

Sugarbeet Processing Precipitated Calcium Carbonate Lime Effects on a Crop Rotation and Soil Properties: Sites 2 and 3.

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Introduction and Objective

Each year in Idaho and Oregon, 351,000 Mg of precipitated calcium carbonate (PCC) (a byproduct of sucrose extraction from sugarbeet) is produced and stockpiled at sugarbeet processing factories. Currently there are limited disposal strategies for the PCC and these stockpiles continue to grow over time. The simplest solution would be to apply the PCC directly to agricultural fields each year, however the effects of PCC on high pH soils and crop rotations in the growing area are not well understood and growers are understandably hesitant. The data from Site 1 (CB1) was published in 2024. This poster focuses on CB2 and CB3 data. The objective of this study is to determine if there were negative effects of PCC sugarbeet, dry bean and barley yields.

Materials and Methods

- Sugarbeet-dry bean-barley rotation (2 rotation cycles) (Figure 1).
- Crop Blocks (CB) rotations were started in subsequent years account for temporal variability. Other than starting year, all other methods were the same for each CB (Figure 1).
- Treatments: 3 tons/acre (4 years), 10 tons/acre (4 years), 40 tons/acre (1 year).
- Experimental design: randomized block with four replications.
- Soil samples were taken each year in the fall a depth of 0-30 cm in each plot.
- Studies were furrow irrigated to match crop ET requirements.
- Crop yields and quality were determined.

CB1	CB2	CB3
Crop Plan:	Crop Plan:	Crop Plan:
2015 – Sugarbeet	2016 – Sugarbeet	2017 – Sugarbeet
2016 – Dry Beans	2017 – Dry Beans	2018 – Dry Beans
2017 – Barley	2018 – Barley	2019 – Barley
2018 – Sugarbeet	2019 – Sugarbeet	2020 – Sugarbeet
2019 – Dry Beans	2020 – Dry Beans	2021 – Dry Beans
2020 – Barley	2021 – Barley	2022 – Barley
Lime Plan (Fall):	Lime Plan (Fall):	Lime Plan (Fall):
2014 (3, 10, 40)	2015 (3, 10, 40)	2016 (3, 10, 40)
2015 (3, 10)	2016 (3, 10)	2017 (3, 10)
2016 (3, 10)	2017 (3, 10)	2018 (3, 10)
2017 (3, 10)	2018 (3, 10)	2019 (3, 10)
Final Rates – 2018:	Final Rates – 2019:	Final Rates – 2020:
3 – 12 tons/acre	3 – 12 tons/acre	3 – 12 tons/acre
10 – 40 tons/acre	10 – 40 tons/acre	10 – 40 tons/acre
40 – 40 tons/acre	40 – 40 tons/acre	40 – 40 tons/acre

Figure 1. Experimental design and details.

Conclusions

- PCC did not decrease sugarbeet, dry bean, or barley yields.
- PCC did not negatively affect sugarbeet quality measurements.
- PCC contains significant plant available P (30 lbs P₂O₅/ton).
- PCC across growing areas and time contains a relatively stable concentration of P.
- CB1 data published: Tarkalson, D.D., Bjorneberg, D.L., Neher, O.T., Olsen, D., and Dean, G. Effects of sugar beet processing precipitated calcium carbonate on crop production and soil properties. Journal of Sugar Beet Research. 61:35-50, 2024.

Results

Table 2. Selected average chemical characteristics and constituent contents of the PCC used in this study.

	PCC	Study Soil
CCE (%)	75	--
pH	8.4	8.0
EC (µS/cm)	2280	709
NO ₃ -N (mg/kg)	183.8	--
NH ₄ -N (mg/kg)	8.5	--
N (mg/kg)	2986	990
C (mg/kg)	117109	31820
P (mg/kg)	6559	1025
K (mg/kg)	1008	3561
Ca (mg/kg)	289069	61290
Na (mg/kg)	453.2	266
Al (mg/kg)	3636	18217
Cu (mg/kg)	16.3	12.9
Zn (mg/kg)	36.2	159
Cd (mg/kg)	0.40	0.60
Pb (mg/kg)	0.92	11.8

Table 3. Total rates of selected constituents applied from the PCC treatments. Rates are based on total lime applied for each treatment: 12, 40, and 40 tons/acre for the 3, 10, 40 treatments, respectively.

Constituent	Total lbs/acre		
	3 (12 tons/acre)	10 (40 tons/acre)	40 (40 tons/acre)
NO ₃ -N	4.4	14.7	14.7
NH ₄ -N	0.21	0.68	0.68
N	54	239	239
C	2113	9379	9379
P ₂ O ₅	361	1203	1203
K ₂ O	29	96	96
Ca	6943	23152	23152
Na	11	36	36
Al	88	291	291
Cu	0.4	1.3	1.3
Zn	0.9	2.9	2.9
Cd	0.010	0.032	0.032
Pb	0.022	0.074	0.074

- PCC applications did not change concentrations in the soil of listed constituents (Table 1 and Table 2).

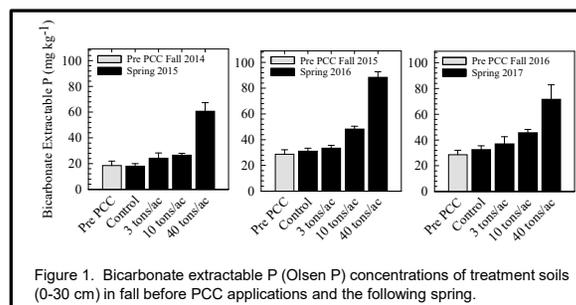


Figure 1. Bicarbonate extractable P (Olsen P) concentrations of treatment soils (0-30 cm) in fall before PCC applications and the following spring.

Table 3. PCC nutrient content from past studies and this study

Study	Location	Year	PCC Nutrient Content (lbs/ton)		
			P ₂ O ₅	K ₂ O	Zn
Twin Falls, ID ASCO Facility (used in CB2 and CB3)	Idaho	2016	30	2.4	0.07
Paul, ID ASCO Facility	Idaho	2022	25	4.0	0.05
Sallsbery and Hills, 1987	California	1976	24	---	---
Sims et al., 2010	Minnesota	2005	24	2.5	---
Sims et al., 2010	North Dakota	2005	22	3.8	---
Hergert et al., 2017	Nebraska	2012	21	2.7	0.09
Hergert et al., 2017	Wyoming	2012	24	4.5	0.09
Hergert et al., 2017	Colorado	2012	21	4.6	0.09

Table 4. Did PCC treatments affect crop production factors compared to no PCC? Means across all treatments are presented in parentheses.

	CB2		CB3	
	2016	2019	2017	2020
Sugarbeet Root Yield (tons/acre)	No (27.8)	No (31.5)	No (23.5)	No (33.1)
Sugarbeet ERS Yield (lbs/acre)	No (7382)	No (9237)	No (5946)	No (10549)
Sugarbeet Sugar Conc. (%)	No (16.0)	No (17.0)	No (14.9)	No (18.4)
Dry Bean Yield (dry lbs/acre)	2017 (3770)	2020 (2656)	2018 (3613)	2021 (2079)
Barley Grain Yield (dry lbs/acre)	2018 (5623)	2021 (4401)	2019 (4975)	2022 (4920)