

Journal of the Arkansas Academy of Science

Volume 39

Article 27

1985

Lime Needs and Trends in Arkansas

Clifford S. Snyder

University of Arkansas, Fayetteville

Stanley L. Chapman

University of Arkansas, Fayetteville

Follow this and additional works at: <http://scholarworks.uark.edu/jaas>

 Part of the [Environmental Monitoring Commons](#)

Recommended Citation

Snyder, Clifford S. and Chapman, Stanley L. (1985) "Lime Needs and Trends in Arkansas," *Journal of the Arkansas Academy of Science*: Vol. 39, Article 27.

Available at: <http://scholarworks.uark.edu/jaas/vol39/iss1/27>

This article is available for use under the Creative Commons license: Attribution-NoDerivatives 4.0 International (CC BY-ND 4.0). Users are able to read, download, copy, print, distribute, search, link to the full texts of these articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author.

This Article is brought to you for free and open access by ScholarWorks@UARK. It has been accepted for inclusion in Journal of the Arkansas Academy of Science by an authorized editor of ScholarWorks@UARK. For more information, please contact scholar@uark.edu, ccmiddle@uark.edu.

LIME NEEDS AND TRENDS IN ARKANSAS

CLIFFORD S. SNYDER and STANLEY L. CHAPMAN
University of Arkansas
Cooperative Extension Service
Little Rock, AR 72203

ABSTRACT

Consumption of agricultural lime in Arkansas declined significantly during the past seven years. During each of the past four years, lime consumption was lower than any time since 1960. The quantity of lime needed for optimum crop production on Arkansas' soils is estimated to be 2,678,700 metric tons (MT) (3,000,000 tons), based on University of Arkansas soil testing summaries. Since 1980, less than 285,728 MT (320,000 tons) of lime have been used each year. It is the natural tendency for most soils in Arkansas to become more acidic with time. Periodic addition of agricultural limestone, however, can neutralize soil acidity and help to maintain soil productivity. Nitrogen fertilizers, applied for the production of most agricultural crops, may also contribute to the acidification of soils. The annual consumption of acid-forming nitrogen fertilizers in Arkansas increased from approximately 223,225 MT (250,000 tons) during fiscal year 1974-75 to about 392,876 MT (440,000 tons) by fiscal year 1983-84. At least 2.5 times more lime was needed than was used, just to neutralize the residual acidity from acid-forming nitrogen fertilizers alone, during the same period. Shifts in crop hectareages did not account for the magnitude of decline observed in lime consumption. If lime consumption does not increase in the future, and if acid-forming nitrogen fertilizer consumption follows the current increasing trend, soil acidity will cause a decline in the yields of acid-sensitive crops.

INTRODUCTION

Liming has been regarded for many years as an essential component of prosperous agriculture in the Southern United States (Adams and Pearson, 1967). It is the natural tendency for most soils in the southern U.S. and Arkansas to increase in acidity over time. Periodic additions of ground agricultural limestone can neutralize acidity near the surface (0 to 15 centimeters) of most soils. If allowed to go unchecked, soil acidity may build up to levels that cause crop yield reductions or failure.

Thompson and Sabbe, in 1969, estimated that 8.9 million metric tons (MT) (10 million tons) of lime would be needed to bring all of the acid soils in Arkansas to pH 6.5. Sabbe and others (1973) summarized the fertility status of Arkansas soils based on soil samples submitted to the University of Arkansas Soil Testing Laboratory between 1961 and 1964. They found that 72.9% of the soil samples submitted had a pH of 6.0 or below and required lime. The last report on lime needs in Arkansas was by Chapman (1976).

The objectives of the work presented here were: (1) to update the knowledge regarding soil acidity and lime needs in Arkansas; (2) to attempt to determine what factors have most likely influenced past trends; and (3) to examine the potential impact current lime trends may have on future agricultural productivity.

