NEW INDUSTRIAL GYPSUM BY-PRODUCT PROGRAM FOR LOUISIANA AGRICULTURE

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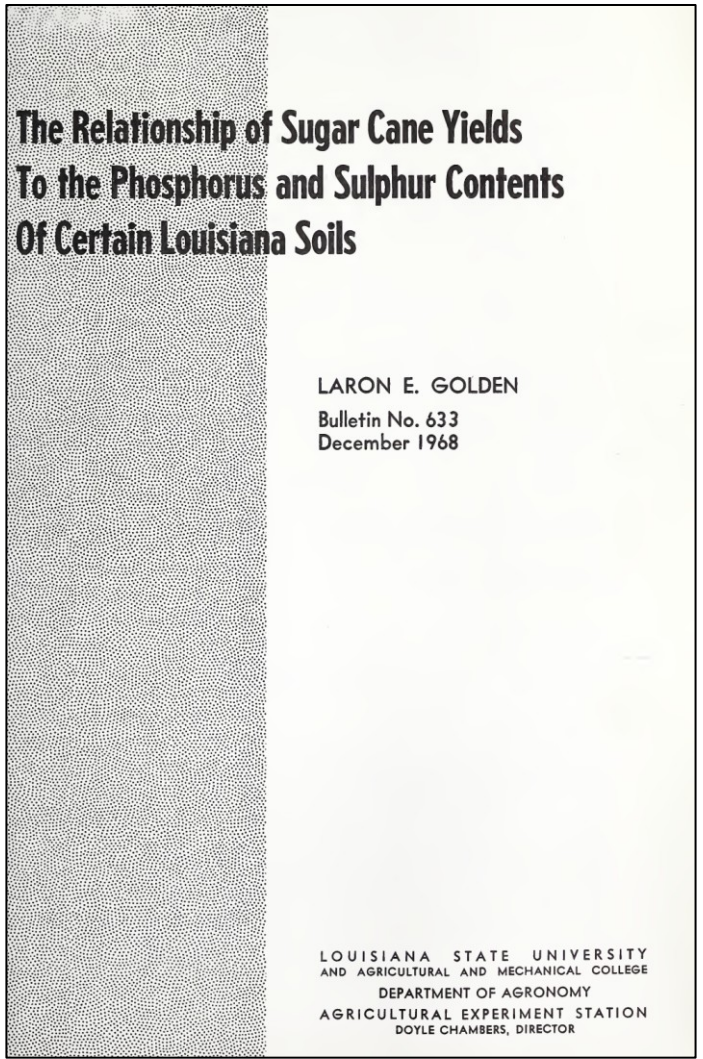
SOME PLANTS NEED SULPHUR
SOME PLANTS DO NOT NEED SULPHUR

SULPHUR REQUIREMENTS IN SUGARCANE


The Relationship of Sugar Cane Yields
To the Phosphorus and Sulphur Contents
Of Certain Louisiana Soils

LARON E. GOLDEN

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LOUISIANA STATE UNIVERSITY
AND AGRICULTURAL AND MECHANICAL COLLEGE
DEPARTMENT OF AGRONOMY
AGRICULTURAL EXPERIMENT STATION
DOYLE CHAMBERS, DIRECTOR

PHOSPHORUS REQUIREMENTS IN SUGARCANE

- Objective: Compare sugarcane yields obtained from check and normal superphosphate treatments. The response of interest was P.
- 50 fertilizer experiments were conducted at 29 locations during a 9-year period, 1958 – 1966.
- The normal superphosphate rate was 200 lbs. per acre (**0-40-0-24**).
- Normal superphosphate contains on average **20%** $\mathbf{P_2O_5}$ and **11.9% S**.

