Growth Regulators

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Section Editor

Container-grown Knock Out™ Rose Affected by Fertilizer Rate and Plant Growth Regulator

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Significance to the Industry: Nursery growers use patience and skill to cultivate plants that are desirable to consumers. Plants left unpruned often appear “leggy”, become top heavy in containers, and are not desirable to consumers. Additionally, racks with a fixed or narrow range of shelf heights are frequently used to ship plants. Therefore, it is necessary to train plants to a compact, symmetrical form that is appropriate for shipping and conducive to retail sales. By applying plant growth regulators and providing plants with the proper amount of fertilizer, growers can produce plants with uniform growth and desirable characteristics for both shipping and consumers.

Nature of Work: Knock Out™ rose is a popular cultivar with consumers because it establishes easily, provides color throughout the season, and is resistant to a variety of diseases and insects. Like many container-grown plants, roses require pruning during the growing season to achieve uniformity in growth. Some growers report as many as three to four prunings being necessary for Knock Out™ rose. While hand pruning is an option, it can be hazardous with roses and other thorny plants, and multiple prunings can be problematic due to the cost and availability of labor (Holland et al., 2007). An alternative method of height control, such as plant growth regulators (PGRs), could greatly benefit the industry by reducing financial costs and worker hazards associated with pruning thorny plants. Plant response to PGRs is affected by rate, timing, number of applications, and can vary across cultural and environmental conditions (Bruner et al., 2002; Kessler and Keever, 2008). This research compares the effect of pruning to a single PGR application. Additionally, it provides insight into whether high nitrogen counteracts PGR application by either supporting growth of one or a few shoots exhibiting apical dominance, enhances the effect of a PGR application, or has no influence on plant response to PGR.

On April 11, 2013, Knock Out™ roses were potted into 3 gal containers filled with 85% pine bark: 15% peat and immediately irrigated. Two fertilizer treatments [medium labeled rate (65g) and high labeled rate (95g)] and three branching treatments [dikegulac sodium at 3100 ppm (DS), a hand-pruned control leaving 5 nodes (hand-pruned), and a water control (untreated)] were applied. Both fertilizer treatments were applied as a top dress using 15N-3.9P-9.9K, 3-4 month control release fertilizer (Osmocote® Plus 15-9-12, Everris, The Netherlands) on April 16, 2013. Pruned plants were hand-pruned on June 7, 2013. On June 14, 2013, DS was applied using a CO_2 backpack sprayer until foliage was thoroughly wetted. Plants were grown outdoors at the University of Tennessee Nursery Research Complex, Knoxville, TN (lat. 35.98°N, long. 83.91°W, USDA plant hardiness zone 7a) under full sun with drip irrigation. Initial irrigation was applied for 3 min at 8:00AM and 1:00PM, (5.1 oz applied) and after 8 weeks irrigation was applied at 8:00AM, 1:00PM and 5:00PM (7.7 oz applied) using 3.2 gal/h pressure-compensating spray stakes (PCNL Spray Stake; Netafim, Fresno, CA). Initial (IGI) and final (FGI) growth index [GI = ((height + width + perpendicular width)/3)] was measured to determine increase in growth (IG) over the experiment (IG = FGI - IGI), and initial branch (IB) and final branch (FB) count (number of growing points) was recorded to determine branch increase (BI) over the experiment (BI = FB - IB). Additionally, plant symmetry was used as an indicator of plant quality. Plant symmetry was visually rated after observing each plant over the top and in profile on a 1 - 5 scale: 1 representing sparse, asymmetrical branching without covering the container substrate surface and 5 representing full, symmetrical branching with 100% coverage of the substrate surface. Phytotoxicity was rated using the following ranking: 0 being no phytotoxicity and 10 being plant death. The experiment lasted 105 days. Experimental design was a completely randomized design with 12 single pot replications.

Data were analyzed using linear models with the GLIMMIX procedure of SAS (SAS Institute Inc, Cary, NC). Treatment differences were determined using the LSMEANS statement according to the Holm-Simulation method, alpha = 0.05.

