The effects of combinations of lime and fertilizers on yields of cotton, corn, and hairy vetch

B E. Newman

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The Effects of Combinations Of Lime and Fertilizers On Yields of Cotton, Corn, And Hairy Vetch

B. E. Newman

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Acknowledgments

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The Effects of Combinations of Lime and Fertilizers on Yields Of Cotton, Corn, and Hairy Vetch

B. E. Newman

Introduction

The Agricultural Stabilization and Conservation Service of the United States Department of Agriculture estimated that less than 300,000 tons of lime were used on Louisiana croplands in 1967. It has also been estimated that this is only one-third of the lime needed annually for optimum agricultural production in Louisiana.

The adjustment of soil reaction to the proper level is important in good soil management. This must be done if maximum production and profits from the use of fertilizers are to be obtained.

There are many benefits derived from the use of lime other than the neutralization of soil acidity. In addition to supplying two secondary plant nutrients, calcium and magnesium, lime influences the solubility of certain compounds of iron, aluminum, manganese, and many other elements. Some compounds come into solution in strongly acid soils and "lock-up" both native and applied phosphorus, making it less available to the plant. High levels of aluminum and manganese are known to be toxic to some crops. Lime renders these elements less soluble and, as a result, less harmful to the crop. Lime also affects the utilization of nitrogen and potassium.

The frequency with which lime should be applied depends on many factors and can best be determined by soil analysis. Excessive use of lime should be avoided. Too much lime may reduce the availability of iron, phosphorus, manganese, boron, copper, and zinc, and may also suppress the availability of potassium. A well-balanced fertilization and liming program is essential in a successful farming operation.

Review of Literature

Most soil scientists agree that use of the word "lime" refers to any material high in calcium or which corrects certain physiological conditions when applied to a moderately- or strongly-acid soil. Bear (4) stated that the elements calcium and magnesium have other functions in the soil and plant than those of simply neutralizing soil acid. He also stated that if the soil is deficient in magnesium, then a limestone

1 Department of Agronomy.

2 Italic numbers in parentheses refer to Literature Cited, page 13.
product high in magnesium, such as dolomitic limestone, is to be preferred over one that is high in calcium.

Russell (28) stated that the secondary effects of high acidity or low pH in a soil are shortage of available calcium and sometimes phosphate on the one hand, and an excess of soluble aluminum, manganese, and perhaps other metallic ions on the other. He also stated that these harmful effects of soil acidity can always be corrected by the judicious use of calcium carbonate, which raises the pH and the level of available calcium and lowers that of manganese and aluminum.

Bender and Eisenmenger (5) have shown that the calcium content of certain plants varies with the calcium saturation of the soil, and Batholomew (3) has obtained evidence indicating that soluble magnesium salts increase the absorption of phosphates. Magnesium may also play an important role in the translocation of phosphorus in plants (24, 32). Magnesium may be applied to the soils in a number of materials (7, 14), the principal one being dolomitic limestone.

Newman and Brupbacher (20) reported that acidic carriers of nitrogen supplemented with dolomitic limestone produced significantly higher yields of seed cotton than did acidic carriers of nitrogen without lime. They also reported that the extractable manganese content of the soil was less from plots that had received an acidic carrier of nitrogen supplemented with lime than from those receiving a similar source of nitrogen without lime.

Crinkle leaf, a disorder of cotton occurring on very acid soils, was first described by Neal (18), working on cotton diseases in Louisiana in 1937. The work of Neal and Lovett (19) on Memphis (formerly Lintonia) and Olivier silt loam soils in Louisiana in 1938 indicated that excessive manganese caused crinkle leaf in cotton and that this disorder could be eliminated with lime by increasing the pH of the soil. Adams and Wear (1), in Alabama, concluded that crinkle leaf in cotton could be expected as sufficient acidity developed in soils that have a potential for supplying soluble manganese, and that the necessary preventive measure for crinkle leaf in the field was adequate liming.