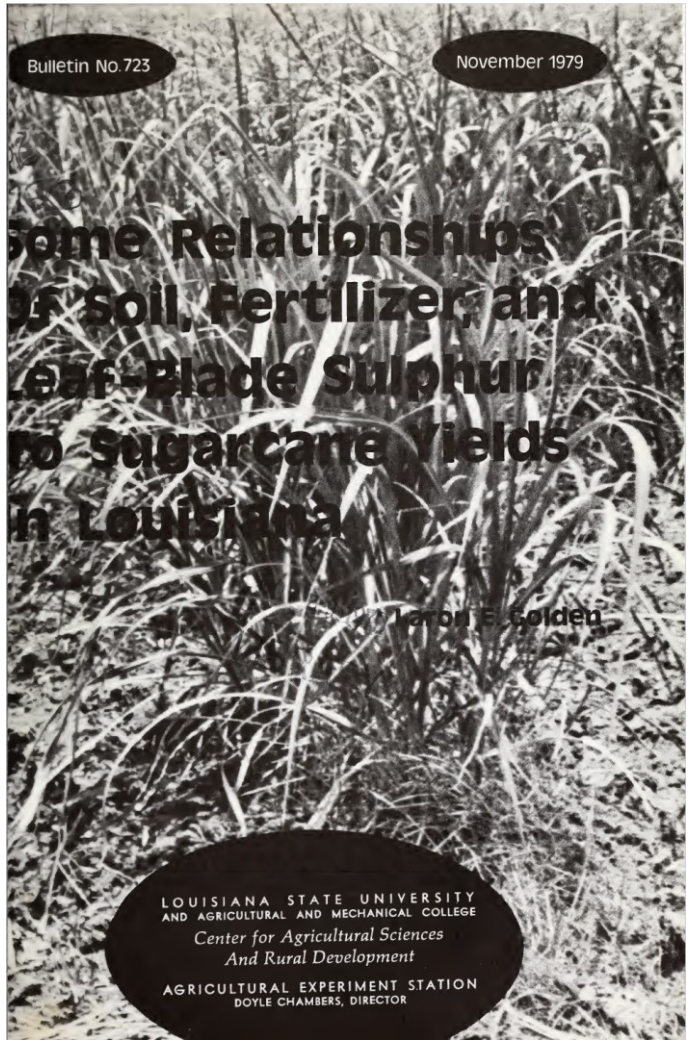
WE HAVE APPLIED BY-PRODUCT PHOSPHOGYPSUM IN THE PAST.

Normal superphosphate is made by reacting **ground phosphate rock** with **sulfuric acid**, producing a mixture of **monocalcium phosphate** (the plant-available form of phosphorus) and **calcium sulphate (gypsum)**.

Gypsum is removed from the reaction mixture using **solid–liquid filtration**. Wet-process phosphoric acid plants use large vacuum filters or belt filters to **separate gypsum solids from the acid liquor**.

PHOSPHORUS REQUIREMENTS IN SUGARCANE

- Cane yield response: plantcane < first stubble < second stubble
- Clay soil responded better than coarse texture soils
- The value derived from S in normal superphosphate had rarely been considered during fertilizer trials (1946 – 1966) because normal superphosphate was applied primarily as a source of P.
- Field experiments with fertilizer S were started in 1966 from sources independent of P.



SOME RELATIONSHIPS OF SOIL FERTILIZER AND LEAF BLADE SULPHUR TO SUGARCANE YIELDS IN LOUISIANA (1979)

SOME RELATIONSHIPS OF SOIL FERTILIZER AND LEAF BLADE SULPHUR TO SUGARCANE YIELDS IN LOUISIANA

- 38 field sites were evaluated using primarily stubble cane crops.
- Across the 38 sites, the average yield response to sulphur was **1.71** standard tons/acre.
- The average response for the 27 sites on medium-fine to fine-textured soils was **2.20** standard tons/acre.

