Crop Production

Nitrogen and Water Loss by Leaching from Different Composted Cranberry Pomace Media

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Cranberry pomace compost has been successfully used to produce hardy mums, flowering hanging baskets and mixed containers of flowering annuals in Massachusetts. These grower trials have shown the promise of using cranberry pomace as a component in growing media and have familiarized growers with its use. Projects at UMass studying plant growth response to pomace mixes under controlled conditions have also shown positive results (Cox, 2008a; Cox, 2008b; Cox and Lopes, 2007).

During the course of my work at UMass I noticed that growing media consisting of high percentages of cranberry pomace tended to drain more rapidly following watering and dry out faster compared to a commercial peat-based medium and other pomace media containing lower levels of pomace. One issue of concern about using composts is what, if any, contribution do composts make to nutrient leaching and runoff. Problematic levels of nutrient leaching could occur from a compost potting mix if it's too "rich" in natural nutrient content and/or if it doesn't retain well nutrients applied from water-soluble fertilizers.

This article looks at nitrogen and water loss by leaching from 4-inch geraniums as it relates to plant growth, cranberry pomace media formaulation, and media physical properties. This project was supported by a grant from New England Floriculture, Inc.

How the plants were grown

Two types of composted cranberry pomace were tested. One type consisted of pomace composted in the open in a static pile for nearly 3 years ("old") resulting in a dark brown material of granular consistency. The initial pH and EC of this material was 5.5 and 0.57 mmho/cm. The second type of pomace was about 6 months old ("new") after composting in the open in a static pile. New pomace compost was light brown in color and some seeds and fruit skins could still be seen. The initial pH and EC of this material was 5.8 and 0.88 mmho/cm. The physical properties (bulk density, air-filled pore space, container capacity, and total porosity) of the growth media were measured before planting and will be discussed later.

Plug seedlings of 'Elite Red Geranium' were obtained from a commercial propagator and potted on 23 September 2008 in 4-inch plastic pots of Fafard 3B commercial mix or different media made with cranberry pomace. Pomace media were formulated with old or new pomace at levels of 100% or 50% pomace by volume. The 50% medium contained 40% sphagnum peat moss and 10% coarse perlite. Dolomitic limestone at 5 lb. /yd^3 was added to the pomace media.

The method of watering and fertilizing was designed so that the same amount of water and fertilizer was applied to all plants regardless of growing medium. Plants were watered at two to four day intervals as needed. At each watering the same volume of water soluble fertilizer or plain water was applied to plants in all treatments. The fertilizer solution was made by dissolving Plantex® 20-2-20 to supply 200 ppm N. Over the course of the growing period each plant received 740 milligrams (mg) of N and 4610 milliters (ml) (156 fl. oz.) of water per pot.

Pots were suspended through the lids of larger containers to collect the leachate as the plants grew. At 10 day intervals the leachate volume was measured and ammonium-N (NH_4-N) and nitrate-N (NO_3-N) concentrations were measured to calculate the amount of N leaching from each pot. Days from potting to flowering were recorded and at harvest (24 November), 60 days after potting, plant height, plant diameter,

leaf area (area of the single leaf at the base of the first flower stalk), flower stalk length, and shoot dry weight were measured.

Results

Plant growth. Geranium plants growing in both types of cranberry pomace and Fafard 3B were largely indistinguishable from one another. There was no difference in time to flower among the treatments (Table 1). However, growth measurements revealed that plants grown in Fafard 3B or with either level of new pomace were taller and of greater diameter, and weighed more than plants grown with old pomace. The flower stalks of plants grown with Fafard 3B or new pomace were longer than the stalks of old pomace plants. Plants grown with new pomace had the largest leaves of all treatments. Overall, plants grown with new pomace grew more than those with old pomace. Pomace level, regardless of pomace age, had no effect on plant growth other than greater shoot dry weight with 100% pomace. In general, the growth responses of geranium in this study were similar to those described in an earlier article (Cox, 2007).

Table 1. Growth of 'Elite Red' geranium in different composted cranberry pomace.

Growing medium	Days to flower	Height (cm)	Plant diameter (cm)	Leaf area (cm^2)	Flower stalk length (cm)	Dry weight (gm)
Fafard 3B	48ns[z]	21.9ab	29.6a	96.1bc	18.6ab	12.7a
100% Old pomace	45	19.3b	26.5b	89.5c	17.3b	8.9c
50% Old pomace	46	19.9b	28.1ab	92.0c	17.1b	10.4b
100% New pomace	48	22.6ab	29.7a	122.6a	20.0a	11.9a
50% New pomace	46	24.0a	29.7a	119.1ab	19.1a	13.2a
Old pomace	46	19.5	27.3	90.8	17.2	9.7
New pomace	47	23.3	29.7	120.9	19.6	12.6
Significance[y]	ns	**	**	**	**	**
100% pomace	47	20.9	28.8	105.6	18.1	11.8
50% pomace	46	21.9	28.1	106.0	18.6	10.4
Significance	ns	ns	ns	ns	ns	**

[z]Means followed by different letters are statistically different at P=0.01or not significant (ns).
[y]Pair of means are statistically different at P=0.01 (**) or not significant (ns).

Nitrogen leaching. The amount of NH_4-N, NO_3-N, and the total of both N forms which leached during the experiment was greatest where plants were grown with 100% old pomace and least with the Fafard 3B and 50% new pomace treatments (Table 2). Nitrogen leaching from the 50% old pomace and 100% new pomace treatments was less than 100% pomace but greater than Fafard 3B and 50% new pomace. Overall, more N leaching occurred with media containing old pomace and from media containing 100% pomace. Despite the differences in leaching loss of N between growing media, the level of N found in the leaves did not significantly differ among treatments.

