Nitrogen and Potassium Nutrition of Geraniums Grown in Spent Mushroom Substrate (SMS) Fertilized with Leachate from SMS©

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INTRODUCTION

Spent mushroom substrate (SMS) can effectively be used for the production of greenhouse and nursery crops. Young et al. (2002) demonstrated that marigolds could be grown in SMS from three sources. In this research the procedure was to take the fresh SMS and leach the soluble salts from the SMS then use the SMS immediately as a growing media amendment. The problem with this procedure was that a waste product containing high salt content was generated. Many of the salts in the SMS leachate are plant nutrients and could be supplied to the plant as a replacement for existing fertilizer nutrients. A preliminary study determined that marigolds could be grown using the SMS leachate as the primary source for fertilizer nutrients.

Objectives

- To determine the pattern of potassium (K) and nitrate (NO_3^-) leaching from SMS
- To determine changes in K and NO_3^- content of recycled irrigation water
- To determine the response of geraniums to SMS leachate as a fertilizer

MATERIAL AND METHODS

Nutrient Leaching. Fresh SMS was obtained and sieved through a 2-mm sieve with the coarse SMS used for this work. The SMS was packed into 10 aluminum cores according to a procedure adapted from Bilderback et al. (1982). The 10 cores were divided into two treatments. One treatment was leached immediately while the other was leached at weekly intervals. Once cores were at container capacity each core was leached with 100 ml of reverse osmosis (RO) water. The volume of the leachate from each core was recorded and the pH and EC of the leachate were determined. A 10-ml sample was removed from the leachate from each core and combined into a single 50 ml sample labeled as Leach #1 and analyzed for Ca, K, Mg, P, and nitrate. The other five cores were brought to container capacity then leached and the leachate was labeled Leach #1 Week 1. The rest of the procedure was followed except that the leaching was done once each week rather than 6 times one after another. Between leachings the cores were removed and placed in a covered container to minimize evaporation at room temperature.

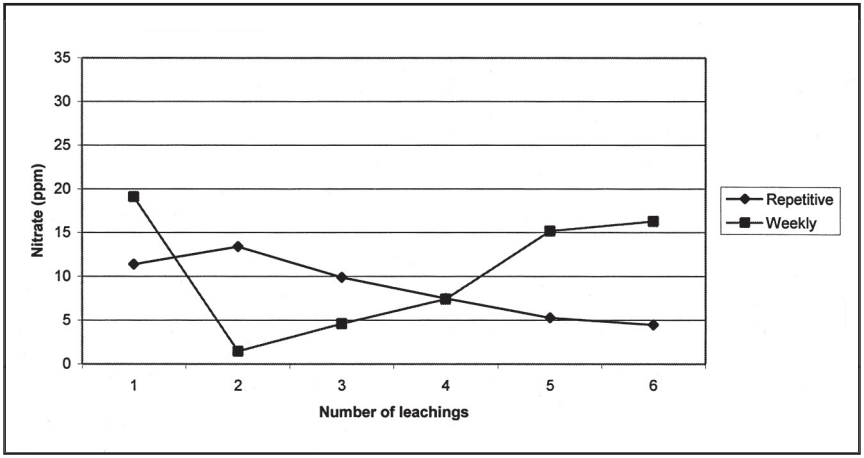

Figure 1. Nitrate release during leaching.

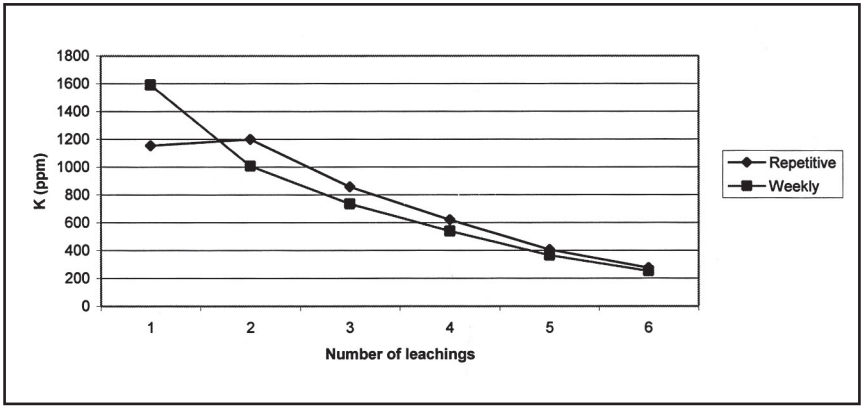

Figure 2. Potassium release during leaching.

Crop Experiments. *Pelargonium* 'Pinto Red' (Pinto Red geranium) was spring grown. Aerated SMS was obtained and two growing mixes created: (1) 1 SMS : 3 peat moss (v/v) and (2) 1 SMS : 1 peat moss (v/v). One-half of the crop was planted in each growing mix. Immediately after planting the mixes were leached by repeatedly irrigating overhead with a hand held nozzle. Leaching was terminated when the pour-through EC was 2 mmhos·cm-1 or less. All the leachate was saved for use in the fertilizer solution.