- This work led to the first recommendation of S in sugarcane: **24 lbs./acre**

Byproduct gypsum at a phosphoric acid factory

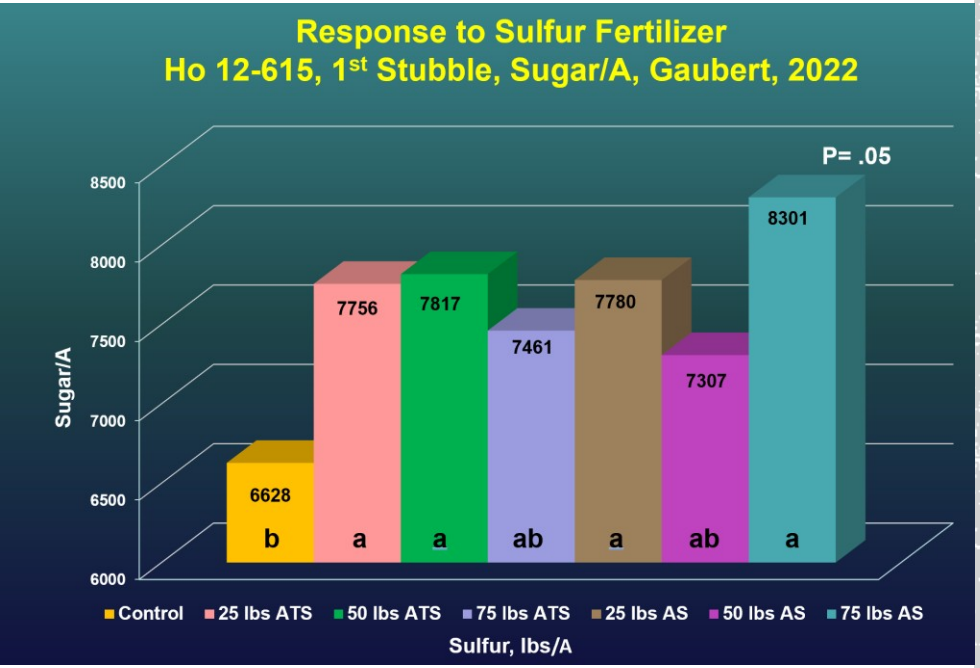
Louisiana has lots of byproduct gypsum

- **Donaldsonville**
- **Convent**
- **Geismar**

Fertilizer	Main Acid Used	P_2O_5 (%)	By-Product Notes
Normal Superphosphate	Sulfuric	~16–22%	Contains gypsum
Double Superphosphate	Mix acids	~32–38%	Lower gypsum
Triple Superphosphate	Phosphoric	~44–52%	No gypsum byproduct

BUT THERE ARE ISSUES

- **Phosphogypsum** contains naturally occurring radioactivity that originates from the phosphate rock used as raw material.
- The main source of radiation in this type of byproduct gypsum is **radium-226 (Ra-226)**, a decay product in the **uranium-238 series**.
- Phosphate rock naturally contains uranium-series radionuclides. During phosphoric acid production, these radionuclides partition unevenly, with **Ra-226 concentrating in the gypsum byproduct**.



RECENT WORK: SULPHUR RESPONSE OF SUGARCANE

Research done by Dr. Rich Johnson

SOME PLANTS NEED SULPHUR
SOME PLANTS DO NOT NEED SULPHUR

CLEANING UP EMISSIONS

COST MONEY

FLUE GAS GYPSUM

Flue gas gypsum is produced during **wet flue gas desulfurization** when power plants or industrial boilers remove **sulfur dioxide (SO_2)** from their exhaust.

The flue gas enters a scrubber and is sprayed with a slurry of **finely ground limestone ($CaCO_3$)** and water.

The SO_2 dissolves into the slurry and reacts with the limestone. Calcium sulfite is formed.

Air is blown into the bottom of the absorber. The oxygen oxidizes **calcium sulfite to calcium sulfate**.

The gypsum slurry is pumped to vacuum belt filters for dewatering.

A PROBLEM RUNS INTO A SOLUTION – HEALTHY PLANTS

WHAT IS THE NEW REGULATION? HOW DOES IT HELP?

- LA R.S. 3:1424. (B). Any agricultural producer or landowner that utilizes gypsum, and any supplier of gypsum to the agricultural producer, shall not be liable for any civil damages arising out of the utilization of the gypsum if all the following requirements are met:
  - C. The commissioner is authorized to promulgate rules and regulations in accordance with the Administrative Procedure Act to implement the provisions of this Section, including the establishment of analytical tolerances for gypsum.
  - (Acts 2025, No. 94, §1.)
- **Gypsum (LAC 7:XI.141 and 143)**

WHAT IS THE NEW REGULATION? HOW DOES IT HELP?