The quantity of lime to apply and the frequency of applications can best be determined through soil analysis. White and Gardner (34) screened limestone into grades and tested its effect in correcting soil acidity. They reported that limestone dust passing a 100-mesh screen and applied to a particular soil produced an alkaline reaction the first year, but by the end of the third year the soil again showed slight acidity. Liming material passing a 60-mesh screen did not produce an alkaline reaction until the second year, the 20-mesh material did not produce a reaction until the end of the third year, and soil to which 8-mesh material was applied still showed a lime requirement of 3,000 pounds per acre at the end of three years.

Much experimental data are available on the benefits of liming and the influence of soil reaction on nutrient availability (33). Bear (7) reported that nitrification processes in the soil are speeded up by
applying liming materials. It has also been reported that liming acid soils has a beneficial effect on the utilization of both applied and native phosphorus (26). Salter and Barnes (29) showed that by maintaining the soil reaction at about pH 7.5, satisfactory crop yields could be produced with minimum investments in phosphate fertilizer. Singh and Seatz (30) reported that phosphorus applied after liming an acid soil was more available to plants than when the phosphorus was applied to the soil three months prior to liming. Robertson, et al (27), concluded that phosphorus interacted with lime and less phosphorus was necessary to give maximum yields on limed soil than on unlimed soil.

Paden and Riley (21) reported higher increases in yield of seed cotton per pound of potassium applied on limed soil than on unlimed soil. Thorp and Hobbs (31) reported that potassium uptake by alfalfa was significantly increased by lime applications. Pearson (23) made an intensive review of the research on the influence of liming on potassium availability and stated that in spite of the fact that liming frequently decreased the solubility of soil potassium, the ultimate effect of liming on the utilization of fertilizer potassium had been found to be highly beneficial.

Russell (28) stated that large dressings of lime may induce magnesium or potassium deficiencies in crops. He explained this phenomenon as ionic antagonism—increasing the relative concentration of any one cation in the soil, as for example, calcium or magnesium as a result of liming, reduced the potassium uptake by the plant because of competition or the antagonistic effects among the cations. Calcium may also be a factor in precipitating soluble phosphorus. It has been reported that when the soil pH gets above 7.0, insoluble calcium phosphates appear (13, 15). Thus, excessive liming may precipitate watersoluble phosphorus compounds into forms that are only partially available.

Pierre and Browning (25) reported that injury to crops from overliming in West Virginia was due to disturbed phosphate nutrition.

The effects of overliming on the availability of certain micronutrients have been reported (8, 33). Too much lime reduces the availability of iron, manganese, boron, copper, and zinc. It is important to recognize the dangers of indiscriminate use of lime (16, 17) and the failure to follow a well-balanced fertilizer and lime program.

It has been widely demonstrated that crop yields and certain physical properties of the soil can be improved through use of winter legumes as a green manure crop (9, 10, 11, 22, 35).

Davis, Hobgood and Brewer (10), in Louisiana, reported that the green weight of hairy vetch (Vicia villosa) was increased 2.9 tons per acre in St. Landry Parish and 2.1 tons per acre in Natchitoches Parish with the application of 500 pounds per acre of basic slag. They also reported the effects of phosphorus on the yield of vetch. The green
weight of vetch was 4.3 tons per acre with the application of 225 pounds per acre of 18 percent superphosphate as compared with only 2.2 tons per acre where no superphosphate was applied.

Bailey, Williamson and Duggar (2) reported that the yield of hairy vetch in Alabama was increased with the application of superphosphate. The green weight of vetch with no fertilizer was 1,589 pounds per acre as compared with 8,874 pounds per acre with the application of 400 pounds per acre of superphosphate.

Harper (12), in Oklahoma, reported the residual effects of fertilizers applied to cotton with and without lime on the yield of hairy vetch and other winter legumes. On the unlimed soil, the 15-year average yield of dry vetch was 862 pounds per acre where no fertilizer was applied to the cotton as compared with 1,456 pounds per acre where 40 pounds per acre of P\textsubscript{2}O\textsubscript{5} were applied to the cotton annually. When an equal amount of P\textsubscript{2}O\textsubscript{5} plus 60 pounds per acre of K\textsubscript{2}O were applied to the cotton, the yields of dry vetch were 1,514 and 1,621 pounds per acre for the unlimed and limed soil, respectively.