METHODS AND MATERIALS

Data from the Arkansas Crop and Livestock Reporting Service (1981a, 1981b, 1982, 1983, 1984) were used to determine the hectareages planted in the following crops between fiscal years 1969-1970 and 1983-1984: corn, cotton, rice, sorghum, soybeans, oats, and wheat. Lime consumption and acid-forming nitrogen fertilizer (Andrews, 1954) usage data were derived from annual Arkansas State Plant Board summaries for the fiscal years mentioned previously. Numbers of lime vendors and lime producers were determined from unpublished reports by the Arkansas State Plant Board for fiscal years (FY) 1974-1975 and 1983-1984. Lime needs were based on soil testing summaries for the state, compiled by the University of Arkansas. Current lime needs were estimated using the following procedure. The percentage of the sampled (soil samples submitted to University of Arkansas in 1983) hectareage with pH values less than 5.8 was calculated. This factor was then multiplied by the total hectareage in each county used for crops and pastures, with \$1,000 or more of agricultural products sold annually. The resulting

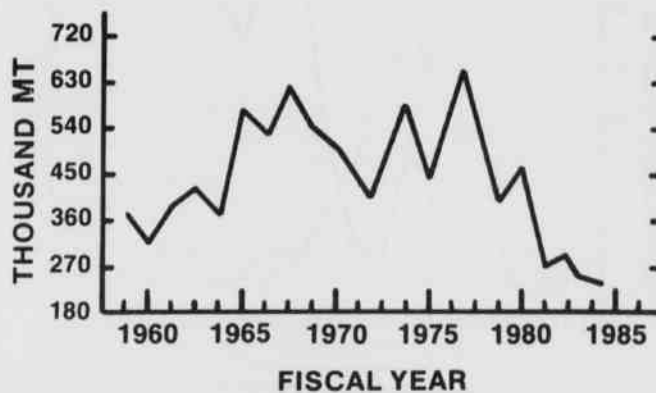


Figure 1. History of lime use in Arkansas since 1959. Data from State Plant Board summaries.

total hectareage with a pH value of 5.8 or less was then multiplied by a conservative lime application of 0.8929 MT per hectare (one ton per acre). This yielded a conservative estimate of the total tons of lime needed on Arkansas soils for maximum crop yields. This quantity of lime would also help to improve and/or maintain soil fertility levels.

Recent trends in crop hectareages, acid-forming nitrogen fertilizer consumption, numbers of lime vendors and producers, and agricultural lime consumption were compared to historic trends summarized by Chapman (1976).

RESULTS AND DISCUSSION

Following 1954, lime consumption has varied (Figure 1). Prior to 1976, there was an increasing trend. Since 1976, the trend has been one of decline. Lime use during FY1983-1984 was lower than at any time since 1959, when more than 312,515 MT (350,000 tons) of lime were sold.

Lime needs have increased from slightly more than 0.89 million MT (one million tons) in the early 70's to approximately 2.7 million MT (three million tons) currently (Figure 2). In FY1974-1975, there were 25 liming material producers registered with the State Plant Board that supplied Arkansas. Currently, there are more than 40. Approximately

Lime Needs and Trends in Arkansas

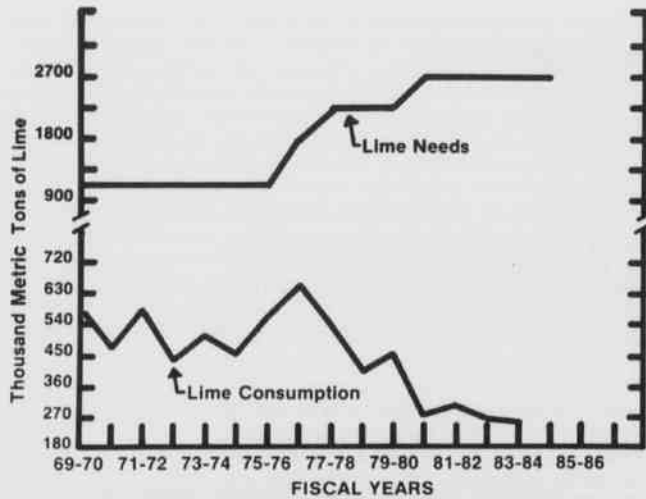


Figure 2. Trends in Arkansas' lime needs versus lime consumption since fiscal year 1969-1970.

