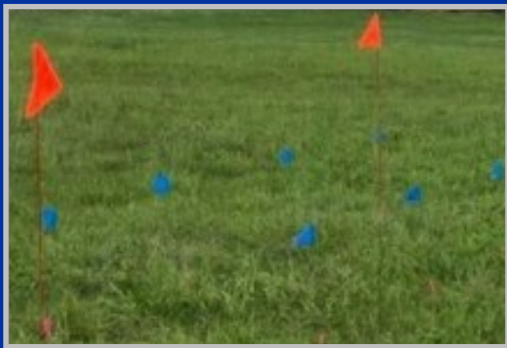

Corn & Soybean News

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COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT
Grain and Forage Center of Excellence
University of Kentucky

Calcium or Lime? Which Raises Soil pH? A Follow-up.

Earlier in the year we wrote a Corn & Soybean News article (*Calcium or Lime? Which Raises Soil pH?*) discussing the differences between calcium and lime and how they influence soil pH. A study stemmed from several agriculture extension agents and ag retailers receiving questions about a "liquid calcium" (Advanced-Cal, AgriTec International) product that claimed to adjust soil pH using a fraction of the ag lime rate. For example, claims were made that 2 to 4 gallons of Advanced-Cal per acre was more effective at adjusting soil pH than a ton or more of agricultural limestone per acre. The liquid calcium product is calcium chloride ($CaCl_2$) which has no liming ability (Equation 1).

Equation 1. $CaCl_2 + 2H^+ \rightarrow Ca^{2+} + 2H^+ + 2Cl^-$

To neutralize acidity, the proton (H^+) must be consumed/neutralized. The neutralization reaction, when calcitic limestone is used, is shown in Equation 2.

Equation 2. $CaCO_3 + 2H^+ \rightarrow H_2CO_3$ à $H_2O + CO_2 + Ca^{2+}$

The acidity, H^+, in Equation 1 remains after the addition of $CaCl_2$, but in Equation 2 the proton (H^+) is neutralized to form water by the carbonate present in the limestone. A liming product MUST contain carbonates (CO_3^{2-}), hydroxides (OH^-), or oxides (O^{2-}). Carbonate forms (agricultural limestones) are the most common source used in agricultural production. The calcium, magnesium or other ions associated with limestone have nothing to do with the neutralizing reaction.

Field and lab incubation studies were established concurrently in the summer of 2021 and ended approximately one year later. The field study was at 16 locations with 3 reps and the laboratory incubation study, with 4 reps, was done at the UKREC. The same treatments were used for both studies: an untreated check (nothing applied), liquid calcium at 5 gal/acre, pelletized lime (RNV 83), and agricultural lime (RNV 79). Both pelletized and ag lime were applied at 2 ton RNV 100 equivalent lime/acre, adjusting the rate for the product RNV. Field study soil samples field study were collected prior to treatment application, again approximately 3 months later and again approximately 12 months later. The incubation study used a Crider silt loam soil with an initial pH of 5.2. Soils were placed in 4-oz specimen cups with small holes in the cap to allow for gas exchange. Cups were maintained at 80% water filled pore space by weight until just before the 6-month sample date, when the building was destroyed by the tornado. Samples were recovered but cup moisture wasn't maintained for the 12-month samples. Destructive sampling occurred at 1, 3, 6 and 12 months. Results for the field study are reported as the average soil pH across locations and as the change in soil pH due to the sites having different initial soil pH levels. Results for the incubation study are reported as average pH across the reps. Data was analyzed using SAS version 9.4 (Cary, NC).

The chemistry associated with the neutralization reaction in equation 2 was confirmed by the field and laboratory studies (Table 1 and Table 2). Further, the lack of pH change in the liquid calcium and check treatments in these experiments is due to the lack of proton (acidity) neutralization, as indicated in Equation 1. The soil pH 3 months after treatment application had increased with both agricultural and pelletized limestone application, but not in the un-treated check and liquid calcium treatments. The lime materials increased soil pH by 0.30 to 0.43 pH units, while the check and liquid calcium amended soil pH decreased slightly during the first three months (Table 1). The lime materials had increased soil pH by 0.67 to 0.77 units approximately 12 months after treatment applications. The check and liquid calcium treated soils both exhibited slight increases in pH about one year after application, but this was not due to a treatment effect, but rather to an environmental effect. There can be seasonal variation in pH due to soil moisture levels, largely associated with soluble fertilizer salts remaining in the soil. The use of a salt solution to determine pH helps to reduce this variation but does not remove 100% of this variation. It is very apparent that liquid calcium was not effective in raising soil pH as compared to the lime materials. The full neutralization reaction of limestone takes between 2 to 3 years in field settings.