- Title 7 AGRICULTURE AND ANIMALS, Part XI. Fertilizers, Chapter 2. Gypsum
  - §141. Definitions
    - Flue Gas Desulfurization Gypsum—gypsum that is produced when sulfur-containing compounds are removed from exhaust gases during the combustion of fossil fuels.
    - Gypsum—calcium sulfate dihydrate.
    - Phosphogypsum—solid waste by-product which results from the process of phosphoric acid production.

WHAT IS THE NEW REGULATION? HOW DOES IT HELP?

- Title 7 AGRICULTURE AND ANIMALS, Part XI. Fertilizers, Chapter 2. Gypsum
  - §143. Gypsum; Requirements for Agricultural Use; Analytical Tolerances

  - A. To use by-product gypsum (phosphogypsum and flue gas desulfurization gypsum) in accordance with R.S. 3:1424, the following shall apply:

    - 1. The provider of the gypsum shall furnish chemical analysis documentation, from an accredited laboratory, for the product to the producer.

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- Title 7 AGRICULTURE AND ANIMALS, Part XI. Fertilizers, Chapter 2. Gypsum
  - §143. Gypsum; Requirements for Agricultural Use; Analytical Tolerances
  - A. To use by-product gypsum (phosphogypsum and flue gas desulfurization gypsum) in accordance with R.S. 3:1424, the following shall apply:

    - 2. The chemical analysis documentation shall include the calcium and sulfur content and content of elements listed in Table 1 of the most recent version of the NRCS Practice 333, Amending Soil Properties with Gypsum Products, Table 1
    - radium-226 concentration in the gypsum-containing product shall not exceed 10 picocuries per gram (pCi/g) and chloride content shall not exceed one-half of one percent (0.5 percent).

WHAT IS THE NEW REGULATION? HOW DOES IT HELP?

- Title 7 AGRICULTURE AND ANIMALS, Part XI. Fertilizers, Chapter 2. Gypsum
  - §143. Gypsum; Requirements for Agricultural Use; Analytical Tolerances.

  - B. The agricultural producer shall use gypsum only on his land or with written authorization from the landowner once the gypsum is analyzed and passes all analytical tolerances established by the department.

    - Mike Strain, DVM, Commissioner

AMENDING SOIL PROPERTIES WITH GYPSUM PRODUCTS - NRCS PRACTICE 333

- CONSERVATION PRACTICE STANDARD
- STATEMENT OF WORK
- IMPLEMENTATION REQUIREMENTS
- CONSERVATION PRACTICE OVERVIEW
- PRACTICE SPECIFICATION
- PRACTICE SPECIFICATION(A): SUM OF BASES & TEXTURE DERIVED CEC

NRCS CONSERVATION PRACTICE STANDARD AMENDING SOIL PROPERTIES WITH GYPSUM PRODUCTS - CODE 333 (AC)

- DEFINITION: Using gypsum (calcium sulfate dihydrate) products to change the physical and/or chemical properties of soil.
- PURPOSE: This practice is used to accomplish one or more of the following purposes:
  - Improve water infiltration.
  - Improve habitat for soil organisms.
  - Improve soil aggregate stability.
  - Reduce dissolved phosphorus in surface and ground water.
  - Reduce subsoil aluminum toxicity.

PRACTICE STANDARD CODE 333 (AC)