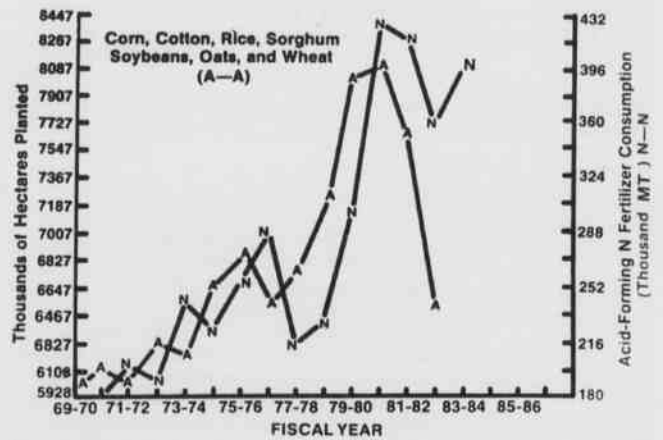


Figure 4. Hectareage planted to major field crops in Arkansas versus consumption of acid-forming nitrogen fertilizer since fiscal year 1969-1970.



Figure 3. Trends in acid-forming nitrogen fertilizer consumption versus lime consumption in Arkansas since fiscal year 1969-1970.

60 percent of the liming material producers are from outside the state. The number of liming material producers within the state has remained essentially the same since FY1974-1975.

There were 176 lime vendors serving the state in FY1974-1975. During the FY1983-1984, there were 167 lime vendors registered with the State Plant Board. It is apparent from these figures that the number of lime vendors has decreased slightly since 1975, while the number of liming material producers has slightly increased.

Possibly, more important than the number of lime vendors is the distribution of vendors within the state. During FY1974-1975, 35 counties in Arkansas had two or more vendors while 10 counties were without a lime vendor. In FY1983-1984, there were still 35 counties that had two or more vendors, but the number of counties without a vendor had increased to 14 since FY1974-1975. However, this shift in the number of counties without a vendor probably did not play a major role in the almost three-fold decline in lime usage since about FY1974-1975.

The average lime cost for the state in FY1974-1975 was \$7.95 per MT (\$8.90 per ton) spread, based on Agricultural Stabilization and Conservation Service estimates. During FY1983-1984, the cost was estimated to be \$15.45 per MT (\$17.30 per ton) spread, or almost double the cost in FY1974-1975. This increased cost was due primarily to increased transportation costs.

Most nitrogen fertilizers used in Arkansas for agricultural crop production can contribute to the acidification of soils (Andrews, 1954; Frizzell and Maples, 1984) and are termed acid-forming nitrogen fertilizers. Costs of these nitrogen fertilizers have more than doubled since 1975 in Arkansas. Unlike lime consumption, acid-forming nitrogen fertilizer consumption has significantly increased since FY1974-1975. Nitrogen fertilizer consumption trends, prior to 1969, roughly paralleled trends in lime consumption (Chapman, unpublished).

Trends in the consumption of acid-forming nitrogen fertilizers and lime since 1969 (Figure 3) do not exhibit the parallel relationship observed before 1969. Instead, lime use has steadily declined, while acid-forming nitrogen fertilizer use has increased.

The amount of lime needed to neutralize the residual acidity from acid-forming nitrogen fertilizer usage in FY1974-1975 was almost 291,846 MT (327,000 tons) (Table 1). More than 446,450 MT (500,000 tons) of lime were applied in FY1974-1975. This was approximately 156,258 MT (175,000 tons) more than was needed just to counteract the acidity from nitrogen fertilizer. In FY1983-1984, approximately 392,862 MT (440,000 tons) of acid-forming nitrogen fertilizers were sold (Table 2). The lime needed to neutralize the residual acidity from the fertilizer was approximately 570,462 MT (639,000 tons). However, only 235,408 MT (263,644 tons) of lime were used during FY1983-1984. Only 41 percent of the lime needed, just to neutralize the acidity caused by nitrogen fertilizers, was actually used.

