the commercial end of our profession. Part-time and small-scale growing is an avenue that is both emotionally enriching and potentially financially rewarding. I estimate that my own operation is approximately two or three growing seasons away from the break even point. Since my current objective is personal satisfaction I am not yet overly concerned about profit. However, I will soon reach a point where I must either remain small with little expectation of economic success or I must increase production to a level where profit is assured (with as much assurance as possible in an agricultural operation). However, with the right effort and the commitment oftime and minimal resources, success as a small-scale grower is possible.

Blending Slow-release Fertilizers for Container Nursery Culture

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Two "manufacture-blended" [(test formula 23N-2.6P-7.5K (23N-6P_2O_5-9K_2O) and test formula 19N-2P-6.6K (19N-5P_2O_5-8K_2O), both 8-9 month release type] and two "custom blended" [3-4 month Sierra 17N-2.6P-10K (17N-6P_2O_5-12K_2O) or 8-9 month Sierra 17N-2.6P-8.3K (17N-6P_2O_5-10K_2O)] mixed with quicker-releasing Osmocote [14N-6P-11.6K (14N-14P_2O_5-11.6K_2O)] controlled-release fertilizers were compared with three unblended 3-4 month or 8-9 month standard industry types. Container-grown dogwood (*Cornus alba* 'Argenteo-marginata'), mock orange (*Philadelphus virginalis* 'Minnesota Snowflake'), and weigela (*Weigela florida* 'Variegata Nana') grew similarly or marginally different in two different media with the four best-performing treatments: Test formula 23N-2.6P-7.5K (23N-6P_2O_5-9K_2O); the two Sierra-Osmocote blends; and unblended 3-4 month Sierra. With unblended and blended 3-4 month Sierra, 30% less N was used, and both dogwood and wiegela grew better with the blend.

INTRODUCTION

Many types of controlled- or slow-release fertilizers are available to the nursery industry. The major nutrients in these fertilizers are typically coated. While the type of coating and/or thickness usually determine the release characteristics, mixtures of quicker- and slower-releasing types (custom blends) have been used to alter the release pattern (Lumis et al., 1993; Hicklenton and Cairns, 1992; Murray et al., 1996). In some recent formulations, easily leached nutrients such as N are coated (controlled release) while others such as P and K are blended in but not coated. These "manufacture blends" are less expensive than traditional all-coated types (industry standards) (Hulme, F.D., private communication).

This trial compared two manufacture- and two custom-blended slow-release fertilizers with several industry standards using three containerized test species grown in two types of media.

MATERIALS AND METHODS

On 30 May 1996, plug-rooted liners of dogwood, mock orange, and weigela were potted in #2 (2 gal) nursery containers filled with bark and municipal leaf and yard waste compost (1 : 1, v/v) (medium A) or bark, peat, and soil (16 : 3 : 1, by volume) (medium B). Seven slow-release fertilizer treatments (Table 1) were topdressed at a rate of 5.5 g actual N per pot (Treatments 1 to 5) or 3.9 g per pot (Treatments 6 and 7).

Dogwood was spaced 60 cm × 60 cm apart and the other two species 60 cm × 45 cm. Each species was arranged in a separate 2-factor (2 media × 7 fertilizers) factorial design with 4 replications and 4 plants per plot. During the growing season, each container received 1 liter of trickle-irrigated water per container twice daily.

At the start of the experiment, triplicate samples of each unamended medium were analysed for selected nutrients and physical properties (Table 2). Substrate samples were collected from the containers (7- to 12-cm depth) on 30 May (planting), 7 June, 17 July, 20 Aug., and 25 Sept. and analysed for pH and electrical conductivity (EC, a measure of soluble salts concentration) using substrate and water (1 : 2, v/v) extracts. Mid-August leaf samples were analysed for total N, P, K, Ca, Mg, Mn, Fe, and Zn. In mid-September, the shoot (leaves + stems) were removed from each plant and their dry weights determined.

RESULTS AND DISCUSSION

Effect of Media. Notwithstanding an excess of K and Cl in medium B, the chemical composition and physical properties of both media were quite acceptable for nursery container culture (Table 2). In fact, dogwood grew equally well in both media. Weigela and mock orange, however, grew better in medium B, which retained higher levels of soluble salts throughout the season (0.42 dS m^{-1}, mean over six sampling dates) than medium A (0.25 dS m^{-1}).