Results and Discussion: DS treated plants had 33% more branches at the end of the experiment due to 58% greater BI than hand-pruned plants (Table 1). Plants respond to dikegulac sodium differently depending on species and environmental conditions but responses generally include increased branching, reduced growth, and improved symmetry (Cochran et al., 2013; Hester et al., 2013). Hand-pruned plants had comparable FB and BI to the untreated plants. There was a greater BI in plants treated with the high rate of fertilizer compared with the medium rate of fertilizer. We used plant symmetry as a proxy of plant quality (plant proportion, density and branch symmetry) and results indicated DS improved plant quality by 33.3% and 38.5% compared with hand-pruned and unpruned plants regardless of fertilizer rate. DS is a DNA synthesis inhibitor that disrupts apical dominance and retards growth (Bhattacharjee and Gupta, 1984; Arzee et al., 1977); therefore, plants treated with DS should be smaller in size compared with untreated plants. This was apparent in the current experiment with DS plants being 11.7% shorter and 9.1% smaller (FGI) than untreated plants. Similar to FB and BI, plants with the high rate of fertilizer were taller (height) and larger (FGI) compared with the plants receiving the medium rate of fertilizer. Phytotoxicity was observed on plants treated with DS 2 weeks after PGR application; however, by the end of the experiment there were no symptoms (data not shown). There were no branching treatment × fertilizer interactions for any of the parameters measured.

Results indicate that DS or hand pruning were not effective methods to increase branching compared with untreated plants. However, if the desired response is to control growth and promote dense and uniform plants without hand pruning, then DS may be an option for growers who produce Knock Out™ roses. Fertilizer rate appeared to influence branching and plant growth but it neither counteracted DS application nor enhanced it.

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Table 1. Branch and growth response of Knock Out™ rose following branching treatments and two rates of fertilizer.

Branching treatment (TRT)[z]	Final branch number		Branch increase[y]		Plant symmetry[x]		Height		FGI[w]	
Dikegulac sodium	300.2	a[v]	246.5	a	3.6	a	71.5	b	86.4	b
Hand-pruned	225.8	b	156.5	b	2.7	b	76.0	ab	92.0	a
Untreated	258.9	ab	208.7	ab	2.6	b	79.9	a	94.3	a
Fertilizer rate (FERT)[u]										
Medium	243.5	b	179.0	b	3.0		72.9	b	87.6	b
High	279.7	a	228.8	a	2.9		78.7	a	94.2	a
TRT	0.0018		0.0050		0.0005		0.0041		0.0001	
FERT	0.0302		0.0255		0.5200		0.0049		0.0001	
TRT×FERT	0.8238		0.3881		0.4469		0.2649		0.7913	

[z]Branching treatment: dikegulac sodium at 3100 ppm; hand-pruned leaving 5 nodes; untreated.
[y]Branch increase = final branch count - initial branch count.
[x]Plant symmetry: was visually rated on a 1 - 5 scale; 1 representing sparse, asymmetrical branching without covering the container substrate surface and 5 representing full, symmetrical branching with 100% coverage of the substrate surface.
[w]FGI: final growth indices = Final GI [(height + width + perpendicular width) ÷ 3] - Initial GI [(height + width + perpendicular width) ÷ 3].
[v]Means with the same letters (within a column) are not significantly different according to the Holm-simulation method for mean comparison, alpha = 0.05.
[u]Fertilizer rate: medium (65g) and high (95g) top dressed with 15N-3.9P-9.9K, 3 – 4 month control release fertilizer (Osmocote® Plus 15-9-12, Scotts Company, Marysville, OH) on April 16, 2013.

Effect of Cutless .33G on Landscape Shrubs Used as Hedge

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Significance to Industry: Cutless .33G and three irrigation methods: micro-sprinkler, drip irrigation, and no-irrigation were evaluated in this study for their effect on growth control in burford holly, elaeagnus, ligustrum, sweet viburnum, and wax myrtle. Plants were planted in fall 2012 and treated in spring 2013. Plant size index recorded monthly indicated that, plant responses to Cutless were species specific, and wax myrtle was the most responsive species with 31% size reduction at 21 lbs/1000 ft2 compared with the untreated plants at 8 weeks after treatment, and sweet viburnum had no response to irrigation or PGR treatment. Irrigation methods had transient effects on plant size with overhead irrigation resulted in smaller plants in elaeagnus and wax myrtle at 4 WAT across Cutless rates. More treatments will be applied in the next two years and observations will be reported when available.

Nature of Work: Shrubs used as border or hedge plantings in urban landscapes require frequent trimming to maintain desired size and shape. During a growing season, pruning often becomes one of the top contributors to landscape service cost because of labor needed for trimming and cleaning up, and associated cost of fuel and equipment wear. In addition, pruning may increase disease problems associated with wounding the plants. Cutless.33G (SePRO Corporation, Carmel, IN) is a granular formulation of the plant growth regulator flurprimidol, a GA3 biosynthesis inhibitor, and is registered for managing growth of woody and perennial plants in established landscapes (1). As indicated by previous studies, its residual effects last longer than Atrimmec possibly because of the longer release period based on its granular formulation (3). Effectiveness of Cutless .33G varies among plant species (2, 3, 4). In addition, its effectiveness depends on timely delivery of the material to roots, which is affected by irrigation method and amount. Drip or micro sprinklers are commonly used in landscape plantings including hedges and borders. The objective of this 2-year study was to determine possible interactions between three irrigation methods (overhead micro-sprinkler, drip, and no irrigation) and three rates of Cutless.33G (0, 14, and 21 lbs/1000 ft2) applied to five woody ornamental plants that are often used as hedges in a simulated landscape field.

