Container Crop Response to Two Spent-Mushroom-Compost Media Treated with Acid-Reaction Chemicals©

Calvin Chong
Department of Plant Agriculture, University of Guelph, Guelph, Ontario N1G 2W1, Canada,

Danny L. Rinker
Department of Plant Agriculture, University of Guelph, Vineland Station, Ontario L0R 2E0, Canada

During the past 20 years, researchers have been advocating the use of spent mushroom compost (SMC) in potting mixes (Chong and Rinker, 1994). The high pH (8.0–8.2 with 5.5–7.0 recommended for most crops) of Ontario generated SMC make this organic byproduct less desirable for use as amendment in potting mixes. Plant response to pH reduction in initially high pH media has been reviewed by Bishko et al. (2003) and Fisher et al. (2003). This study compared the response of three container-grown species to two SMC-amended mixes treated with nitric acid and various rates of sulfur.

Cotoneaster (*Cotoneaster dammeri* 'Coral Bounty'), forsythia (*Forsythia* × *intermedia* 'Lynwood), and weigela (*Weigela* 'Nana Variegata') were grown from plug-rooted liners through one season in #2 containers filled with either 2 SMS : 1 sawdust or 1 SMS : 2 sawdust (v/v). Each mix was pre-incorporated with powdered sulfur at rates of 0, 0.3, 0.6, 1.2, and 2.4 $kg \cdot m^{-3}$. Plants were trickle-irrigated with 2 L of water per container per day without or with nitric acid injected at 100 times dilution from a stock solution comprised of 1 L of concentrated acid per 160 L of water. Plants also received 200 ppm of N as 20-20-20 (20.0 N – 8.7 P – 16.6 K) fertilizer containing micronutrients, injected three times per week with irrigation. Plants of each species were arranged in a separate split-plot design with five replications of the main plots (+/- nitric acid). Subplots were the two mixes and five rates of sulfur.

The initial physical and chemical properties of the mixes, including pH and electrical conductivity (EC, a measure of soluble salts concentration) are shown in Table 1. The pH was also measured in the substrates at various intervals during the season. In mid-August, samples of leaves were taken for analysis of N, P, K, Ca, Mg, Fe, Mn, and Zn. In late September, plant height and top dry weight were determined.

During the season, nitric acid had no measurable effect on pH of the media (Table 2), although both cotoneaster and forsythia (not weigela) had higher end-of-season top dry weight in the acid-treated media (Table 3). Increasing rates of sulfur decreased the pH moderately in both mixes, especially during early- and mid-season (Table 2), although only growth of weigela was affected (Table 3), increasing curvilinearly in top dry weight with increasing rates of sulfur. The two media showed no difference in pH (Table 2) or effect on growth of the three species (Table 3). Height of the three species was unaffected by acid or sulfur treatments, except for slightly taller forsythia plants in the acid-treated media (data not shown).

Early chlorosis observed on some plants disappeared by mid-season, and was likely due to transplanting and/or weather-related factors (Chong and Rinker, 1994). This notwithstanding, throughout the season, there was no symptom that was suggestive of nutrient toxicity or deficiency. As expected (Chong and Rinker,

Table 1. Initial chemical and physical analysis of the two spent mushroom compost media at the start of trial.

	Recommended	Media[z]	
Chemical properties[y]	values	1 SMS : 2S	2 SMS : 1S[z]
pH	5.5-7.0	7.6	7.9
Soluble salts ($dS \cdot m^{-1}$)	≤1.0	2.0	2.6
NO_3^- (ppm)	100-200	29	32
P (ppm)	6-9	3	3
K (ppm)	150-250	1090	1400
Ca (ppm)	200-300	255	329
Mg (ppm)	70-200	100	146
Cl (ppm)	0-50	848	978
Fe (ppm)	0.3-3.0	0.8	1.0
Mn (ppm)	0.3-3.0	0.2	9.2
Zn (ppm)	0.3-3.0	0.1	0.1
Physical properties[x]			
Bulk density ($g \cdot cc^{-1}$)		0.26	0.30
Total porosity (%)		64	64
Aeration porosity (%)		21	19
Moisture retention capacity (%)		43	45

[x] Triplicate samples determined on air dry weight basis.
[y] Duplicate samples. pH and soluble salts measured in 1 part medium: 2 parts water (v/v) extracts. Concentrations of all nutrients measured in saturated medium extracts.
[z] SMS = spent mushroom substrate; S = sawdust.

