OF DOLOMITIC LIMESTONE AND SUPERPHOSPHATE ON NUTRIENT RELEASE AND AZALEA GROWTH

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Abstract. **Container-grown 'Mrs. G. G. Gerbing' azaleas (*Rhododendron* L.) fertilized with 4, 16-g Woodace fertilizer tablets with or without S or Osmocote 18N-3P-10K (12 g per container) applied every 90 days, had similar shoot dry weights after 12 months. The addition of 2% S to the tablets resulted in increased root dry weight. Root dry weight was equal to that of plants fertilized with Osmocote. There was a significant negative correlation between NH_4:K and NO_3:K in the leachate and root growth. These results indicate the use of tablets with S or Osmocote for fertilization of azaleas depends primarily on ease of production management and product and labor cost.**

Controlled-release fertilizers are often used in production of woody ornamental plants because they reduce the number of fertilizer applications, thus a labor savings (1, 3, 7, 8). However, a disadvantage of these products is that the release rate may be inadequate and unpredictable under certain environmental conditions (7).

The carriers of nutrients in controlled-release fertilizers differ with manufacturer, but some include ammonium nitrate, potassium nitrate and urea. Isobutylidene diurea (IBDU) is a N carrier that is slowly soluble, therefore extending N release with time (4). Sartain and Ingram (7) reported that IBDU resulted in juniper and azalea growth equal to or greater than Osmocote 18N-3P-1OK. Woodace fertilizer tablets, manufactured by Mitsubishi Chemical Industries LTD. of Japan in cooperation with Estech Inc. Chicago, Ill., contain IBDU as the N carrier.

Ingram and Yeager (unpublished data) found that Woodace compressed fertilizer tablets 14N-1P-2K resulted

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in greatest growth of 'Mrs. G.G. Gerbing' azalea after 12 months when four 16-g tablets were inserted in the surface of the growth medium compared to the middle or the combination of surface and middle placement. Woodace-fertilized plants had slightly less shoot dry weight than Osmocote fertilized plants, but Osmocote plants were more chlorotic. Yeager and Ingram (10) found that plants fertilized with the Woodace tablets had greater shoot and root dry weights if the medium was not amended with dolomitic limestone, while weights were not different when superphosphate was incorporated.

The following experiment was conducted to determine the influence of sulfur added to compressed fertilizer tablets and growth medium amendments of superphosphate and dolomitic limestone on growth medium nutrient levels and vegetative growth of 'Mrs. G. G. Gerbing' azalea.

Methods and Materials

Rooted stem tip cuttings of *Rhododendron* 'Mrs. G.G. Gerbing' were transplanted into #1 containers (3 liters) on 24 Apr. 1984 and grown under 60% shade in Gainesville, Fla. The container medium consisted of pine bark, Canadian peat and sand (2:1:1 by volume) amended with 1.8 kg/m^3 of Perk (micronutrient formulation by Estech Inc. Chicago, Ill.). Sixteen percent of the volume of the growth medium was filled with air at container capacity and 40% was filled with water. Plants were irrigated with city utility water with a pH of 7.0.

Four 16-g Woodace tablets with and without the addition of 2% sulfur (elmental sulfur) to each tablet were evaluated in combination with 0 and 3 kg/m^3 of superphosphate (9% P) and 0 and 3 kg/m^3 dolomitic limestone incorporated into the growth medium. The tablets were inserted into the surface of the growth medium. The 2x2x2 factorial arrangement of treatments plus Osmocote as an industry standard was replicated 7 times in a randomized complete block design with 1 plant constituting an experimental unit. Woodace fertilizer tablets contained 14% N, 1% P, 2% K, 2.3% Ca, 3.2% Mg, 0.05% Cu, 1.1% Fe, 0.2% Mn, 0.005% Mo, and 0.08% Zn. Phosphorus and K carriers were silico-phosphate and potassium silicate, respectively. Osmocote 18N-3P-10K was incorporated at 6 kg/m^3 and 12 g were surface applied every 90 days. Superphosphate and dolomitic limestone each at 3 kg/m^3 and Perk at 1.8 kg/m^3 were incorporated in the medium for this treatment, which was used for comparison to the fertilizer tablet treatments. Osmocote is a resin coated fertilizer trademarked by Sierra Chemical Co. Milpitas, Calif.