Effect of Fertilizer. The spring of 1996 was later than normal, cool, and exceptionally wet. Prevailing temperatures during the rest of the season were moderate. Salt levels in the containers were low to moderate (season range, 0.19-1.25 dS m^{-1}). Consequently, all three species grew at most only moderately well with the four best-performing fertilizer treatments [Fig. 1; the 8-9 month test formula 23N-2.6P-7.5K (23N-6P_2O_5-9K_2O (Treatment 4); the 8-9 month Sierra-Osmocote blend (Treatment 5); and the two 3-4 month Sierra treatments, blended (Treatment 6) and unblended (Treatment 7)], *which performed similarly or marginally different, depending on species. With the two* 3-4 month Sierra Treatments 6 and 7, 30% less N was used (Table 2), and the blend was consistently better with two of the three species (dogwood and weigela) (Fig. 1).

Lumis et al. (1993) reported that mock orange and weigela grew best with a T140/40 Nutricote blend compared with unblended Nutricote T140 or 8-9 month Sierra 17N-2.6P-10K (17N-6P_2O_5-10K_2O; spirea grew similarly with T140/40 blended and T140 unblended Nutricote. Murray et al. (1996) obtained larger pot-in-pot shade trees with T270/70 blended Nutricote than with liquid or liquid plus slow-release fertilizers. These results were due largely to more rapid early-season release of nutrients (salts) from the blended fertilizers. Hicklenton and Cairns (1992) also

Table 1. Controlled-release fertilizer and rates applied.

No.	Treatment Fertilizer formulation		Release time (mo)	Topdress rate g pot^{-1z}	Topdress rate Actual N(g pot^{-1})
1	Sierra High N 22-4-8	Industry standard	8-9	25.0	5.5
2	Sierra 17-6-10	Industry standard	8-9	32.4	5.5
3	Test formula 19-5-8	Manufacture blend	8-9	28.9	5.5
4	Test formula 23-6-9	Manufacture blend	8-9	23.9	5.5
5	Sierra 17-6-10 (85% N) + Osmocote 14-14-14 (15% N)	Custom blend	8-9/3-4	27.5 + 5.9	5.5
6	Sierra 17-6-12 (85% N) + Osmocote 14-14-14 (15% N)	Custom blend	3-4/3-4	19.5 + 4.2	3.9
7	Sierra 17-6-12	Industry standard	3-4	23.0	3.9

[z] #2 (2-gal) pot (6-liter actual size).

