Comparisons of Exceptional Quality Biosolids Amendments as Disturbed Soil Amendments

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---Introduction--

Exceptional Quality biosolids products are increasingly being used as amendments in urban landscapes. EQ biosolids can be a valuable amendment for disturbed, urban soil by imparting beneficial effects that can improve soil physical and chemical properties and providing sources of nutrients for improving plant biomass.

---Objectives--

To assess newly developed EQ biosolids products developed from Blue Plains and Alexandria biosolids for use in urban landscapes using tall fescue and soybean as bioassay plants.

---Materials & Methods---

• The experimental design was **Randomized Complete Block Design**: 2 plants, 6 treatments, and 4 replications. (48 pots)

• **Two types of plants**: tall fescue (Rebels Southern Blend, with a seeding rate of 0.53g/ 6-inch pot) and soybean (seeding rate 5 seeds/ 6-inch pot). Soybeans were harvested before floral bud development to assess phytotoxicity and nutrient deficiency.

• **Six treatments**:

- 4 EQ biosolids amendments (400 cm^3 each) incorporated into 1,500g of Old Hickory topsoil (Orangeburg fine-loamy, kaolinitic, thermic Typic Kandiudults) medium. Treatments:
  - Alex 50 (50% Alexandria EQ biosolids+25% sawdust+25% sand)
  - BP 50 (50% Blue Plains EQ biosolids+25% sawdust+25% sand
  - BP 40 (40% Blue Plains EQ biosolids+40% sawdust+15% sand+5% mineral fines)
  - TAG 50 (50% Tagro EQ biosolids+25% sawdust+25% sand) – industry std.
  - TPM (Tagro potting medium) contains 20% Tagro EQ biosolids, 20% sawdust, and 60% aged bark – industry std.
  - Control – inorganic fertilizer
- All treatments applied to meet the agronomic N rate of tall fescue (150 kg N/ha).

• **Sampling and analysis**:

- Growth period: Soybean – 5 wks, tall fescue – 11 wks
- Plant parameters: above and below ground biomass, soybean ht, total nitrogen and plant N uptake.
- Soil: Total nitrogen, total carbon, inorganic nitrogen (NO_3^- and NH_4^+), Mehlich 1 extractable P, K, and pH.

---Results and Discussion--

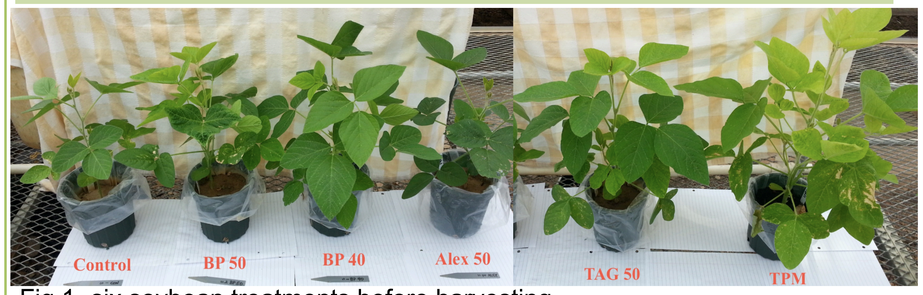

Fig 1- six soybean treatments before harvesting

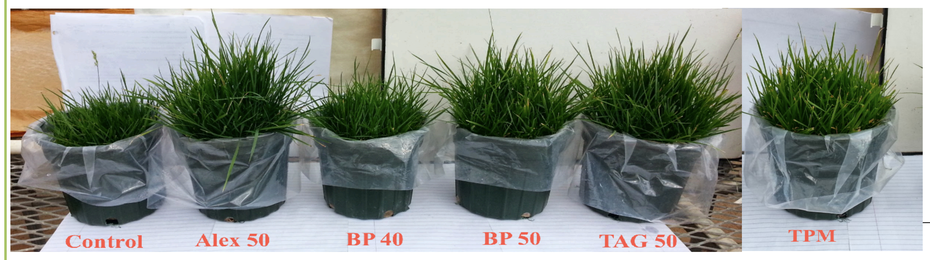

Fig 2- six soybean treatments before final cutting

Table 1- comparison of three different biosolids amendments

Biosolids amendments	Organic C, g kg^{-1}	TKN, g kg^{-1}	Organic N, g kg^{-1}	NH_4-N, g kg^{-1}	C/N ratio	Total P, g kg^{-1}
TAG 50	289	12.9	8.68	4.22	13.0	9.13
BP 50	242	14.1	10.7	3.38	9.97	9.12
Alex 50	244	14.1	9.07	5.03	10.0	11.2