Leachates from each container were collected 30, 60, 90, 150, 210, 270, and 330 days after the initiation of the experiment. Leachate NH_4, NO_3, P, K, Ca, and Mg concentrations and pH were determined using standard procedures (6). Twelve months after experiment initiation, stems were severed above the uppermost roots and shoot and root dry weights were determined after 48 hrs at 70°C.

Results and Discussion

There were no interactions and data presented are main effects. The addition of S to the tablet or amending the growth medium with superphosphate or dolomitic limestone did not affect shoot dry weights (Table 1). Shoot dry weights for plants fertilized with Osmocote were comparable to the aforementioned treatments. The addition of S to the tablets and amending the growth medium with dolomitic limestone (3 kg/m^3) resulted in increased root dry weight of 'Mrs. G.G. Gerbing' azalea. Root dry weights were not different for plants grown with or without the superphosphate amendment. Root dry weights of plants fertilized with Osmocote were comparable to root dry weights of plants grown in the medium amended with dolomitic limestone or fertilized with tablets containing sulfur.

Table 1. Effects of Woodace fertilizer tablets (4, 16g tablets per 3-liter container) containing sulfur and growth medium amendments of dolomitic limestone and superphosphate on shoot and root dry weight of 'Mrs. G.G. Gerbing' azaleas after 12 months.

Treatment	Shoot dry wt. (g)	Root dry wt. (g)
Tablet composition		
0 sulfur	74.6a[z]	220a
2% sulfur	72.3a	342b
Dolomitic limestone (kg/m^3)		
0	72.7a[z]	266a
3	74.2a	340b
Superphosphate (kg/m^3)		
0	72.9a[z]	279a
3	73.4a	282a
Osmocote[y]	79.5	344

[z]Mean separation within main effect and column by Duncan's multiple range test, 5% level.
[y]Osmocote 18N-3P-10K incorporated at 6 kg/m^3 and surface applied thereafter, at 12 g per container every 90 days.

Leachate NO_3 prior to day 210 was greater for the container medium fertilized with tablets than fertilized with Osmocote (Fig. 1A). After day 210 the release rate was equally low. Comparisons of leachate analyses between tablets and Osmocote were made with treatments receiving dolomitic limestone and superphosphate amendments. Ammonium leachate levels were similar for all treatments except for a higher concentration on day 150 for containers fertilized with tablets without S (Fig. 1B). Ammonium and NO_3 levels were below 20 ppm on day 210 and 270 (November and January, respectively) regardless of fertilization treatment. Phosphorus leachate levels for all treatments ranged from 8 to 14 ppm on day 30 with highest concentrations noted on days 60 and 90 and the lowest (1 to 3 ppm) on day 210 (November) (Fig. 1C).

Leachate K concentrations ranged from 20 to 36 ppm on day 30 with mean maximum concentrations recorded (32 to 86 ppm) for all treatments on day 60 (Fig. 1D). Potassium levels decreased between day 60 and 210 with a modest increase in January (day 270) and March. After day 90, there was a higher concentration of K in the leachate of plants fertilized with Osmocote, but it should be noted that Osmocote was reapplied on days 90, 180, and 210. Potassium levels in the leachate averaged 10 to 33 ppm higher through day 150 if S had been added to the tablet compared to tablets without S. This higher leachate K level was not due to pH of the growth medium, because the mean pH was identical for the 2 treatments through day 150, decreasing from 6.1 on day 30 to 4.2 on