**Experimental Procedures**

An experiment was initiated in 1955 on the Perkins Road Agronomy Research Farm at Baton Rouge. The soil on which the experiment was located was classified as Richland (later changed to Loring) silt loam. A composite sample of the surface soil was taken from the experimental area for chemical analyses. The extractable phosphorus, potassium, calcium, and magnesium were determined. A sample of the soil was extracted with a 0.05 normal nitric acid solution using a soil-to-extraction solution ratio of 1:20. The amounts of potassium and calcium in the extract were determined using a Perkin-Elmer Model 52C flame photometer. The concentration of magnesium in the extract was determined by the Clayton yellow colorimetric method. The concentration of phosphorus in the soil was determined from an aliquot of the soil extract after a color had been developed by adding a solution containing ammonium molybdate, sulphuric acid, and an acidified solution containing stannous chloride. The intensity of the color developed was measured using a Fisher electrophotometer.

Soil reaction (pH) and lime requirement were determined according to procedures described in Louisiana Agricultural Experiment Station Bulletin No. 632 (6). The extractable nutrients in the soil were as follows: 15 ppm of P, 42 ppm of K, 391 ppm of Ca, and 92 ppm of Mg. The pH of the soil was 5.6. It was determined that 3,000 pounds per acre of CaCO\textsubscript{3} would be necessary to obtain a pH value of 6.5 to 7.0.

The chemical and screen analyses of liming materials used in the experiment were as follows:
Chemical Analysis

<table>
<thead>
<tr>
<th></th>
<th>Dolomitic Limestone</th>
<th>Oyster shell flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>CaCO₃</td>
<td>MgCO₃</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>50.0</td>
<td>97.0</td>
</tr>
<tr>
<td>MgCO₃</td>
<td>40.0</td>
<td>—</td>
</tr>
<tr>
<td>Neutralizing power</td>
<td>97.4</td>
<td>97.0</td>
</tr>
</tbody>
</table>

Screen Analysis

<table>
<thead>
<tr>
<th>%</th>
<th>Dolomitic limestone</th>
<th>Oyster shell flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-mesh</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>200-mesh</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

The fertilizer materials used in the experiment were ammonium nitrate (33.5 percent N), ordinary superphosphate (20 percent available P₂O₅) and muriate of potash (60 percent K₂O).


Hairy vetch was planted each year immediately after harvesting the cotton or corn and the vetch green manure was turned under in the spring approximately three weeks before planting cotton or corn. Yield data from nine crops of cotton, four crops of corn and three crops of vetch were obtained.

A split-plot design with three replications was employed. One of the three main plots was treated with dolomitic limestone, one with oyster shell flour, and one received no lime. The main plots were subdivided into eight subplots, each consisting of six 42-inch rows 90 feet long. Fertilizer mixtures in which N, P₂O₅ and K₂O were combined at three different levels (0, 32, and 64 pounds per acre) were applied to the subplots annually. The liming materials were applied broadcast at the rate of 3,000 pounds per acre each and thoroughly disked into the soil approximately three months prior to planting of the first crop of cotton in 1955. No additional lime was applied throughout the duration of the experiment.

Yield data for cotton and corn were taken from the two inside rows of each subplot. Vetch yields were taken from the second and fifth rows of each subplot.

### Results and Discussion

The effects of sources of lime and of no lime in combination with various fertilizer mixtures on the nine-year average yields of seed cotton are shown in Table 1. In most cases the yields obtained with dolomitic limestone were slightly higher than those obtained with oyster shell flour. Yield differences between the two sources of lime were not statistically significant except where no fertilizer was applied, and in
TABLE 1.—Effects of Lime and Fertilizer Mixtures on 9-Year Average Yields of Seed Cotton on Loring Silt Loam, Baton Rouge

