# Container Crop Response to Liquid and Slow-Release Fertilisers and Substrates From Bark Wastes and Composts©

**K. L. McLachlan and R.P. Voroney**
University of Guelph, Dept. of Land Resource Science, Guelph, Ontario, N1G 2W1 Canada

**C. Chong**
University of Guelph, Dept. of Plant Agriculture, Guelph, Ontario, N1G 2W1 Canada

**B. E. Holbein and H.-W. Liu**
Super-Blue-Box-Recycling Company (SUBBOR), Suite 401, 2275 Lakeshore Blvd. W., Etobicoke, Ontario, Canada

There is increasing use of bark wastes and waste-derived composts in container culture but little information on the effect of different types of fertilisers or substrate formulations. This study compared the growth response of potentilla (*Potentilla fruticosa*) and ninebark (*Physocarpus opulifolius*) grown from liners in #2 containers filled with three bark-based media and three waste-derived composts (Table 1).

Plants were fertilised with either Nutryon 17N–1.7P–8.7K (17N–5$P_2O_5$–12$K_2O$) 6-month controlled-release fertiliser incorporated (6.5 kg·$m^{-3}$) before planting, or with 20N–8.7P–16.6K (20N–20$P_20_5$–20$K_2O$) water-soluble fertiliser at a rate of 100 ppm N twice a day every other day with the irrigation water until 15 July, then 200 ppm thereafter. Each plant received 1 L of trickle-irrigated water per container twice daily. The plants were arranged in a split-plot design with media as main plot (three replications) and both species and fertiliser as subplots (six plants each). Selected physical and chemical properties of the media were determined at planting (Table 1). The pH and electrical conductivity (EC, an indication of soluble salts concentration) were determined using the saturated-medium-extract procedure at planting and at various intervals during the season. At the end of the season, the shoot of each plant was removed and dried; substrate subsidence [vertical distance (cm) from the container rim] was measured in each container.

Plants of both species grew better with liquid than slow-release fertiliser (Fig. 1), although there were significant species × fertiliser and media × fertiliser interactions (Table 2).

With liquid fertiliser, (A) contrast analysis indicated no significant difference in growth of both species with either bark-based media or waste-derived composts (Fig. 1); and (B) there was a positive curvilinear relationship between top dry weight and substrate subsidence with potentilla ($y = 70 + 5.5x - 0.5x^2$, $r^2 = 0.96$, $P<0.05$), but no similar relationship with ninebark.

With slow-release fertiliser, (A) the bark-based media outperformed the composts (Fig. 1); and (B) top dry weight of both species was negatively correlated with subsidence (ninebark, $r = -0.76$; and potentilla, $r = -0.88$, $P<0.01$), due likely to less root mass resulting from slower growth with slow-release compared with liquid fertiliser. Liquid fertiliser promoted more growth, making the substrate biomass less resistant to change.

At planting just before the first irrigation, salt levels (dS·$m^{-1}$) were relatively low in the bark-based media [PB (pine bark), 1.6; FM (Favourite mix), 1.6; and

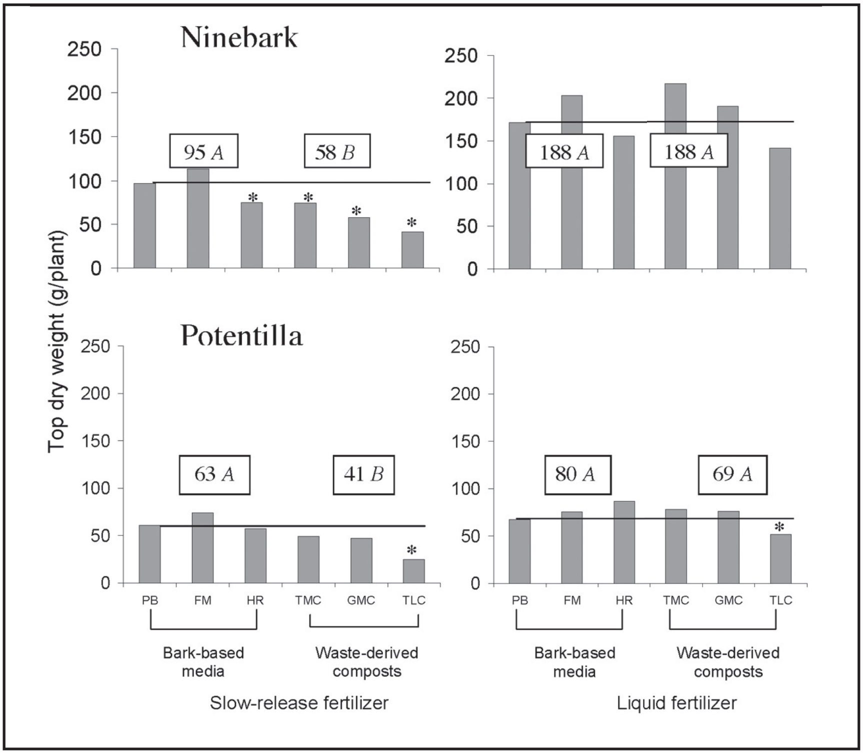


**Figure 1.** End-of-season top dry weight (adjusted means) of ninebark and potentilla grown in three bark-based media (PB=Pine bark; FM=Favourite mix; and HR=Horticultural Research Institute of Ontario nursery mix) and three waste-derived composts (TMC=Toronto municipal leaf and yard waste compost; GMC=Guelph municipal solid waste compost; and TLC=Turkey litter compost) under two fertiliser regimes (slow-release and liquid). Within species and fertiliser treatments, orthogonal contrasts were used to compare top dry weight between the bark-based media and the waste-derived composts. Plants were considered to be of minimum marketable size if growth was at least comparable to that in the PB medium, represented also by the horizontal line extending across each graph. An asterisk (*) over a bar indicates significant difference compared with the PB medium according to LS means procedure.