Table 2- Soybean and tall fescue biomass and tall fescue root wt

Treatment	Soybean mean dry weight (g)	Soybean mean height (cm)	Tall fescue mean dry wt(g) 0-6 wks	Tall fescue mean dry wt(g) 0-11 wks	Tall fescue mean root dry wt(g)
TPM	12.5 a	42.8 a	3.13 a	5.71 ab	3.3
TAG 50	7.5 ab	39.0 a	2.85 ab	5.58 abc	3.4
BP 40	5.5 bc	31.3 b	2.35 abc	4.18 c	2.9
BP 50	5.2 bc	36.5 ab	3.03 a	5.99 ab	1.7
Alex 50	4.6 bc	38.0 ab	2.22 bc	6.55 a	2.6
Control	3.6 c	8.3 c	1.90 c	4.81 bc	1.8

• BP 50 and Alex 50 performed well compared to the similar well-established TAG 50 blend for soybeans and tall fescue.
• Alex 50-amended tall fescue dry weight increased compared to the other biosolids treatments after week 7. This was likely due to the delayed N release from the Alex 50.
• No phytotoxicity or nutrient deficiency were observed in any treatments.

Table 3- Soybean and tall fescue plant total nitrogen and total N uptake

Treatment	Total N in soybean (mg N/g plant)	Total N in tall fescue (mg N/g plant)	Tall fescue N uptake (TN x biomass)(mg N)
BP 40	35.45 b	37.4	156 c
TAG 50	26.13 b	35.7	201 abc
Control	35.54 b	37.0	178 bc
BP 50	31.75 b	39.77	237 ab
Alex 50	47.64 a	38.8	254 a
TPM	14.92 c	34.3	195 abc

• Alex 50 and BP 50 had higher N uptake in tall fescue compared to TAG 50; possibly due to the lower C/N ratio of Alex 50 and BP 50 that contributed to more mineralized N resulting in more N uptake.

Table 4- Soybean soil total C, P, K, and pH

Treatment	Total C in soil (mg C/g soil)	Total N in soil (mg N/g soil)	P in soil (mg P/ kg soil)	K in soil (mg K/kg soil)	pH
TAG 50	9.43 b	0.74 b	87 a	36 b	5.61 bc
Alex 50	10.35 ab	0.99 a	55 b	30 b	5.48 c
BP 40	11.76 a	0.90 ab	46 b	81 a	5.82 b
BP 50	9.40 b	0.82 ab	45 b	28 b	5.64 bc
Control	4.59 c	0.38 c	31 c	41 b	6.32 a

Table 5- Tall fescue soil total C, P, K, and pH

Treatment	Total C in soil (mg C/g soil)	Total N in soil (mg N/g soil)	P in soil (mg P/ kg soil)	K in soil (mg K/ kg soil)	pH
TAG 50	8.60 a	0.62 a	80 a	12 b	5.82 bc
Alex 50	7.25 ab	0.71 a	51 b	11 b	5.60 c
BP 40	8.34 a	0.67 a	41 b	59 a	6.10 ab
BP 50	6.48 b	0.54 a	38 c	11 b	5.59 c
Control	4.30 c	0.35 b	29 d	16 b	6.47 a

• Soil responses to treatments in soybean and tall fescue:
  • Total carbon was high in Alex 50 and BP 40 as in TAG 50
  • Alex and BP raised soil P less than TAG 50
  • BP 40 had highest K in soil, due to the addition of mineral fines
  • pH was depressed by all 4 biosolids treatments, likely due to NH_4^+ nitrification to NO_3^-.

---Conclusions---

• Alex 50 is the best amendment among all the other treatments, because it provided the highest long term N availability resulting in the highest biomass over time.
• The inclusion of mineral fines in the BP 40 supplements the low K in biosolids.
• Alex and BP amendments pose less P environmental risk than TAG 50 due to lower P:PAN ratio.