<table>
<thead>
<tr>
<th>Fertilizer mixtures, N-P&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt;-K&lt;sub&gt;2&lt;/sub&gt;O</th>
<th>Dolomitic limestone</th>
<th>Oyster shell flour</th>
<th>No lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds per acre</td>
<td>Yield of seed cotton, pounds per acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-64-64</td>
<td>2,064</td>
<td>1,914</td>
<td>1,706</td>
</tr>
<tr>
<td>32-64-64</td>
<td>1,985</td>
<td>1,953</td>
<td>1,693</td>
</tr>
<tr>
<td>64-64-64</td>
<td>1,920</td>
<td>1,814</td>
<td>1,194</td>
</tr>
<tr>
<td>64-32-64</td>
<td>1,800</td>
<td>1,730</td>
<td>1,300</td>
</tr>
<tr>
<td>64-0-64</td>
<td>1,232</td>
<td>1,127</td>
<td>747</td>
</tr>
<tr>
<td>64-64-32</td>
<td>1,676</td>
<td>1,062</td>
<td>1,135</td>
</tr>
<tr>
<td>64-64-0</td>
<td>1,283</td>
<td>1,174</td>
<td>1,008</td>
</tr>
<tr>
<td>0-0-0</td>
<td>1,232</td>
<td>1,035</td>
<td>994</td>
</tr>
</tbody>
</table>

Least significant difference at 5 percent level for comparing fertilizer mixtures for any one source of lime = 159 lbs/A.

Least significant difference at 5 percent level for comparing sources of lime for any one fertilizer mixture = 170 lbs/A.

this case the higher yield was obtained with dolomitic limestone. Yield differences between dolomitic limestone and no lime were statistically significant at all levels of fertilization. Yield differences between oyster shell flour and no lime were statistically significant at all levels of fertilization except where potassium was not included in the fertilizer mixture and where no fertilizer was applied.

There were no significant increases in the yield of seed cotton from the application of nitrogen with either source of lime or without lime. The decrease in yield from the application of 64 pounds per acre of nitrogen to the unlimed soil was statistically significant. In most years, especially those with unusually high rainfall during the growing season, plants in the high-nitrogen plots were extremely rank, and yields were reduced to some extent by boll rot. Symptoms of severe manganese toxicity, or crinkle leaf, were also observed in unlimed plots where the 64-pound-per-acre rate of nitrogen had been applied. The very good crops of hairy vetch (Table 4) turned under prior to planting probably account for the lack of significant increases in yield from nitrogen applications.

There were no significant increases in the yield of seed cotton from the application of more than 32 pounds per acre of P<sub>2</sub>O<sub>5</sub> with either source of lime or without lime. The 32-pound-per-acre increment of P<sub>2</sub>O<sub>5</sub> increased the yield of seed cotton by 568 pounds per acre with dolomitic limestone, 603 pounds per acre with oyster shell flour and 553 pounds per acre on the unlimed soil. Slight increases in yield were obtained from an additional 32 pounds per acre of P<sub>2</sub>O<sub>5</sub> with dolomitic limestone and oyster shell flour, but the increases were not statistically significant.

Yield increases from the application of 32 pounds per acre of K<sub>2</sub>O were 393 and 488 pounds of seed cotton per acre with dolomitic limestone and oyster shell flour, respectively, as compared with an increase of only 127 pounds of seed cotton per acre on the unlimed...
soil. An additional 32 pounds per acre of K₂O increased the yields of seed cotton 244 pounds per acre with dolomitic limestone, 152 pounds per acre with oyster shell flour, and only 59 pounds per acre on the unlimed soil. These data suggest that liming accentuates the need for higher rates of K₂O on soils as low as 42 ppm in extractable K.

Potash deficiency symptoms were observed on cotton in the limed plots where K₂O was not included in the fertilizer mixtures. These observations probably illustrate the phenomena explained by Russell (28) as ionic antagonism. In this case the relative concentration of calcium and magnesium was increased as a result of liming, which may have reduced the uptake of potassium by the plants. Potassium deficiency symptoms were not observed in plots where potassium was included in the fertilizer mixtures nor in the unlimed plots where potassium was not included in the fertilizer mixture.