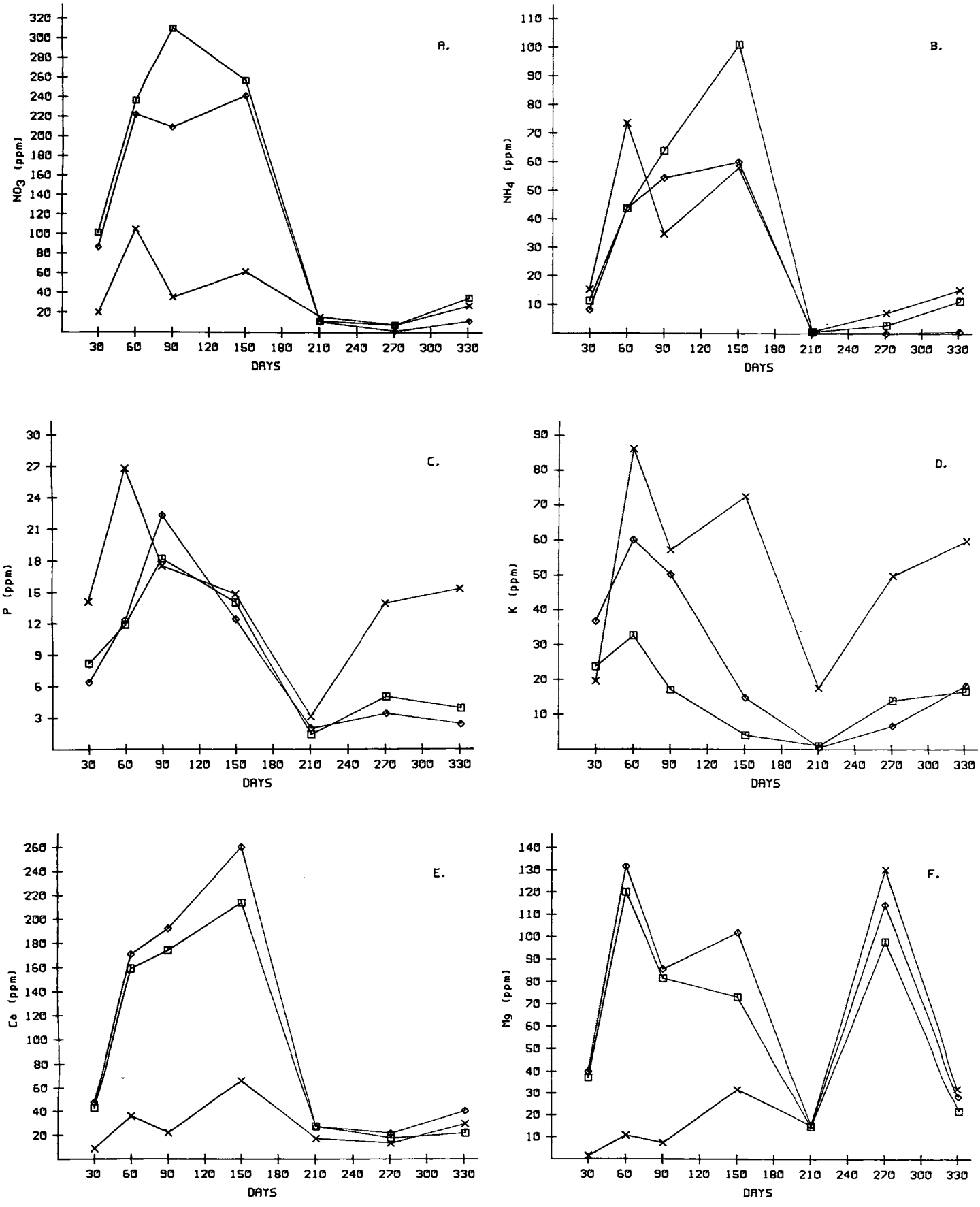

Fig. 1. Influence of Woodace fertilizer tablets with 0% S(□——□), tablets with 2% S (◇——◇) and Osmocote 18N-3P-10K (x——x) on leachate concentrations of NO_3[A], NH_4[B], P[C], K[D], Ca[E] and Mg[F].

Table 2. Mean NH_4:K and NO_3:K in the leachate as affected by the addition of sulfur to compressed fertilizer tablets, amending the growth medium with dolomitic limestone or fertilization with Osmocote.

