Fertilizer Placement and Herbicide Rate Affect Weed Growth in Containers

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Nature of Work: Successful weed management is necessary to produce saleable container crops. Weed control in container production is achieved primarily through use of preemergence herbicides in conjunction with some hand-weeding. Preemergence herbicides are expensive and not 100% effective. Cultural practices and environmental factors influence weed and crop growth. Placement of controlled release fertilizers (CRFs) will affect the spatial availability of nutrients in containers, and thus could affect weed growth. In container production, CRFs are commonly applied by one of three placement methods: topdressing (applied on the substrate surface after potting), incorporating (mixing CRFs into the substrate prior to potting), or dibbling (placing CRFs just below the liner rootball while potting). Fertilizer placement affects container crop growth. Meadows and Fuller (4) reported dibble placement of Osmocote 18N-2.6P-10.0K (18-6-12) and 17N-3.0P-10.1K (17-7-12) to be more efficient than incorporation, resulting in faster plant “green-up” and superior plant quality. Fertilizer placement also affects seedling establishment. Seeds require available nutrients for establishment. Physiological tradeoffs prevent most plants from adapting to environments of high and low nutrient availability, and agricultural weeds are at one end of this adaptive continuum, in that they generally outcompete other corps in high nutrient environments but compete poorly in low nutrient environments (3). Bark is the primary component used in outside container nursery crop production. Bark substrates are inherently low in available nutrients (2). Thus without a fertilizer source, weed germination and growth would be limited. When CRFs are used as the sole source of nitrogen (N), phosphorus (P), and potassium (K) in containers, placement (topdressed, incorporated, or dibbled) should affect the level of available nutrients on the container surface, thus affecting weed seedling establishment and subsequent growth.

Little research has addressed the effects of cultural practices on weed growth and herbicide effectiveness in container production. The objectives of this research were to determine the effect of fertilizer placement on weed seedling establishment, container crop growth, and potential interactions with preemergence herbicide efficacy.

Experiment 1. The first experiment was conducted at the North Willamette Research and Extension Center (NWREC) in Aurora, Ore. 'Stewartsonia' azalea (Rhododendron 'Stewartsonia') were potted April 30, 2002, in #1 (3-L) containers with a 100% Douglas fir bark amended with 1.5 lbs/yd^3 Micromax micronutrients. Treatment design was a 3×4 factorial, with 3 fertilizer placement methods and 4 herbicide rates. Osmocote 18N-2.6P-10.0K (18-6-12; Scotts Co.) was applied at potting at 0.4 oz per container either topdressed, incorporated, or dibbled.

Topdressed fertilizers were placed on the container surface, incorporated fertilizers were premixed into the bark just prior to potting, and dibbled fertilizers were placed immediately beneath the root ball of azalea liners, 8 cm below the container surface. Azaleas were selected for uniformity from a larger group and were approximately 7.5 inches tall and 7 inches wide at potting. On May 7, 2002, Ornamental Herbicide 2 (OH2, 2% oxyfluorfen + 1% pendimethalin) was applied at 0, 25, 50, or 100 lbs/acre with a handheld shaker. Applications were immediately followed by 0.5 inch of irrigation, and containers were overhead irrigated with 0.5 inch/day thereafter. Approximately 60 seeds of common groundsel (*Senecio vulgaris*) were applied to the surface of each container May 8, 2002. Data collected included weed control ratings on a scale from 0 to 100 (where 0 = no control and 100 = complete control) 5 and 8 WAT, azalea quality rating on a scale from 1 to 10 (where 1 = poor quality and 10 = excellent quality) 8 WAT, and azalea growth index [(height + width + width)÷3] 8 WAT. Data were subjected to analysis of variance, regression analysis, and means were separated with Duncan's multiple range test ($\alpha = 0.05$). Weed counts were square root transformed prior to analysis to improve homogeneity of variance; however, actual values are reported in tables and text. The experiment was arranged in a completely randomized design with 8 replications per treatment combination.

Experiment 2. Expt. 2 was conducted similarly to Expt. 1 with the following exceptions. The experiment was conducted at the Truck Crops Branch Experiment Station in Crystal Springs, Miss. 'Compacta' holly (*Ilex crenata*) were potted May 18, 2002 in 8:1 (v:v) pinebark:sand medium amended with 5 lb/yd^3 of dolomitic limestone and 1.5 lb/yd^3 of Micromax micronutrients. Rout (oxyfluorfen + oryzalin; Scotts Co.) was applied May 19, 2002, using the same herbicide rates applied in Expt. 1 with the addition of a hand-weeded check. Osmocote 17-7-12 was applied at 0.6 oz per container; and was placed 3 inches below the container surface for the dibbled treatments. Containers were overseeded with 20 prostrate spurge (*Chamaesyce prostrata*) seeds per container. Data collected included prostrate spurge counts 4 and 8 WAT, weed control ratings 8 WAT, weed shoot dry weight 12 WAT, and holly growth index 12 WAT.

Results and Discussion: *Experiment 1.* CRF placement and herbicide rate interacted to affect weed control ratings. By 8 WAT, weed control in topdressed and incorporated containers increased linearly and quadratically, respectively, with increasing herbicide rate (Table 1). In topdressed and incorporated containers, the recommended herbicide rate (100 lb/acre) provided 86 and 92% control, respectively. Lower rates, while less than the recommended rate, provided poor control. Dibbled containers did not respond to herbicide rate, and averaged 91.5% control across rates. Even when no herbicides were used in dibbled containers, weed control was acceptable.