The effects of sources of lime and various fertilizer mixtures on earliness of cotton are shown in Table 2. The percentages of the total yield of seed cotton harvested at the first harvest were higher from the limed than from the unlimed plots. The differences in the percentages in favor of lime were more pronounced where the 64-64-64, 64-64-32, and 64-64-0 fertilizer mixtures were used. The cotton plants tended to develop more vegetatively and for a longer period of time on the unlimed plots than on the limed plots where the 64-64-64 mixture was used. This growth characteristic of the plants not only resulted in later maturity, but also in a reduction in yield. Lime apparently reduced the relative vegetative growth of the plants and stimulated earlier maturity.

Potassium deficiency symptoms, such as premature shedding of leaves and improper development and opening of bolls, were more pronounced in limed plots than in unlimed plots where the 64-64-0 mixture was used. In this case, the growth characteristics of the plants due to potassium deficiency resulted in a higher percentage of cotton harvested at the first harvest from the limed plots than from the unlimed plots where potassium was not included in the fertilizer mixtures. The lowest percentage of the total yield of seed cotton harvested at the first harvest

<table>
<thead>
<tr>
<th>Fertilizer mixtures, N-P₂O₅-K₂O</th>
<th>Dolomitic limestone</th>
<th>Oyster shell flour</th>
<th>No lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds per acre</td>
<td>Percent total yield harvested at first harvest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-64-64</td>
<td>78.9</td>
<td>83.2</td>
<td>78.7</td>
</tr>
<tr>
<td>32-64-64</td>
<td>76.9</td>
<td>74.7</td>
<td>70.3</td>
</tr>
<tr>
<td>64-64-64</td>
<td>72.9</td>
<td>70.3</td>
<td>59.3</td>
</tr>
<tr>
<td>64-32-64</td>
<td>69.5</td>
<td>71.4</td>
<td>62.5</td>
</tr>
<tr>
<td>64-0-64</td>
<td>66.6</td>
<td>58.5</td>
<td>56.2</td>
</tr>
<tr>
<td>64-64-32</td>
<td>73.9</td>
<td>78.9</td>
<td>57.1</td>
</tr>
<tr>
<td>64-64-0</td>
<td>82.2</td>
<td>85.7</td>
<td>67.9</td>
</tr>
<tr>
<td>0-0-0</td>
<td>88.9</td>
<td>89.1</td>
<td>85.1</td>
</tr>
</tbody>
</table>
TABLE 3.—Effects of Lime and Fertilizer Mixtures on 4-Year Average Yields of Corn on Loring Silt Loam, Baton Rouge

<table>
<thead>
<tr>
<th>Fertilizer mixtures, N-P₂O₅-K₂O</th>
<th>Dolomitic limestone</th>
<th>Oyster shell flour</th>
<th>No lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds per acre</td>
<td>Yield of corn, bushels per acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:64-64</td>
<td>53.3</td>
<td>50.7</td>
<td>45.3</td>
</tr>
<tr>
<td>64:64-64</td>
<td>64.7</td>
<td>63.9</td>
<td>55.3</td>
</tr>
<tr>
<td>96:64-64</td>
<td>70.8</td>
<td>71.0</td>
<td>63.2</td>
</tr>
<tr>
<td>96:32-64</td>
<td>67.0</td>
<td>63.7</td>
<td>56.5</td>
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<tr>
<td>96:0-64</td>
<td>47.9</td>
<td>43.9</td>
<td>34.7</td>
</tr>
<tr>
<td>96:64-32</td>
<td>66.8</td>
<td>66.8</td>
<td>57.7</td>
</tr>
<tr>
<td>96:64-0</td>
<td>63.3</td>
<td>59.7</td>
<td>53.4</td>
</tr>
<tr>
<td>0:0-0</td>
<td>36.8</td>
<td>35.1</td>
<td>29.6</td>
</tr>
</tbody>
</table>

Least significant difference at 5 percent level for comparing fertilizer mixtures for any one source of lime = 3.5 bu/A.

Least significant difference at 5 percent level for comparing sources of lime for any one fertilizer mixture = 3.8 bu/A.

was obtained where phosphorus was not included in the fertilizer mixtures applied with or without lime.