The experiment was conducted in Hammond, LA (US Department of Agriculture Plant Hardiness Zone 8b) in 2012. Nine field beds, each 196’ long x 4’ wide, were prepared by adding bedding mix (a mix of top soil and utility trim compost, Natures Best Inc., Baton Rouge) and pine bark to make raised beds. Each long bed was then divided into 18 plots, each 12' long x 4' wide. The experimental design was a Split Plot with three main plots each included three long beds (subplots), each assigned with one of the three irrigation methods. A total of fifty-four plants each of azalea, burford holly, elaeagnus, ligustrum, sweet viburnum, and wax myrtle in 3-gal containers were transplanted on 9 Oct. 2012 with three plants per plot (treatment unit, 4' center-to-center) and three units per subplots. All plants were trimmed slightly to have similar size within the species at the time of transplant. The layout of the individual plots for each species within a main plot was a Completely Randomized Block Design with three replications. Plants were fertilized with Agriform 21 g tablets (20N-4.8P-3.9K) at 2 tablets per plant at planting. All plants were irrigated with micro-sprinklers for the first 6 months after transplant. Irrigation was changed to treatment irrigation methods and schedule on 4 Mar. 2013. Drip irrigation was delivered by two 0.5 gph emitters (RainBird, Azusa, CA) per plant. Micro-sprinkler treatment was delivered by seven Antelco sprinklers (0.04 orifice) arranged on both sides of the individual plots (Antelco Corp., Longwood, FL). Both irrigations were scheduled to deliver 0.5 gallon of water to each plant at each watering. Plants with the no irrigation treatment depend on rainfall as the only source for water. Total precipitation from 4 mar. 2013 to 31 Dec. 2013 was about 9.3 inches (LSU AgCenter Weather Reports). Cutless was applied on 10 Apr. 2013 as topdress to bed surface, which was followed with a light rainfall event (0.02 inch). The amount of Cutless to apply at each rate was calculated based on plot area, 48 ft2. Plants were measured monthly for growth responses and photosynthesis rates. Growth measurements presented as size index (height x widest width x perpendicular width to the widest width). Data were analyzed by ANOVA and as repeated measurement for each species (SAS v 13.1, SAS Institute, Cary, NC). Only first year growth responses are presented here.

Results and Discussion: Plant size index (SI) increased over time for each species from May to September (data not shown). However, there was no consistent response of SI to PGR or irrigation treatments when data were analyzed as repeated measurements (data not shown). The effects of irrigation and Cutless on SI and their interactions varied among plant species and date of measurement (Table 1). Sweet viburnum had no response to irrigation or PGR treatments. For the other four species, effects tended to become less significant or no longer significant by September, which was ~20 weeks after Cutless application (azaleas were not treated because of small plant size).

In May, interactions between irrigation and PGR were significant in ligustrum and wax myrtle but did not affect the main effects of PGR or irrigation (Table 1). Irrigation effect was significant in elaeagnus and wax myrtle (Fig. 1), where drip irrigation resulted in larger plants than overhead irrigation, and was similar or slightly larger than no-irrigation. However, this effect was transient and no significant irrigation effect was found for any species from later measuring dates over the growing season (Table 1). In June, despite the interaction in ligustrum which did not respond to either PGR or irrigation treatment, SI of the other three species was affected by PGR treatment (Fig. 2). Across irrigation methods, SI decreased with increasing Cutless rate in burford holly, elaeagnus and wax myrtle, with wax myrtle responded most significantly among the three (31% size reduction at 21 lbs/1000 ft2 compared with the untreated plants).

From these preliminary results over the first growing season, effect of Cutless .33G varied among plant species with wax myrtle being the most responsive and sweet viburnum being no response. With 9.2 inch of rain over the growing season, irrigation method only had transient effect on plant growth. Effect of Cutless was slightly affected by irrigation but the interaction was also transient and not significant in most cases. More treatments will be applied in the next two years and observations will be reported when available.

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Table 1. Significances of treatment effect for Cutless .33G rate and irrigation methods, and their interactions as indicated by ANOVA p-values with t-test at α = 0.05.

