Gasified Rice Hull Biochar is a Source of Phosphorus and Potassium for Container-Grown Plants

In the greenhouse and floriculture industry the increasing cost of fertilizer has created a need for alternative nutrient sources and better use efficiency. Biochar is one such source that provides ample nutrients and other useful physical and biological benefits when incorporated in potting media. The objective of this research was to determine the potential nutritional value of gasified rice hull biochar (GRHB) when amended to a typical greenhouse substrate.

Two experiments were conducted in the greenhouse using geranium (*Pelargonium xhortorum* 'Maverick Red') potted in commercial soilless medium (Sunshine Mix #2) and amended with 0 to 10% GRHB. Control pots were fertilized with a commercial complete liquid fertilizer (20N-4.4P-16.6K) while GRHB-amended crops were fertilized with ammonium nitrate (AN). Additional GRHB substrates were amended with either 1.5 lb/yd^3 micronutrient package (Micromax).

Our data show that GRHB amendment rates up to 10% (by volume) have little or no effect on substrate pH. Amendment with GRHB increased available phosphate and potassium in substrate leachates compared to the commercially fertilized controls (Table 1). Gasified rice hull biochar provided sufficient phosphorus (P) and potassium (K) to the substrate to grow a geranium crop for six weeks without any additional P or K fertilizers (Table 2). It was necessary to provide a micronutrient fertilizer source in addition to the GRHB to avoid chlorosis in geranium foliage as substrates amended with GRHB alone were chlorotic and smaller in growth.

It was concluded that GRHB provides a source of readily available P and K to support a six week production cycle of geranium, but lacks the correct concentration or balance of micronutrients for healthy growth. Gasified rice hull biochar could be an important source of P and K for greenhouse and nursery container crops in the future.

Table 1. Substrate pH, electrical conductivity, and nitrate, phosphate, and potassium concentration in leachates of containers with a commercial substrate (Sunshine Mix #2) amended with either 0, 5 or 10% gasified rice hull biochar (GRHB) and fertilized with a commercial complete fertilizer (20N-4.4P-16.6K), ammonium nitrate (AN), and/or a commercial micronutrient fertilizer (MM).

		Substrate pH		Electrical cond.		Nitrate (mg·L^{-1})		Phosphate (mg·L^{-1})		Potassium (mg·L^{-1})	
GRHB rate (%)	Fertilizer	3 WAP[z]	6 WAP	3 WAP	6 WAP	3 WAP	6 WAP	3 WAP	6 WAP	3 WAP	6 WAP
0	20N-4.4P-16.6K	7.07	6.97	1.32	1.75	54.7	4.4	4.7	3.7	7.2	1.4
5	AN	6.52	6.57	2.61	3.26	133.6	286.7	156.7	136.0	119.8	68.0
	AN+MM	6.47	6.59	2.99	2.23	45.2	29.2	72.7	17.3	100.6	8.5
10	AN	6.74	6.63	3.19	3.73	180.2	275.3	228.9	214.9	266.8	124.8
	AN+MM	6.64	6.58	3.16	2.51	46.8	18.9	121.3	42.5	246.3	13.2

Table 2. Foliar nutrition of geranium (*Pelargonium xhortorum* 'Maverick Red') grown in a commercial substrate (Sunshine Mix #2) amended with either 0, 5% or 10% gasified rice hull biochar (GRHB) and fertilized with a commercial complete fertilizer (20N-4.4P-16.6K), ammonium nitrate (AN), and/or a commercial micronutrient fertilizer (MM).

WAP[z]	GRHB rate (%)	Fertilizer	N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
3	0	20N-4.4P-16.6K	3.49	0.41	2.85	1.11	0.85	0.24	27.61	2.75	80.98	114.98	54.84
	5	AN	3.22	0.63	4.14	1.13	0.80	0.26	36.53	2.09	61.21	345.16	74.86
		AN+MM	3.43	0.58	4.10	1.09	0.67	0.25	43.64	10.91	67.87	499.68	102.03
	10	AN	2.91	0.59	4.69	1.06	0.77	0.25	34.48	1.89	74.30	418.56	70.94
		AN+MM	3.19	0.59	4.55	1.04	0.70	0.26	41.66	6.38	98.23	481.26	95.07
6	0	20N-4.4P-16.6K	1.96	0.22	1.68	0.97	0.68	0.16	16.22	2.81	39.45	83.61	34.30
	5	AN	2.72	0.73	3.68	1.38	0.84	0.23	27.80	1.90	24.42	341.93	85.21
		AN+MM	1.54	0.40	1.65	1.02	0.58	0.16	24.09	5.08	24.19	374.01	69.53
	10	AN	2.41	0.62	4.38	1.28	0.81	0.20	26.48	2.11	16.09	435.37	91.55
		AN+MM	1.67	0.55	2.98	1.12	0.61	0.17	26.97	6.51	14.65	480.67	81.22

For more information, contact: James Altland, james.altland@ars.usda.gov, USDA-ARS- ATRU, 27 Horticultural Insects Research Laboratory, 1680 Madison Avenue, Wooster, OH 44691

For more information, contact: Jim Locke, jim.locke@ars.usda.gov, USDA ARS-ATRU, University of Toledo, Mail Stop 604, 2801 W. Bancroft, Toledo, OH 43606

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