The laboratory incubation results support those found in the field experiment (Table 2). The lime materials increased soil pH after 1 month, relative to the check and liquid calcium treatments. These results were also observed at 3, 6 and 12 months of incubation. Soil moisture was maintained at approximately 80% pore filled volume until shortly before the 6-month sampling, an F4 tornado destroyed the building where the incubating samples were stored. The samples were recovered but their 80% pore filled volume status was not maintained for the rest of the experiment. The drier soil conditions in the 12-month samples could explain why the lime material treatments showed a slight pH decrease over that time period. This does coincide with field observations over the same time period.

Soil acidity is neutralized by the consumption of protons, not the addition of calcium. The results of this study support the chemistry in Equations 1 and 2. Liming acid soils should be based on products that contain carbonates, oxides or hydroxides, the associated RNV, and using an application rate based on soil pH and buffer pH - NOT the amount or form of calcium present in a product.

Table 1. Soil pH 0, 3 and 12 Months After Field Application. Data is averaged over 16 field sites.

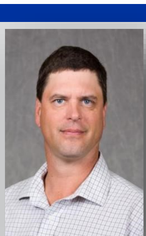
	----------------------Soil pH-----------------------			-----------Change in Soil pH----------	
Treatment	**Initial soil pH (<0.854)**	**Soil pH (3 m) (<0.001)**	**Soil pH (12 m) (<0.001)**	**Change in 3 m[2] (<0.001)**	**Change in 12 m[3] (<0.001)**
Check	5.76 a[1]	5.64 a	5.87 a	-0.10 a	0.11 a
Liquid Calcium	5.76 a	5.71 a	5.83 a	-0.02 a	0.08 a
Pelletized Lime	5.82 a	6.07 b	6.48 b	0.30 b	0.67 b
Ag Lime	5.76 a	6.16 b	6.51 b	0.43 b	0.77 b

[1] Different letters within a column indicate significant differences at the 0.01 probability level.
[2] Change after 3 months (soil pH at 3 month – initial soil pH)
[3] Change after 12 months (soil pH at 12 months – initial soil pH)

Table 2. Soil pH After 1, 3, 6 and 12 Months of Laboratory Incubation. Initial pH was 5.2.

	------------------------Incubation Time in months and (Pr>F) ------------------------			
Treatment	1 (<0.001)	3 (<0.001)	6 (<0.001)	12 (0.001)
Check	5.20 a[1]	5.05 b	4.99 a	5.10 a
Liquid Calcium	5.25 a	5.00 a	4.98 a	4.98 a
Pelletized Lime	5.93 b	6.30 d	6.45 b	6.26 b
Ag Lime	6.10 b	6.20 c	6.38 b	6.20 b

[1] Different letters within a column indicate significant differences at the 0.01 probability level.



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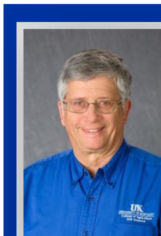

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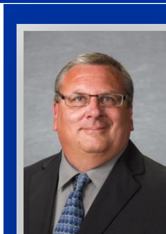

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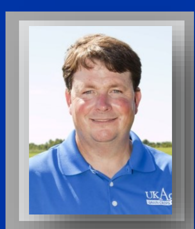
University of Kentucky Crop Pest Management Webinar Series continues

The University of Kentucky has once again organized webinars on field crop protection topics that will be hosted through the Southern Integrated Pest Management Center. The weekly webinars began Nov. 8 and feature University of Kentucky Extension Specialists speaking on topics ranging from Weed Science, Plant Pathology and Entomology.

Presented by University of Kentucky College of Agriculture, Food and Environment — Hosted by Southern IPM Center

Kentucky Pesticide Applicator and Certified Crop Advisor continuing education credits are available. Pre-registration for the webinars is required through the registration URL provided. Dates, speakers and registration links are listed below. All webinars will begin at 10 a.m. EST/ 9 a.m. CST, on the Tuesday morning listed. For more information contact Jason Travis, Agricultural Extension Associate for the University of Kentucky, at (859) 562-2569 or by email at jason.travis@uky.edu.