If the application of acid-forming nitrogen fertilizers continues to increase, or levels off, while lime use continues to decline, soils in Arkansas may become so acidic that yields of acid-sensitive crops (soybeans, wheat, corn, grain sorghum) may drastically decline.

With the exception of the FY1982-1983, the trend in the number of hectares planted to some of our major crops (corn, cotton, rice, sorghum, soybeans, oats, wheat) was similar to the trend in acid-forming nitrogen fertilizer consumption (Figure 4). The impact of hectareage reduction programs on total hectareage in these crops was evidenced in FY1982-1983.

Soybeans are planted to more hectares in Arkansas than any of the other crops. Because soybeans are capable of acquiring most of their nitrogen needs via the symbiotic nitrogen fixation process, an opposite trend between acid-forming nitrogen fertilizer use and soybean hectareage may be expected. Such opposing trends were observed between FY1969-1970 and FY1983-1984.

Trends in acid-forming nitrogen fertilizer use were most closely mimicked by trends in the combined hectareage of wheat and rice. With the exception of soybeans, other crops planted to large hectareages (e.g. wheat, rice, sorghum) will continue to use large quantities of nitrogen fertilizer. At least 90 percent of the nitrogen fertilizers used will pro-

Clifford S. Snyder and Stanley L. Chapman

Table 1. Lime Needed to Counteract Acidity from Acid-Forming Nitrogen Fertilizers in Arkansas (Fiscal Year 1974-1975).

Nitrogen Material	Metric Tons Sold	Metric Tons Lime Needed Per MT Material*	Total Lime Needs (MT)
Ammonium Nitrate	74,989	0.60	44,993
Anhydrous Ammonia	8,920	2.93	26,136
Nitrogen Solutions	27,401	1.32	36,170
Ammonium Sulfate	5,839	1.46	8,525
Urea	106,037	1.66	176,022
TOTAL	223,186		291,846

*Method of W. B. Andrews (1954)

bably be the acid-forming types. This would indicate a continued need for lime in neutralizing the residual acidity from nitrogen fertilizers, not to mention native acidity.

Rice hectareage nearly doubled from FY1974-1975 to present and the hectareage of other crops being irrigated has increased. In the Grand Prairie region of the state, some of the lime needs are being supplied by wells with irrigation water that has relatively high levels of calcium carbonate (Gilmour and Ferguson, 1981). The use of such irrigation water in the Grand Prairie, and possibly other parts of the state, has decreased agricultural lime consumption. However, the magnitude of decrease in lime consumption attributable to such water is unknown.

Many Arkansas farmers have erroneously assumed the lime needs of their entire field were being met when using well water with a high calcium carbonate content to flood or furrow irrigate. In reality, only the upper portion of the field may receive appreciable amounts of lime when such irrigation water is used. The lower portions of such fields may be in need of lime for crops in rotation with rice. Rice tolerates acid soils and flooding better than other major crops. This is because flooding the soil causes the pH to approach neutrality, until the water is removed. Soil testing summaries (unpublished) indicate that such fields are not being adequately sampled or limed. At present, much improvement can be made by increasing the sampling of soils and well water to accurately determine the lime needs for crops in rotation with rice.

Agricultural production inputs such as nitrogen fertilizer, fungicides, herbicides, and insecticides are usually considered short-term investments because of their annual application/response nature. Lime may, in many instances, provide an annual return on investment comparable to the aforementioned inputs. Yet, most farmers consider lime a long-term investment with a relatively low annual rate of return. This is because agricultural limestone, on the average, may continue to neutralize soil acidity for three or more years after application.