Total leachate volume was greatest was greatest in 100% pomace regardless of pomace age. Significantly less N leached with 50% pomace regardless of age and the least N leaching occurred when plants were grown in Fafard 3B.

Growth medium physical properties. Most growers are familiar with the term "bulk density" as the weight of a cubic foot of potting media. Bulk density (BD) of commercial media is generally the moist weight of the mix. The procedure used in this project measured BD as the weight of dry mix. Fafard 3B was the heaviest growing medium, followed by the media made from old pomace, and the lightest media were the two made from new pomace (Table 3). Using new pomace for tall plants in small containers might cause a stability problem, but otherwise the dry BDs were very typical of media used in the greenhouse.

Table 2. Nitrogen leaching from pots containing different composted cranberry pomace media used to grow 'Elite Red' geranium.

Growing medium	NH_4-N (mg/pot)	NO_3-N (mg/pot)	Total N (mg/pot)	Foliar N (%, dry wt.)	Total leachate volume (ml)
Fafard 3B	52.6c[y]	129.1c	181.7c	5.14ns	372c
100% Old pomace	178.8a	280.6a	459.4a	4.96	1363a
50% Old pomace	98.5b	179.5b	278.1b	5.29	784b
100% New pomace	94.1b	223.5b	323.8b	5.17	1296a
50% New pomace	56.5c	118.9c	175.4c	5.36	621bc
Old pomace	138.6	230.1	368.8	5.13	1073
New pomace	75.3	171.2	249.6	5.26	958
Significance[y]	**	**	**	ns	ns
100% pomace	136.4	252.1	391.6	5.07	1330
50% pomace	77.5	171.2	226.8	5.33	702
Significance	**	**	**	ns	**

[z]Means followed by different letters are statistically different at P=0.01or not significant (ns).
[y]Pair of means are statistically different at P=0.01 (**) or not significant (ns).

Air-filled pore space (AFP) is pore space which drains quickly after watering and is then occupied by air. For any given growth medium AFP increases as container height increases. Container capacity (CC) is the pore space which retains water after free drainage. The measurements AFP of all the media in this study were in the desirable range for greenhouse media, but significant differences in AFP did occur among the media. Regardless of compost age, 100% pomace media had greater AFP than Fafard 3B and the 50% pomace media (Table 3). Thus, mixing peat moss with the pomace to create the 50% pomace treatments reduced AFP. Fafard 3B had a higher CC than the pomace media, but there were no differences in CC among pomace media.

Table 1. Physical properties of composted cranberry pomace media.

Growing medium	Dry bulk density (lbs/ft^3)	Air-filled pore space (%)	Container capacity (%)	Total pore space (%)
Fafard 3B	9.3a[z]	8.5c	79.3a	87.7a
100% Old pomace	7.9b	11.8b	72.5b	84.3a
50% Old pomace	6.7c	8.7c	70.2b	78.8b
100% New pomace	6.1d	16.4a	71.0b	87.4a
50% New pomace	5.8d	10.2bc	70.8b	81.0b
Old pomace	7.5	10.2	71.3	81.5
New pomace	6.3	13.3	70.9	84.2
Significance[y]	**	**	ns	ns
100% pomace	6.9	14.1	71.8	85.9
50% pomace	6.3	9.4	70.5	79.9
Significance	**	**	ns	**

[z]Means followed by different letters are statistically different at P=0.01.
[y]Pair of means are statistically different at P=0.01 (**) or not significant (ns).

Total pore space (TP) is the sum of AFP and CC. The desirable TP for greenhouse media is 75 to 85% (this means that 75-85% of a pot of typical soilless media is space occupied by water or air and only 15-25% of pot volume is solids). The TP measurements of all the media were in the desirable range. Mixing peat moss with pomace significantly reduced the TP compared to the other media.

What does it all mean?

Geranium plants grown in a commercial soilless medium, Fafard 3B, and four different media formulated with composted cranberry pomace received the same amount of N from 20-2-20 fertilizer and water over a period of 60 days in length after planting. Nitrogen and water loss by leaching were significantly greater when plants were grown in media consisting of 100% old or 100% new compost compared to Fafard 3B and 50% compost media. The greater N and water loss might be explained by less plant growth in the case of the 100% old pomace treatment where shoot dry weight was much less. Also, in both 100% pomace treatments, less root growth was apparent when the pots were removed. The root systems were healthy, but less developed compared to Fafard 3B. Samller plants and root systems take up less water and nutrients leading to potentially more water and nutrient loss from pots.

Blending peat moss and perlite with pomace compost of either age to produce the 50% pomace medium resulted in significantly less N and water loss and less air-filled pore space. In general, with greater the air-filled pore space more water (and soluble nutrients) is likely to drain from the pot after watering and, in most cases, the sooner the plants must be watered again. The findings here suggest that adding peat moss might have created a "tighter" growing medium, more retentive of N and water than the 100% pomace treatment. Also, plants in 50% old pomace treatment grew larger than the 100% pomace treatment.

Good quality greenhouse plants can be grown in a mix consisting of only composted cranberry pomace. However, growers may find that they can save on water and irrigation operation costs and reduce N loss by mixing pomace with sphagnum peat moss at 40-50% by volume. Under the conditions of this study water loss by leaching was reduced nearly 50% by mixing composted pomace with peat moss.

References

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