The effects of the sources of lime and no lime in combination with the various fertilizer mixtures on the yield of corn are shown in Table 3. Unfavorable weather conditions in 1957 and 1962 were largely responsible for very poor yields of corn for two years of the four-year corn-testing period.

Yields of corn obtained with dolomitic limestone were, in most cases, slightly higher than those obtained with oyster shell flour. The only statistically significant difference in the yield of corn between the two sources of lime occurred when phosphorus was not included in the fertilizer mixtures. In this case, as with cotton, the higher yield of corn was obtained with dolomitic limestone. This difference in yield, 4.0 bushels of corn per acre, suggests that dolomitic limestone increased the effectiveness of soil phosphates more than did oyster shell flour.

Significant increases in the yield of corn were obtained from the use of nitrogen with either source of lime or without lime. The significant increases in yield from the use of nitrogen up to the highest level tested in the experiment, 96 pounds per acre, suggest that a further increase in yield of corn could have been obtained from a rate of nitrogen higher than 96 pounds per acre.

Significant increases in corn yields were also obtained from the application of 32-pound-per-acre increments of P₂O₅ up to the highest level of P₂O₅ tested in the experiment, 64 pounds per acre, both with and without lime. As shown in Table 3, a 32-pound-per-acre increment of P₂O₅ increased the yield of corn 19.1, 19.8, and 21.8 bushels per acre with dolomitic limestone, oyster shell flour, and no lime, respectively. An additional 32 pounds per acre of P₂O₅ further increased yields of corn by 3.8 bushels per acre with dolomitic limestone, 7.3 bushels per acre with oyster shell flour, and 6.7 bushels per acre on unlimed soil.
TABLE 4.—Effects of Residual Fertilizers Applied to Cotton and Corn With and Without Lime on the Yield of Hairy Vetch, Baton Rouge

<table>
<thead>
<tr>
<th>Fertilizer mixtures, N-P₂O₅-K₂O*</th>
<th>Dolomitic limestone</th>
<th>Oyster shell flour</th>
<th>No lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds per acre</td>
<td>Dry weight of vetch, pounds per acre, 3-year average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-64-64</td>
<td>4.118</td>
<td>4.507</td>
<td>4.001</td>
</tr>
<tr>
<td>32-64-64</td>
<td>4.248</td>
<td>4.234</td>
<td>3.743</td>
</tr>
<tr>
<td>64-64-64</td>
<td>3.852</td>
<td>4.332</td>
<td>3.742</td>
</tr>
<tr>
<td>64-32-64</td>
<td>4.239</td>
<td>3.788</td>
<td>3.504</td>
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<tr>
<td>64-0-64</td>
<td>3.058</td>
<td>3.124</td>
<td>3.072</td>
</tr>
<tr>
<td>64-64-32</td>
<td>4.305</td>
<td>3.858</td>
<td>4.022</td>
</tr>
<tr>
<td>64-64-0</td>
<td>3.974</td>
<td>3.746</td>
<td>3.679</td>
</tr>
<tr>
<td>0-0-0</td>
<td>2.979</td>
<td>2.788</td>
<td>2.819</td>
</tr>
</tbody>
</table>

*An additional 32 pounds per acre of N was applied to corn as a sidedressing with all fertilizer mixtures except 0-64-64 and 0-0-0.

Least significant difference at 5 percent level for comparing fertilizer mixtures for any one source of lime = 560 lbs/A.
Least significant difference at 5 percent level for comparing sources of lime for any one fertilizer mixture = 688 lbs/A.

Significant increases in the yield of corn were also obtained with the application of 32-pound-per-acre increments of K₂O, both with and without lime, up to the highest level of K₂O tested in the experiment—64 pounds per acre. Significant increases in corn yields from applications of 32-pound-per-acre increments each of P₂O₅ or K₂O with or without lime suggest also that additional increases in yields could have been obtained from levels of P₂O₅ or K₂O higher than the 64-pound level tested in the experiment.