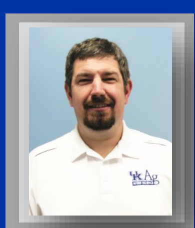


Date: November 15, 2022

Speaker: Dr. Carl Bradley

Title: Managing Important Soilborne Diseases of Soybean in Kentucky

Registration URL: https://zoom.us/webinar/register/WN_t6D6toO8Sh2BhyoD3iw1HQ



Date: November 22, 2022

Speaker: Dr. Travis Legleiter

Title: Implementing Defensive Shifts Against Problematic Kentucky Weeds

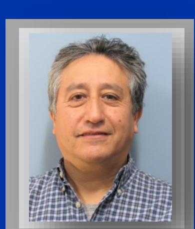
Registration URL: https://zoom.us/webinar/register/WN_QnugWPJJQUynBXDf4io9zg

Date: December 6, 2022

Speaker: Dr. Kiersten A. Wise

Title: Corn Disease Management Questions Asked in 2022

Registration URL: https://zoom.us/webinar/register/WN_KwibLTsHQY6oJjiKzURCEQ



Date: December 13, 2022

Speaker: Dr. Raul Villanueva

Title: Entomological Studies in Corn and Soybeans Under Difficult Circumstances (Covid, a Tornado and Drought in 2022)

Registration URL: https://zoom.us/webinar/register/WN_3KVwBMYKQYKnxzW1K-A0-g

Mark Your Calendar

01	05	23
MONTH	DAY	YEAR

UK Winter Wheat Meeting

9:00 am – 3:00 pm CT

James E Bruce Convention Center
303 Conference Center Dr.
Hopkinsville, KY 42240

COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT
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SAVE THE DATE

2023 Kentucky Crop Health Conference

Agricultural Pest Management Conference @ The National Corvette Museum

350 Corvette Dr. • Bowling Green, Ky. 42101

University of Kentucky
College of Agriculture, Food and Environment

February 9, 2023
9 a.m. to 5 p.m. CST

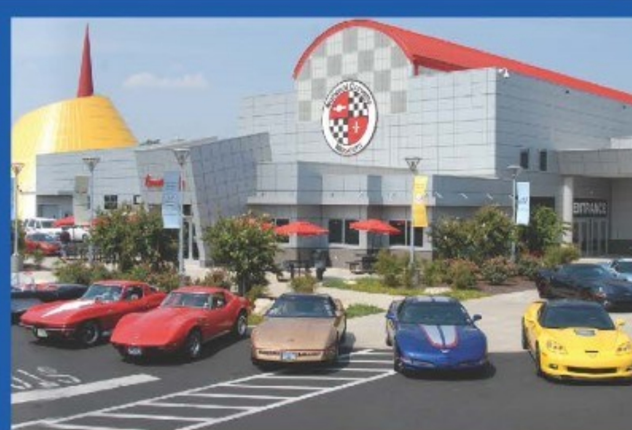
Registration is now open
Limited to 100 participants
https://KentuckyCropHealthConference2023.eventbrite.com

Scan to register

Lunch included
CCA, Kentucky pesticide applicator credits available

An in-depth and enhanced conference covering insect pests, plant pathogens, and weeds affecting Kentucky corn, soybean, and wheat acres. Presentations by University of Kentucky Extension Specialists and invited nationally prominent Extension Specialists from across the United States.

National Corvette Museum



Speed past the competition with the latest Crop Pest Management information!

UPCOMING EVENTS

Nov 15, 2022	UK 2022 Crop Pest Management Webinar Series Managing Important Soilborne Diseases of Soybean
Nov 22, 2022	UK 2022 Crop Pest Management Webinar Series Implementing Defensive Shifts Against Problematic Kentucky Weeds
Dec 6, 2022	UK 2022 Crop Pest Management Webinar Series Corn Disease Management Questions Asked in 2022
Dec 13, 2022	UK 2022 Crop Pest Management Webinar Series Entomological Studies in Corn & Soybeans Under Difficult Circumstances (Covid, a Tornado & Drought) in 2022
Jan 5, 2023	UK Winter Wheat Meeting
Jan 19, 2023	KY Commodity Conference - Bowling Green
Feb 23, 2023	KATS In-depth Mode of Action
March 9, 2023	KATS Soil Fertility and Assessment
March 9-11, 2023	National Commodity Classic - Orlando FL
May 09, 2023	UK Wheat Field Day
May 18, 2023	KATS Crop Scouting Clinic
June 7-8, 2023	KATS Drone Pilot Certification Prep Course
July 13, 2023	KATS Spray Clinic
Jul 25, 2023	UK Corn, Soybean and Tobacco Field Day