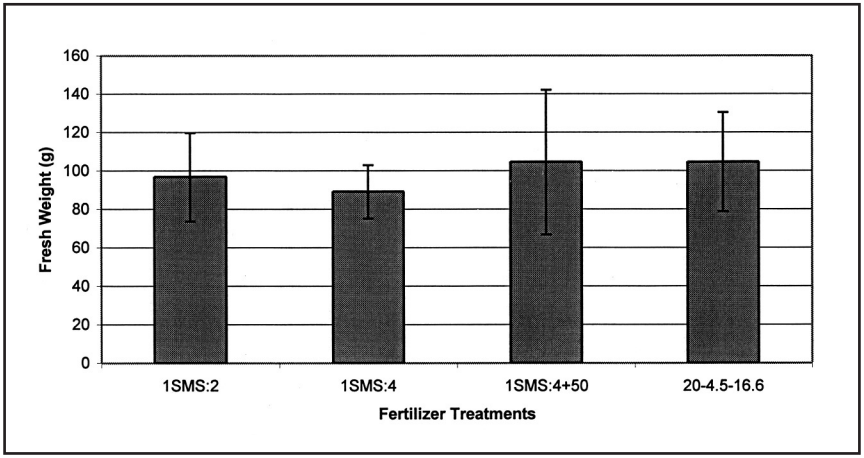

Figure 3. *Pelargonium* 'Pinto Red' growth in 1 SMS : 1 peat (v/v).

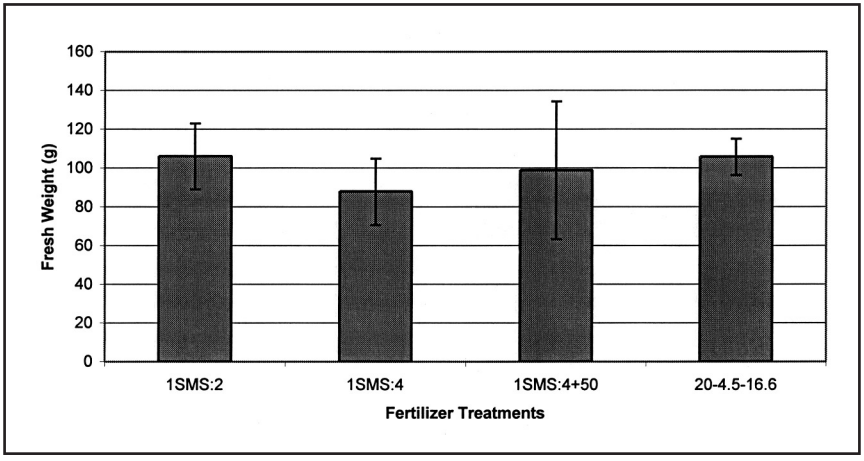

Figure 4. *Pelargonium* 'Pinto Red' growth in 1 SMS : 3 peat (v/v).

One-quarter of each crop was placed on one of four flood and drain benches. Each flood and drain bench was a separate fertilizer treatment. The treatments were:

1) SMS leachate and water (1:2, v/v). EC of solution was about 1.9 mmhos·cm^{-1}.
2) SMS leachate and water (1:4, v/v). EC of solution was about 1.4 mmhos·cm^{-1}.
3) SMS leachate and water (1:4, v/v) plus 50 mg·L^{-1} N from ammonium nitrate; EC was about 1.6 mmhos·cm^{-1}.
4) Commercial Fertilizer Program 20-4.5-16.6 (NPK), 200 mg·Liter^{-1} N; EC was about 1.8 mmhos·cm^{-1}.

Table 1. Macronutrient content in percent of Pinto Red geraniums grown in two growing mixes fertilized with four fertilizer programs.

Fertilizer	Mix	N	P	K	Ca	Mg
1 SMS : 2	25/75	3.10	0.54	3.16	1.10	0.29
1 SMS : 2	50/50	3.09	0.45	3.39	1.22	0.31
1 SMS : 4	25/75	3.21	0.56	2.86	1.25	0.30
1 SMS : 4	50/50	3.24	0.48	2.83	1.26	0.30
1 SMS : 4+50	25/75	3.63	0.55	3.09	1.40	0.32
1 SMS : 4+50	50/50	3.19	0.52	2.58	1.39	0.31
20-4.5-16.6	25/75	4.01	0.61	3.47	1.82	0.30
20-4.5-16.6	50/50	3.45	0.45	2.63	1.56	0.27

Because of the mixture of crops on each bench it was necessary to irrigated daily by subirrigation. At about weekly intervals the EC and pH of the solution was checked and recorded and the water level brought up to volume by adding tap water if the EC is high or SMS leachate and/or fertilizer if the EC was below the set point.

SUMMARY

- Nitrate leaches readily from SMS, but additional nitrate was leached over the next 6 weeks (Fig. 1).
- Potassium leaches readily from SMS and little additional potassium is released over 6 weeks (Fig. 2).
- Fresh weight of geraniums grown in a 50% SMS medium was similar to the growth in a 25% SMS medium. SMS leachate at 1 to 2 or 1 to 4 produced similar amounts of geranium growth as a commercial fertilizer (Figs. 3 and 4).
- Macronutrient analysis of geranium leaves demonstrated that all fertilizer treatments provided adequate macronutrients for geranium growth (Table 1).

CONCLUSION

Leachate from SMS when diluted at 1 to 2 or 1 to 4 with tap water promoted growth of geraniums that was similar to that promoted by a commercial fertilizer.

LITERATURE CITED

Bilderback, T.E., W.C. Fonteno, and **D.R. Johnson.** 1982. Physical properties of media composed of peanut shells, pine bark, and peat moss and their effects on azalea growth. J. Amer. Soc Hort. Sci. 107:522-525.

Young, J.R., E.J. Holcomb, and **C.W. Heuser.** 2002. Greenhouse growth of marigolds in three leached sources of spent mushroom compost over a 3- year period. HortTechnology 12(4):701-705.