In recent years, more and more farmers have been forced to rent the land they farm in order to maximize the production efficiency of their inputs and simultaneously minimize their cost per unit of output (i.e. crop yield). Many of these farmers can only get short-term rental agreements with their landlords. Because liming involves a large capital expenditure, and because there is a risk of not being able to rent the same land in successive years, these farmers are reluctant to use lime.

CONCLUSIONS

Shifts in crop hectareages did not account for the magnitude of decline observed in lime consumption during the last 14 years. The supply and availability of lime has remained relatively constant during the same period. It appears that increased transportation costs have contributed to the declining use of lime in Arkansas' agriculture. Yet, farmers have not curtailed the use of other production inputs such as nitrogen fertilizer, even though these input costs have increased in a manner similar to lime costs.

If soil acidity increases beyond the surface 15 centimeters (six inches) of soil into the subsoil, it may be economically impossible to correct by typical direct incorporation of lime (Frizzell and Maples, 1984).

Table 2. Lime Needed to Counteract Acidity from Acid-Forming Nitrogen Fertilizers in Arkansas (Fiscal Year 1983-1984).

Nitrogen Material	Metric Tons Sold	Metric Tons Lime Needed Per MT Material*	Total Lime Needs (MT)
Ammonium Nitrate	62,318	0.60	37,391
Anhydrous Ammonia	7,215	2.93	21,139
Nitrogen Solutions	70,556	1.32	93,134
Ammonium Sulfate	4,031	1.46	5,886
Urea	248,742	1.66	412,912
TOTAL	392,862		570,462

*Method of W. B. Andrews (1954)

Landlords and farmers need to adopt wise soil management to include lime where needed to prevent potential yield-limiting soil acidity.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of the Arkansas State Plant Board, the Arkansas Crop and Livestock Reporting Service, and the Agricultural Stabilization and Conservation Service.

LITERATURE CITED

- ADAMS, F., and R. W. PEARSON. 1967. Crop Response to Lime in the Southern United States and Puerto Rico, pp 161-207. In R. W. Pearson and F. Adams (eds.) Soil Acidity and Liming, Monograph 12. American Society of Agronomy, Madison, Wisconsin.
- ANDREWS, W. B. 1954. The Response of Crops and Soils to Fertilizers and Manures, 2nd edition. State College, Mississippi.
- ARKANSAS CROP AND LIVESTOCK REPORTING SERVICE. 1981a. Agricultural Statistics for Arkansas, 1980. Report Series 262, 44 pp.
- ARKANSAS CROP AND LIVESTOCK REPORTING SERVICE. 1981b. Arkansas Crop Statistics, 1960-1979. Report Series 261, 102 pp.
- ARKANSAS CROP AND LIVESTOCK REPORTING SERVICE. 1982. Agricultural Statistics for Arkansas, 1981. Report Series 268, 44 pp.
- ARKANSAS CROP AND LIVESTOCK REPORTING SERVICE. 1983. Agricultural Statistics for Arkansas, 1982. Report Series 280, 56 pp.
- ARKANSAS CROP AND LIVESTOCK REPORTING SERVICE. 1984. Census of Agriculture, Preliminary Report, 5 pp.
- CHAPMAN, S. L. 1976. The Lime Supply-Demand Situation in Arkansas, pp. 20-30. Proc. of the 25th Annual Arkansas Plant Food and Lime Conference.
- FRIZZELL, M., and R. MAPLES. 1984. Effect of Nitrogen on Soil Acidity. Arkansas Farm Research 33(6):12.
- GILMOUR, J. T., and J. A. FERGUSON. 1981. Liming Silt Loam Soils Cropped to Rice and Soybeans. Arkansas Farm Research 30(1):7.

Lime Needs and Trends in Arkansas

SABBE, W. E., L. H. HILEMAN, J. L. KEOGH, and R. MAPLES. 1973. Summary of Soil Test Data and Fertilizer and Lime Recommendations for 1961 to 1964. University of Arkansas Agricultural Experiment Station. Report Series 205.

THOMPSON, L. F., and W. E. SABBE. 1969. Arkansas' limestone needs. Arkansas Farm Research 18(1):9.