Days after potting	NH_4:K					NO_3:K				
	Tablets[z]		Dolomite (lbs./yd³)			Tablets[z]		Dolomite (lbs./yd³)		
	with S	without S	5	0	Osmocote[y]	with S	without S	5	0	Osmocote[y]
30	1.4	1.8	0.4	2.8	0.8	3.0	4.0	3.0	4.1	1.4
60	1.5	3.0	0.9	3.5	0.9	3.4	4.8	5.1	3.2	1.3
90	1.6	4.2	1.9	3.9	0.6	3.6	12.5	10.0	6.0	0.6
150	3.6	31.6	19.6	16.5	0.8	11.8	80.2	54.2	37.8	0.9
210	0.4	1.0	0.8	0.5	0.1	12.6	30.3	24.2	18.5	1.5
270	0.6	0.4	0.3	0.2	0.2	0.4	2.2	1.5	1.2	0.2
330	0.7	0.6	0.5	0.3	0.3	0.8	2.9	2.5	1.3	0.5

[z]Woodace 14N-1P-2K compressed fertilizer tablets with and without 2% sulfur (4, 16 g tablets per 3 liter container).
[y]Osmocote 18N-3P-10K incorporated at 6 kg/m³ and surface applied thereafter at 12 g per container every 90 days.

day 150. The mean leachate pH for the Osmocote treatment decreased from 5.1 on day 30 to 3.3 on day 150 and increased thereafter to a pH of 4.0 on day 330.

Leachate Ca and Mg concentrations prior to day 210 were consistently higher for the medium fertilized with tablets compared to Osmocote (Fig. 1E and 1F). This is to be expected with the relatively high concentration of Ca and Mg in the tablets. These data represent the treatments with dolomitic limestone and superphosphate in the growth medium.

The NH_4 to K ratio (NH_4:K) and the NO_3 to K ratio (NO_3:K) in the leachates were generally lower for the growth medium that received tablets with S than those receiving tablets without S (Table 2). The NH_4:K was similar for the medium with and without dolomitic limestone, while the NO_3:K was generally greater when dolomitic limestone had been applied (Table 2). The Osmocote treatment resulted in leachates with a generally lower NH_4:K and NO_3:K than the tablets. There was a significant negative correlation between NH_4:K (0.0007) and NO_3:K (0.006) in the leachate and root dry weights for all treatments.

Nitrogen to K ratio in the soil solution has been reported to affect growth of other plants; however, plant responses appear to be similar over a wide range. Poole and Conover (5) reported a N:K of about 1:1 was optimum for 2 *Aglaonema commutatum* cultivars. Wright and Niemiera (9) suggested a N:K of 5:3 with P near one-third of K was optimum for *Ilex crenata* 'Helleri'. Leachate analyses in our experiment using S in the fertilizer tablets or a dolomitic limestone amendment show the NH_4:K and NO_3:K ranged from 0.3 to 19.6 and 0.4 to 54.2, respectively. These findings further exemplify the need to determine the critical ratio of N:K throughout a growing season.

It has also been suggested that luxury levels of nutrients in proper balance and near optimal water and aeration conditions in the growth medium could result in increased shoot:root ratio. Increasing number of weekly applications of 300 ppm N, 167 ppm P, and 247 ppm K (2) and increasing rates of 20N-8.7P-16.7K water soluble fertilizer increased shoot:root ratio of *I. crenata* 'Helleri' (11). Yeager and Wright (12) concluded that shoot:root ratio of 'Helleri' holly can be controlled by N rates and frequency of application. Phosphorus concentrations greater than 17 ppm did not influence shoot or root growth.

Four 16-g Woodace fertilizer tablets containing 2% S resulted in shoot and root dry weights after 12 months comparable to Osmocote 18N-3P-10K applied every 90 days at the rate of 12 g per container. Container-grown 'Mrs. G. G. Gerbing' azaleas fertilized with four 16-g Woodace fertilizer tablets with or without S or Osmocote 18N-3P-1OK (12 g per container) applied every 90 days, had similar shoot dry weights after 12 months. These results indicate the choice of using the tablets with S or Osmocote 18N-3P-10K for fertilization of azaleas depends primarily on ease of production management and product and labor costs.

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