The Value and Benefits of Lime

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American Crystal Sugar Company has a readily accessible supply of lime available at each factory.

The benefits of lime application include long term control of Aphanomyces, addition of phosphorus and other nutrients and no negative impact on rotational crops.

Spent lime is a by-product of the beet sugar purification process. It is generated by heating mined calcium carbonate limestone to form calcium oxide and carbon dioxide. These two products are injected into the thick juice during sugar beet processing and they reform as calcium carbonate. When the calcium carbonate reforms it captures and adsorbs many of the impurities in the juice and precipitates out from the juice. The precipitate forms a solid lime product that needs to be discarded, leaving behind the thin juice from which sugar is extracted. The five American Crystal Sugar Company beet processing factories in North Dakota and Minnesota produce approximately 350,000 tons (dry weight basis) of spent lime annually.

The value of liming acidic soils to raise the pH to 7.0 or above has been practiced for many decades. Use of sugarbeet factory spent lime can provide several other benefits for crop production. Benefits of lime use include 1) raising soil pH; 2) application of substantial quantities of P, K and other soil micro-nutrients; and 3) reducing impact of Aphanomyces root rot.

Lime application recommendations

- Apply 10-15 wet tons per acre
- Apply 1 year before sugarbeets
- Spread as evenly as possible
- Incorporate thoroughly with tillage
- Contact your Agriculturist for assistance with plans for lime applications.

Lime and Aphanomyces control

Aphanomyces root rot has caused very major losses of yield at many locations in Minnesota and North Dakota for well over 20 years. Dr. Carol Windels, University of Minnesota, NWROC began evaluating applications of lime to reduce stand loss and root rot rating and increase yields about 20 years ago. Research indicated liming will increase yield, sugar percent, RST, RSA, and revenue per acre. Benefits of liming at an application rate of 10 ton/acre or more have been shown to last for 5 to 10 years.

Tolerant Variety **No Lime** Susceptible Variety

Tolerant Variety **5 Tons Lime** Susceptible Variety

Tolerant Variety **10 Tons Lime** Susceptible Variety

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Table 1 shows an increase in Revenue per Acre with the application of spent lime 37 months prior to the planting of sugarbeets.

Table 1. Soil pH, stands, root rot ratings and harvest data for a tolerant variety planted May 17, 2007 (37 months after liming) in a field with severe Aphanomyces, (RRI of 98) UM-NWROC, C. Windels.

Lime Rate Wet T/A	Lime Rate Dry T/A	pH	% Stand Loss 35 DAP	Stand Plants/100' Post Thinning	RRR (0-7)	RST Lb	RSA Lb	REV/A $
0	0	6.4	69	140	3.8	255	4021	353
5	2.7	7.3	61	139	3.2	261	5021	447
10	5.3	7.5	54	145	3.0	270	5793	542
15	8.0	7.7	57	149	2.9	263	5361	486
20	10.6	7.6	55	160	2.7	271	6083	576

What fertilizer value does spent lime have?

The most important nutrient is P. Each ton of applied lime will raise the soil test P level about 1 ppm, Table 3. Table 2 shows the fertilizer value of one ton of lime. Ten tons of lime has a P fertilizer value of over **$100**.

Total benefit from yield increase from 10 ton/A lime and fertilizer value would be nearly $400, Table 1 & 2.

Table 2. Average nutrient content of spent lime - A. Sims, UM NWROC, 2005

Nutrient	Lbs/Dry Ton	$ Value
P_2O_5 equiv.	20.0	$15.00
K_20 equiv.	3.5	$ 1.75
Total		$16.75

11-52-0 @ $825 ($P_2O_5$) 0-0-60 @ $750 ($K_2O$)

Lime applied October 2003 to a Fargo silty clay soil

Olsen soil test P and Ca significantly increased. Soil pH, Mg and EC also increased, but not to any degree that would negatively influence crop yields. Lime application rate had no effect on NO3-N, K or Na. Liming will seldom increase soil pH above 8.2 regardless of application rate.

Table 3. Various chemical properties (soil test analysis analyzed on soils collected in May 2005) from the Hillsboro Spent Lime Trial.

Lime Wet Tons A^{-1}	Olsen P ppm	pH	EC dS M^{-1}	Ca ppm	Mg ppm
0-3 Inch Soil Depth					
0	19.5	7.42	0.67	3357	1038
5	24.1	7.66	0.71	4118	1097
10	31.5	7.74	0.69	4643	1185
20	41.7	7.75	0.73	5210	1280
30	56.6	7.78	.076	5332	1402

Impact of lime rate on crop yields

Research at NDSU and the University of Minnesota has evaluated the effect of liming on sugarbeets and other crops in the sugarbeet rotation. Crops evaluated have been wheat, soybeans and dry edible beans. Tables 4 and 5 show no adverse effects on wheat or soybean yields with varying amounts of spent lime applied.

Table 4. Effect of lime on wheat following sugarbeet in 2004 and following soybean in 2005, two year average, UM-NWROC.

Lime Rate Dry Tons	Yield (bu)	Test Wt. (lbs)	Protein (%)
0	71.5	58.6	13.0
5	73.0	58.2	13.3
10	71.3	58.3	13.1
15	73.0	58.4	13.0
Stat Sign	NS	NS	NS

Table 5. 2005 Soybean yield, oil and protein following sugarbeet at different spent lime rates applied in 2004. Trial shows lime applications had no effect on soybean yields, UM-NWROC.

Variety	Lime Treatment (TDM/A)	Yield (bu/A)	Oil (%)	Protein (%)
Garst 0211RR Chlorosis Susceptible Variety	0	41.5	20.0	29.6
	5.0	45.4	19.5	31.4
	10.0	42.1	20.1	29.7
	15.0	42.6	19.5	31.1
Gold Country 923RR	0	42.9	19.8	30.5
	5.0	45.7	19.1	32.2
	10.0	43.8	19.8	30.4
	15.0	45.3	19.2	32.1