Table 2. Changes in pH of the two spent mushroom compost media at various intervals during the season in response to acid-reaction chemicals.

		pH					
Treatments		4 June	10 June	17 June	8 July	24 July	19 August
Acid	With	7.1[z]	7.2	7.2	7.3	7.0	7.2
	Without	6.9	7.1	7.2	7.3	7.3	7.3
	LSD (5%)	NS[y]	NS	NS	NS	NS	NS
Media	1 SMS : 2S[x]	7.1	7.0	7.2	7.3	7.2	7.3
	2 SMS : 1S	7.0	7.3	7.1	7.3	7.2	7.2
	LSD (5%)	NS	NS	NS	NS	NS	NS
Sulfur	0	7.6	7.5	7.5	7.6	7.3	7.4
($kg \cdot m^{-3}$)	0.3	7.2	7.3	7.3	7.4	7.1	7.3
	0.6	7.2	7.1	7.3	7.3	7.2	7.3
	1.2	6.7	7.0	7.0	7.1	7.0	7.2
	2.4	6.4	7.0	6.8	7.0	7.2	7.1
	Linear	**[w]	*	*	*	NS	*
	Quadratic	*	*	*	*	NS	NS

[w] **, *, Significantly different at the 1% and 5% level of probability, respectively.
[x] SMS = spent mushroom substrate; S = sawdust.
[y] NS, Not significantly different at 5% level of probability.
[z] Each datum is an average of two replications over three species.

Table 3. End-of-season top dry weight of three nursery species in response to two spent mushroom compost media treated with acidifying chemicals.

Treatments		Top dry weight (g/plant)		
		Cotoneaster	Forsythia	Weigela
Acid	With	139	80	52
	Without	117	67	49
	LSD (5%)	11	8	NS
Media	1 SMS : 2S[z]	128	76	51
	2 SMS : 1S	128	72	49
	LSD (5%)	NS[y]	NS	NS
Sulfur ($kg \cdot m^{-3}$)	0	125	74	45
	0.3	134	74	48
	0.6	124	74	52
	1.2	128	72	52
	2.4	129	73	55
	Linear	NS[y]	NS	*
	Quadratic	NS	NS	*

[y] NS, *, Not significantly different and significantly different, respectively, at the 5% level of probability.

[z] SMS = spent mushroom substrate; S = sawdust.

1994), the initial moderately higher than recommended EC values in the spent compost media (2.0-2.6 $dS \cdot m^{-1}$) was quickly leached to values ≤ 1.0 $dS \cdot m^{-1}$, the recommended threshold. In leaves of the three species, differences (if any) in foliar nutrients due to treatments were small (data not shown) and of little or no physiological significance.

LITERATURE CITED

Bishko, A.J., P.R. Fisher and **W.R. Argo.** 2003. The pH response of a peat-based medium to application of acid-reaction chemicals. HortScience 38:26-31.

Chong, C. and **D.L. Rinker.** 1994. Use of spent mushroom substrate for growing containerized woody ornamentals: An overview. Compost Sci. Util. 2:45-53.

Fisher, P.R., R.M. Wik, B.R. Smith, C.C. Pasian, M. Kmetz-Gonzalez, and **W.R. Argo.** 2003. Correcting iron deficiency in calibrachoa grown in a container medium at high pH. HortTechnology 13:308-312.