Treatment		May	June	July	Aug.	Sept.
Weeks after Cutless application		4	8	12	16	20
Elaeagnus	Rate	NS	0.0142	0.0094	NS	NS
	Irrig.	0.0481	NS	NS	NS	NS
	Interaction	NS	NS	NS	NS	NS
Burford holly	Rate	0.0050	0.0463	NS	0.0273	0.0544
	Irrig.	NS	NS	NS	NS	NS
	Interaction	NS	NS	0.0481	NS	NS
Ligustrum	Rate	0.0129	NS	NS	NS	NS
	Irrig.	NS	NS	NS	NS	NS
	Interaction	0.0081	0.0008	NS	NS	NS
Wax Myrtle	Rate	NS	<.0001	<.0001	<.0001	0.0128
	Irrig.	0.0034	NS	NS	NS	NS
	Interaction	0.0070	NS	NS	NS	NS
Sweet viburnum	Rate	NS	NS	NS	NS	NS
	Irrig.	NS	NS	NS	NS	NS
	Interaction	NS	NS	0.0595	0.0206	NS

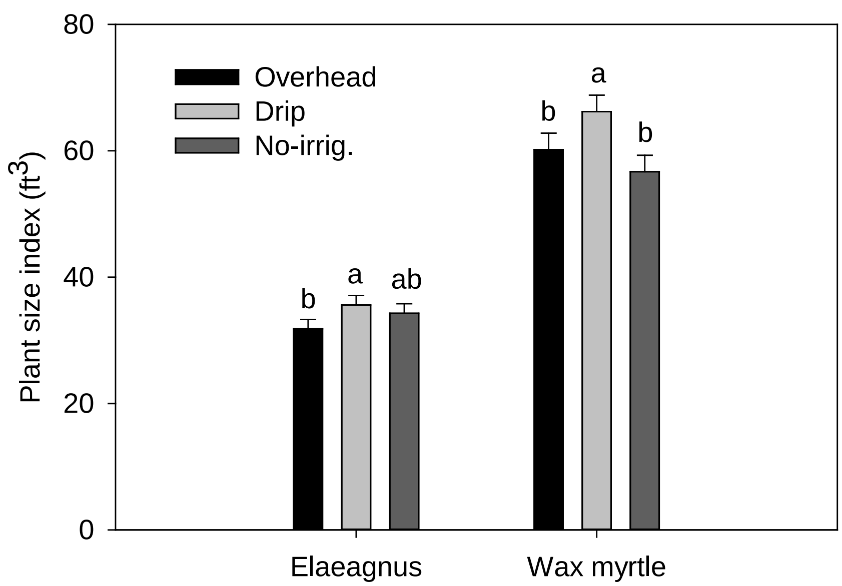

Fig. 1. Size index of elaeagnus and wax myrtle in May 2013 at 4 weeks after Cutless .33G application and 8 weeks after irrigation treatment began. Results were averaged across Cutless rate.

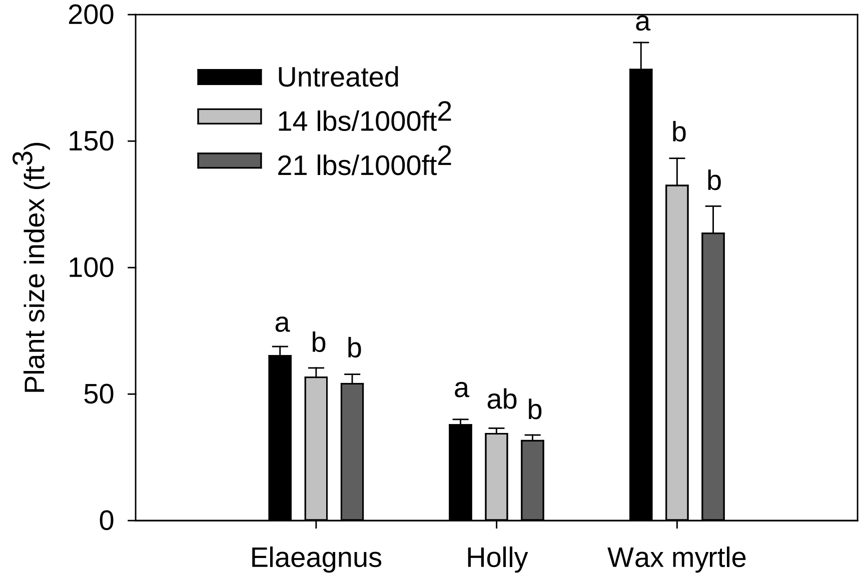

Fig. 2. Size index of elaeagnus, holly, and wax myrtle in June 2013 at 8 weeks after Cutless .33G application and 12 weeks after irrigation treatment began. Results presented were averaged across irrigation methods.