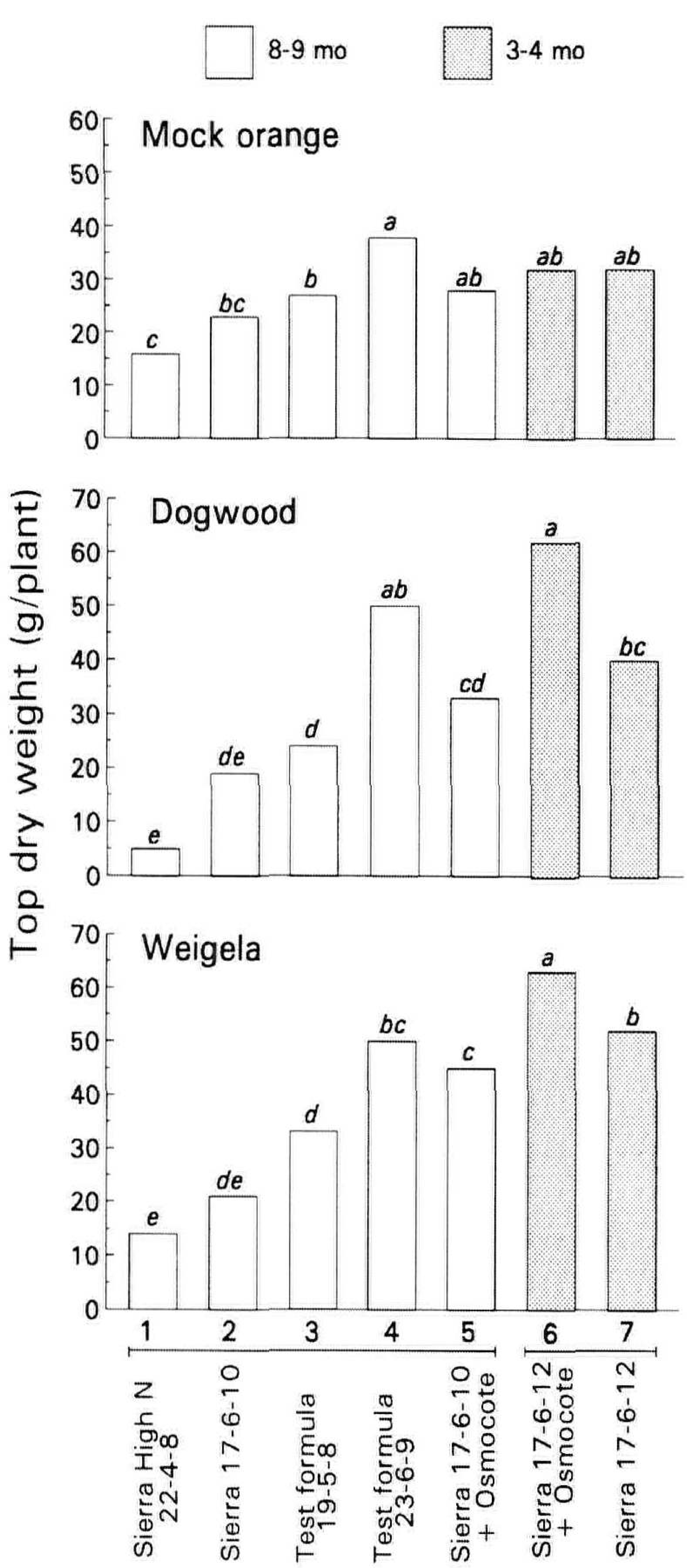

Figure 1. Top dry weight of three containerized nursery crops in response to seven slow-release fertilizer treatments. Data were averaged over two media. There was no fertilizer × media interaction. Comparisons between individual fertilizer treatment means are separated (*a-e*) by LSD at *P* 0.05.

Table 2. Chemical and physical analysis[z] from saturated paste extracts of the two media at the start of the experiment.

Variable	Recommended values	Bark, peat, and soil (16 : 3 : 1, by volume) (medium A)	Bark and compost (1 : 1,v/v) (medium B)
Chemical properties			
pH	5.5-7.0	5.5	6.8
Solublesalts (dS m^{-1})[x]	1.0	0.16	0.56
Nitrate (NO_3^--N, ppm)	100-200	1	1.3
Phosphorous (P, ppm)	6-9	9	7
Potassium (K, ppm)	150-200	40	268
Calcium(Ca, ppm)	200-300	23	63
Magnesium (Mg, ppm)	70-200	17	27
Sodium (Na, ppm)	0-50	21	43
Chloride (Cl, ppm)	0-50	24	242
Iron (Fe, ppm)	0.3-3.0	0.3	1.9
Manganese (Mn, ppm)	0.3-3.0	0.5	1.3
Zinc (Zn, ppm)	0.3-3.0	0.03	0.1
Copper (Cu, ppm)	<0.6	0	0
Physical properties			
Bulk density (g cm^{-3})	0.20-0.75	0.32	0.36
Total pore space (%)	>50	74	67
Air pore space (%)	15-30	37	40
Water pore space (%)	25-35	37	27

[z] Each datum is an average of 3 samples.
[x] Values converted from saturated past extract to 1:2 medium:water extract by a factor of 2.5.

obtained quicker release from blended T40/100 compared with unblended T100 Nutricote. While growth of juniper was unaffected, cotoneaster grew more rapidly at first with the blend but by end-of-season the influence of both treatments was no longer evident.

In this study, salt readings were different (P <0.05) on three of six medium sampling dates: 7 June, range 0.20 to 0.34 dS m^{-1}; 13 June, 0.21 to 0.37; and 17 July, 0.19 to 1.25. Interestingly, end-of-season growth was positively correlated with readings on 7 June [early season, mock orange r=0.596*, n=14 (2 media × 7 fertilizers)] and 17 July (mid season, dogwood r=0.592* and weigela r=0.586*). Raymond et al. (1998) found positive correlations between initial (time of planting) salt values in compost media and growth of each of four container-grown shrubs.

There were some differences in contents of foliar nutrients due to media or fertilizers (data not shown), but variations within species were within limits found normally in container nursery stock (OMAFRA 1997). Highest or near-highest foliar N concentrations in plants from Sierra High N 22N-1.7P-6.6K (22N-$4P_2O_5$-$8K_2O$) (Treatment 1) suggest an imbalance in the release pattern and/or utilization of N. This treatment notably and consistently produced the lowest salt readings and the poorest growth of all three species (Fig. 1).

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