Incorporating CRFs reduced azalea growth index by 9% compared to dibbling and 11% compared to topdressing (Table 2). Azalea growth index increased linearly with increasing herbicide rate. Differences were small, not obvious by casual observation, and only revealed after statistical analysis. Across fertilizer placement methods, weed control and azalea growth index increased with increasing herbicide rate, suggesting competition from common groundsel. Berchielli-Robertson et al. (1) also reported competition from container weeds to reduce crop growth. Dibbling and topdressing CRFs resulted in higher quality ratings than incorporating. This concurs with Meadows and Fuller (4) who reported higher quality ratings of three azalea cultivars from dibbling compared to incorporating.

Experiment 2. By 8 WAT, weed control in containers where fertilizers were dibbled was > 90%, while control in topdressed and incorporated treatments were 85% and 88%, respectively. The Rout label recommends reapplication intervals not be less than 12 weeks (3 months), however, when CRFs were topdressed or incorporated, control was at best marginal by only 8 WAT. In Expts. 1 and 2, incorporation generally resulted in numerically greater, though statistically similar, weed control compared to topdressing (summarizing across all measured weed parameters). Previous research supports these observations. In two separate experiments evaluating Rout (among other products) for prostrate spurge control, Rueter and Glaze (5) reported 86 and 96% control of prostrate spurge (*Euphorbia humistrata*) 8 and 12 WAT, respectively, after incorporating CRFs; while Whitwell and Kalmowitz (6) reported 52 and 59% control of prostrate spurge (also *Euphorbia humistrata*) 8 and 12 WAT after topdressing CRFs. Fertilizer placement may explain some of the discrepancy between results in these two studies.

Weed shoot dry weight was 56 and 61% less in containers where CRFs were dibbled compared to topdressed and incorporated, respectively. Weed shoot dry weight decreased quadratically with increasing herbicide rate.

Holly growth index was greater in dibbled containers than topdressed or incorporated, though differences were not commercially important. Growth index increased linearly with increasing herbicide rate. Similar to Expt. 1, increased growth index was likely a result of reduce weed pressure in containers with higher herbicide rates.

Significance to Industry: In conclusion, data herein suggest that topdressing CRFs results in poorer weed control when compared to dibble-applied CRFs even when recommended herbicide rates are used. Furthermore, reduced herbicide rates may be possible when combined with dibble-applied fertilizers. Results were generally similar across two geographical regions, using different herbicides and weed species. Dibbling CRFs reduced weed shoot dry weights compared to topdressing and incorporating, and resulted in acceptable weed control even when no herbicides were used. Dibbling fertilizers is a cultural practice that can be incorporated into most nursery production systems to reduce weed pressure and improve effectiveness of preemergence herbicide programs without adversely affecting crop growth.

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Table 1. Effect of fertilizer placement and herbicide rate on weed control in containers 8 WAT (Expt. 1).

	OH2[y] (lb/acre)				
Fertilizer placement	0	25	50	100	
Topdressed	19 c	65 b	75 b	86 a	Q***
Incorporated	55 b	79 ab	71 b	92 a	L***
Dibbled	85 a	89 a	95 a	97 a	NS

[z]Weeks after herbicide treatment.

[y]Ornamental Herbicide 2 (Scotts Co., Marysville, Ohio).

[x]Means with different letters are significantly different, separated by Duncan's Multiple Range test (a = 0.05).

L, Q, and NS represent linear, quadratic, and nonsignificant rate response, respectively.

*, **, and *** represent significance where P ≤ 0.05, 0.01, and 0.001.

Table 2. Effect of fertilizer placement and herbicide rate on azalea growth index (Expt. 1).

Fertilizer placement	Growth index (cm)[z]	Quality rating[y]
Topdressed	33.0 a[x]	6.7 a
Incorporated	29.3 b	5.5 b
Dibbled	32.0 a	7.0 a
Ornamental Herbicide 2 (lb/acre)		
0	29.8	6.1
25	31.9	6.5
50	31.7	6.0
100	32.2	7.0
	L*	Q*

[z]Growth index = (height + width + width)/3.

[y]Quality rating on a scale from 1 to 10 where 1 = poor quality and 10 = high quality.

[x]Means with different letters are significantly different, separated by Duncan's Multiple Range test (a = 0.05).

L and Q represent linear and quadratic rate response.

*, **, and *** represent significance where P ≤ 0.05, 0.01, and 0.001.

Table 3. Effect of fertilizer placement and herbicide rate on weed numbers in containers (Expt. 2).

		Control (%)	Weed SDW[y]	
Fertilizer placement		8 WAT	12 WAT	Holly growth index (cm)
Topdressed		85 b	6.4 a	8.9 b
Incorporated		88 ab	7.2 a	8.5 b
Dibbled		93 a	2.8 b	9.7 a
Handweed		100	0.0	9.4
OH2	0	69	11.4	8.7
	25	94	4.9	9.1
	50	94	4.5	8.7
	100	99	1.1	9.3
		L***Q***	L***Q**	L*

[z]Weed numbers were square root transformed prior to analysis, actual values are presented.

[y]Shoot dry weight (g).

[x]Growth index = (height + width + width)/3.

[w]Weeks after herbicide treatment.

[v]Means with different letters are significantly different, separated by Duncan's Multiple Range test (a = 0.05).

L and NS represent linear and nonsignificant rate response, respectively.

*, **, and *** represent significance where P ≤ 0.05, 0.01, and 0.001.