The effects of sources of lime and no lime and the residual effects of the fertilizer mixtures applied to the cotton and corn on the yield of hairy vetch are shown in Table 4. In most cases, the higher yields of vetch were obtained from the limed plots and from those that had received 32 or 64 pounds per acre of P₂O₅ in the fertilizer mixtures applied to the cotton and corn. Those plots produced from 600 to 1,000 pounds per acre more vetch, on a dry weight basis, than did those where phosphorus was omitted from the fertilizer mixtures. There was very little difference in the yield of vetch from plots that had received no phosphorus in the fertilizer mixtures and those that had received no fertilizer at all.

Summary

An experiment to study the effects of two sources of lime and no lime in combination with fertilizer mixtures on the yield of cotton, corn, and hairy vetch was conducted over a 13-year period on Loring silt loam at Baton Rouge. The effects of lime and the various fertilizer treatments on earliness of cotton and the residual effects of the treatments on the yield of hairy vetch were also determined.
The average yields of cotton and corn obtained with dolomitic limestone were, in most cases, slightly higher than those obtained with oyster shell flour. Differences in effects on yields between the two sources of lime in favor of dolomitic limestone were statistically significant where no fertilizer was applied to cotton or corn and where phosphorus was omitted from the fertilizer mixture for corn.

Differences in effects on yields between dolomitic limestone and no lime were statistically significant at all levels of fertilization with both cotton and corn. Yield effect differences between oyster shell flour and no lime were statistically significant at all levels of fertilization with corn and at all levels of fertilization with cotton except where potassium was omitted from the fertilizer mixture and where no fertilizer was applied.

In most cases, lower yields of seed cotton were obtained from the application of nitrogen with either source of lime, or with no lime. The decrease in yield of seed cotton with the application of 64 pounds per acre of nitrogen to unlimed soil was statistically significant. Corn yields were significantly increased with applications of up to 96 pounds per acre of nitrogen with both sources of lime and with no lime.

There were no significant increases in yield of seed cotton from the application of more than 32 pounds per acre of P2O5 with either source of lime or without lime. The significant increases in the yield of corn from the application of 32-pound-per-acre increments of P2O5 with or without lime suggest that, under the conditions of this experiment, additional increases in corn yields could be expected from applications of phosphorus at rates higher than 64 pounds per acre.

Cotton yields were increased significantly with 32-pound-per-acre increments of K2O applied with dolomitic limestone and oyster shell flour up to the highest level of K2O tested in the experiment, 64 pounds per acre.

There was no significant increase in the yield of cotton from a 32-pound-per-acre rate of K2O applied to unlimed soil. The 64-pound-per-acre rate of K2O applied to unlimed soil significantly increased the yield of cotton.

The results of this experiment suggest that additional increases in the yield of cotton could be expected from a rate of K2O higher than 64 pounds per acre applied with either dolomitic limestone or oyster shell flour, and that no further increase in cotton yields could be expected from a rate of K2O higher than 64 pounds per acre applied to unlimed soil.

Additional increases in the yield of corn could also be expected from a rate of K2O higher than 64 pounds per acre applied with either source of lime or without lime.

Lime apparently accentuates the need for higher rates of potassium fertilization more with cotton than with corn.

Potash deficiency symptoms were more pronounced in limed plots than in unlimed plots where potassium was not included in the fertilizer mixtures.
A higher percentage of the total yield of cotton was harvested at the first harvest from the limed plots than from the unlimed plots with all fertilizer mixtures.

The lowest percentage of the total yield of cotton harvested at the first harvest was obtained with the 64-0-64 mixture with or without lime.

The highest percentage of the total yield of cotton harvested at the first harvest was obtained where no fertilizer was applied to the limed and unlimed plots.

Where fertilizers were applied, the highest percentage of the total yield of cotton harvested at the first harvest was obtained with the 64-64-0 mixture on the limed plots and the 0-64-64 mixture on the unlimed plots.

The residual effect of fertilizer mixtures applied to cotton and corn on the yield of vetch was more closely associated with phosphorus applications than with nitrogen or potassium applications. Higher yields of vetch were, in most cases, obtained on the limed soil.

**Literature Cited**