**Table 1.** Chemical and physical analyses of bark-based media and waste-derived composts before planting.

| Variable | Recommended values[y] | Bark-based media[z] | | | Waste-derived composts[z] | | |
|---|---|---|---|---|---|---|---|
| | | PB | FM | HR | TMC | GMC | TLC |
| | | Chemical analysis[x] | | | | | |
| EC (dS·m$^{-1}$) | 3.5 | 1.6 | 1.6 | 0.7 | 3.5 | 12.0 | 23.1 |
| pH | 5 .5– 7 | 5.3 | 6.1 | 5.4 | 8.2 | 8.1 | 6.0 |
| *Macronutrients* (ppm) | | | | | | | |
| $NO_3$-N | 100-200 | 2 | 1 | 3 | 9 | 171 | 1818 |
| $NH_4$-N | 10 | 1 | 69 | 1 | 4 | 8 | 41 |
| $PO_4$ | 6-9 | 10 | 16 | 1 | 3 | 0 | 297 |
| K | 150-250 | 149 | 195 | 52 | 930 | 1701 | 6729 |
| Ca | 200-300 | 152 | 56 | 60 | 129 | 262 | 360 |
| Mg | 70-200 | 69 | 20 | 22 | 36 | 70 | 935 |
| $SO_4$ | <300 | 613 | 267 | 217 | 193 | 1239 | 4122 |
| Na | <50 | 45 | 24 | 20 | 85 | 2099 | 1288 |
| Cl | <50 | 79 | 172 | 38 | 766 | 3485 | 1270 |
| *Micronutrients* (ppm) | | | | | | | |
| Al | - | 0.53 | 1.12 | 2.09 | 0.85 | 0.75 | 7.40 |
| B | - | 0.39 | 0.50 | 0.23 | 0.83 | 0.95 | 4.75 |
| Cu | 0.3 - 3.0 | 0.03 | 0.06 | 0.02 | 0.13 | 0.20 | 1.70 |
| Fe | 0.3 - 3.0 | 0.14 | 0.66 | 1.25 | 1.34 | 1.55 | 6.30 |
| Mn | 0.3 - 3.0 | 5.18 | 0.86 | 1.28 | 0.25 | 0.20 | 2.75 |
| Zn | 0.3 - 3.0 | 0.27 | 0.24 | 0.09 | 0.15 | 0.50 | 1.35 |
| Mo | - | 0.02 | 0.02 | 0.01 | 0.10 | 0.30 | 0.30 |
| Physical analysis[w] | | | | | | | |
| Total porosity (%) | >50 | 68 | 75 | 69 | 64 | 72 | 68 |
| Air-filled porosity (%) | 15-30 | 18 | 35 | 19 | 20 | 32 | 26 |
| Water retention capacity (%) | 25-35 | 50 | 40 | 50 | 44 | 40 | 42 |

[z] Bark-based media: PB = Pine bark; FM = Favourite Mix, Gro-bark (Ontario) Ltd.; and HR = Horticultural Research Institute of Ontario nursery mix. Waste-derived composts: TMC = Toronto municipal leaf and yard waste compost; GMC = Guelph municipal solid waste compost; and TLC = Turkey litter compost.

[y] Source: OMAFRA (2000).

[x] EC, pH, and nutrients measured from saturated medium extracts (greenhouse procedure).

[w] Expressed on an air-dry basis.

**Table 2.** Analysis of variance (mean squares) for top dry weight (g per plant).

| Effect | df | Mean squares |
|---|---|---|
| Media (M) | 6 | 2983** |
| Replication (R) | 2 | 245 |
| Error (a) | 12 | 362 |
| Species (S) | 1 | 77037** |
| Fertiliser (F) | 1 | 88233** |
| M × S | 6 | 574 |
| M × F | 6 | 1952** |
| F × S | 1 | 35318** |
| Error (b) | 39 | 488 |

** Significant at $P$<0.01.

HR (Horticultural Research Insitute of Ontario nursery mix), 0.7] but higher in the composts [TMC (Toronto municipal leaf and yard waste compost), 3.5; GMC (Guelph municipal solid waste compost) 12.0; and TLC (turkey litter compost), 23.1] (Table 1). The salt levels in the media decreased rapidly (within days) after planting and remained low, except until mid-season for TLC and, to a lesser degree, GMC. The diminutive growth of potentilla in the TLC compost (both slow-release and liquid), and of ninebark in four slow-release fertilised substrates including the TLC (Fig. 1), seemed to be related to early exposure of plants in these treatments to high salt levels (Chong, 1999).

**Acknowledgements.** This work was jointly funded by an Industrial Postgraduate Scholarship to the senior author from the Natural Sciences and Engineering Research Council and by SUBBOR.

## LITERATURE CITED

**Chong, C.** 1999. Experiences with the utilization of wastes in nursery potting mixes and as field soil amendments. Can. J. Plant Sci. 79: 139-148.

**Ontario Ministry of Food and Rural Affairs (OMAFRA).** 2000. Nursery and landscape plant production: Publication 383. Queen's Printer for Ontario. Toronto, Ontario.