ALFALFA GROWTH ON ACID SOILS TREATED WITH GYPSUM AND A COAL COMBUSTION BY-PRODUCT

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Background. Many east Texas soils are acidic. One of the problems associated with acid soils is that below pH 5.5, aluminum is soluble and plant-available. Soluble aluminum is toxic to the roots of some plants. Roots of aluminum-sensitive plants will not grow into soil with high aluminum levels, thus limiting water and nutrient uptake, and ultimately plant productivity. Forage legumes are often intolerant of acid soils and the associated high aluminum levels. Alfalfa is a high nutritive-value forage legume that is sensitive to low soil pH. Alfalfa could provide an alternative for producers seeking a high crude protein, high digestible energy forage to incorporate into their system. However, because of its low tolerance for aluminum, acid soils, particularly subsoils, limit the potential usefulness of alfalfa in east Texas. Although lime applications are effective for raising surface-soil pH, there is little immediate benefit to the subsoil. Gypsum (calcium sulfate) has been shown to be effective in reducing the toxic effects of high subsoil aluminum. A by-product that consists of gypsum and calcium sulfite is often produced when electric generating facilities clean the flue gasses that are released when coal or lignite are burned. Field experiments were established in 1999 at two locations to evaluate the effectiveness of surface-applied gypsum and flue gas scrubber sludge obtained from the Martin Creek power plant for reducing the toxic effects of acid subsoils on alfalfa. One field site was on the Stephen F. Austin State University Walter Todd Beef Farm on a Sacul fine sandy loam soil. The other site was on the Texas Agricultural Experiment Station research farm at Overton on a Cuthbert fine sandy loam. Both sites had high aluminum subsoils. Soils were limed in the spring. The materials were applied at rates of 0, 2.2, 4.5, and 6.7 tons/acre with each treatment replicated four times. Alfalfa was planted in the fall of 1999. Soil fertility was maintained to support alfalfa production, and the crop was harvested during the following three seasons.

Research Findings. Alfalfa yields were low during all three years, and were not significantly affected by the calcium sulfate and scrubber sludge treatments (Table 1). Yields decreased by year three, particularly at Overton. Although increased levels of calcium and sulfur were detected in the subsoils at each location, amendments were not effective in reducing toxic subsoil aluminum levels on these soils.

Application. Sites with subsoil pH below 5.0 and with very high levels of soluble aluminum are not suitable for alfalfa. The excessive aluminum levels could not effectively be reduced by gypsum or by-product gypsum on these Sacul and Cuthbert soils in three years.

Table 1. Influence of gypsum and scrubber sludge on alfalfa dry matter yield at the SFA Todd Beef Farm in Nacogdoches Co., and the Texas Agricultural Experiment Station at Overton.

Location	*Year*	*Treatment*[†]	*Harvest 1*	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Total*[‡]
			lb/ac				
Beef Farm, Sacul soil	2000	Check	1297	2317	2220	—	5834
		Gypsum L	1230	2075	2191	—	5497
		Gypsum M	1355	2048	2123	—	5527
		Gypsum H	1168	1711	1969	—	4848
		Sludge L	1202	1976	2137	—	5314
		Sludge M	880	1911	1895	—	4686
		Sludge H	1455	2144	2090	—	5690
	2001	Check	2158	1124	911	588	4782
		Gypsum L	1819	1281	617	511	4228
		Gypsum M	1716	1013	736	528	3992
		Gypsum H	1864	1532	559	528	4483
		Sludge L	1760	1117	939	500	4316
		Sludge M	1880	1221	602	413	4116
		Sludge H	1857	1084	686	568	4195
	2002	Check	2131	1375	—	—	3506
		Gypsum L	1985	1310	—	—	3294
		Gypsum M	2212	1455	—	—	3666
		Gypsum H	2353	1319	—	—	3672
		Sludge L	2047	1472	—	—	3518
		Sludge M	2074	1528	—	—	3602
		Sludge H	2331	1281	—	—	3612
TAES-Overton, Cuthbert soil	2000	Check	1509	1857	994	—	4360
		Gypsum L	1959	2060	1356	—	5375
		Gypsum M	1361	1516	898	—	3775
		Gypsum H	1296	1346	952	—	3594
		Sludge L	1116	1466	1190	—	3772
		Sludge M	828	1068	848	—	2744
		Sludge H	1443	1503	1267	—	4213
	2001	Check	1976	663	2292	1306	6237
		Gypsum L	2093	887	2307	1254	6540
		Gypsum M	1456	1006	1684	1154	5301
		Gypsum H	1488	925	1713	1251	5377
		Sludge L	1611	698	1720	1064	5093
		Sludge M	1704	355	1358	930	4347
		Sludge H	1493	898	1294	1098	4782
	2002	Check	952	1194	—	—	2146
		Gypsum L	911	1131	—	—	2042
		Gypsum M	864	997	—	—	1861
		Gypsum H	664	1056	—	—	1720
		Sludge L	785	816	—	—	1601
		Sludge M	612	695	—	—	1307
		Sludge H	705	728	—	—	1433

[†] Treatment levels: L = 2.2 tons/ac, M = 4.5 tons/ac, H = 6.7 tons/ac.

[‡] Means within a location and harvest, and season total were not different at the 0.05 significance level.