TABLE 1. SCREENING VALUES FOR ELEMENTS IN GYPSUM-CONTAINING PRODUCTS FOR USE AS A SOIL AMENDMENT

Symbol (element)	Units: gram (g), kilogram (kg), milligram (mg)	Screening Value for Gypsum-Containing Products	Comment
Ag (Silver)	mg kg^{-1}		No limit required
Al (Aluminum)	g kg^{-1}		No limit required
As (Arsenic)	mg kg^{-1}	13.1	
B† (Boron)	mg kg^{-1}	200.†	
Ba (Barium)	mg kg^{-1}	1000.	
Be (Beryllium)	mg kg^{-1}	2.5	
Ca (Calcium)	g kg^{-1}		Ca fertilizer; no limit required
Cd‡ (Cadmium)	mg kg^{-1}	1.0	
Co (Cobalt)	mg kg^{-1}	20.	
Cr(III) (Chromium)	mg kg^{-1}	100.	
Cu (Copper)	mg kg^{-1}	95.	
Fe (Iron)	g kg^{-1}		No limit required
Hg (Mercury)	mg kg^{-1}	2.5	
Mg (Magnesium)	g kg^{-1}		Mg fertilizer; no limit required
Mn (Manganese)	mg kg^{-1}	1500.	
Mo (Molybdenum)	mg kg^{-1}	10.	
Ni (Nickel)	mg kg^{-1}	100.	
Pb (Lead)	mg kg^{-1}	30.	
S* (Sulfur)	g kg^{-1}	220.	S fertilizer; *limit access to ruminants
Sb (Antimony)	mg kg^{-1}	1.5	
Se (Selenium)	mg kg^{-1}	50.	

PRACTICE STANDARD CODE 333 (AC)

TABLE 1. SCREENING VALUES FOR ELEMENTS IN GYPSUM-CONTAINING PRODUCTS FOR USE AS A SOIL AMENDMENT

Sn (Tin)	mg kg^{-1}		No limit required
Tl (Thallium)	mg kg^{-1}	1.0	
V (Vanadium)	mg kg^{-1}	136.	
Zn (Zinc)	mg kg^{-1}	125.	

Table 2a: Target ranges for base saturation of cations to improve soil chemical and physical properties.

Base Saturation	Balanced
Calcium	70–80%
Magnesium	10–13%
Potassium	2–5%
Hydrogen	1–10%

PRACTICE STANDARD CODE 333 (AC)

TABLE 1. SCREENING VALUES FOR ELEMENTS IN GYPSUM-CONTAINING PRODUCTS FOR USE AS A SOIL AMENDMENT

Table 2b: Gypsum application rates to improve soil chemical and physical properties.
Goal: Base saturation of calcium = 70 to 80 percent.

CEC	Annual Application Rate (ton gypsum/acre)
<5	0.25
5-10	.5
10–15	1
>15	2

PRACTICE STANDARD CODE 333 (AC)

PLANS & SPECIFICATIONS

Record the following specification components in an approved NRCS CPS Amending Soil Properties with Gypsum Products (Code 333) implementation requirements document:

- The source of the product (e.g., flue gas desulfurization or mined).
- Purpose(s) for its use and the planned outcomes.
- Chemical analysis of the amendment product.
- Soil analyses prior to application demonstrating the need for the amendment.
- Application methodology, including rates, timing, sequence of application with other nutrient materials (i.e., manures, biosolids, fertilizers), and mixing instructions when mixed with manure prior to field application

PROSPECTIVE IN-STATE GYPSUM SOURCES

Coal-Fired Power Plants

Louisiana Generating LLC - Big Cajun II Power Plant, New Roads, Pointe Coupee Parish

Entergy Louisiana LLC - Roy S. Nelson Electric Generating Plant, Westlake, Calcasieu Parish

CLECO Power LLC - Brame Energy Center, Lena, Rapides Parish

Carbon Black Plants

Cabot Corporation - Ville Platte Plant, Ville Platte, Evangeline Parish

Cabot Corporation - Canal Plant, Centerville, St. Mary Parish

Birla Carbon USA Inc. - North Bend Plant, Centerville, St. Mary Parish

Orion Engineered Carbons LLC - Ivanhoe Carbon Black Plant, Franklin, St. Mary Parish

Tokai Carbon CB Ltd - Addis Facility, Addis, West Baton Rouge Parish

RADIUM-226 CONCENTRATION TOLERANCES

Commissioner Strain request to EPA Sec. Zeldin

- 40 CFR 61.204-EPA regulation regarding outdoor ag use of gypsum
- Established max 10 pCi/g for distribution or agricultural use
- Brazil and other exporters allow a higher radium-226 thresh hold