5-1946

Effects of Lime, Fertilizer, and Preceding Legumes on the Yields of Corn and Tobacco

University of Tennessee Agricultural Experiment Station

C.A. Mooers

O.H. Long

Follow this and additional works at: http://trace.tennessee.edu/utk_agbulletin

Part of the Agriculture Commons

Recommended Citation

University of Tennessee Agricultural Experiment Station; Mooers, C.A.; and Long, O.H., "Effects of Lime, Fertilizer, and Preceding Legumes on the Yields of Corn and Tobacco" (1946). Bulletins.

http://trace.tennessee.edu/utk_agbulletin/133
EFFECTS OF LIME, FERTILIZER, AND PRECEDING LEGUMES ON THE YIELDS OF CORN AND TOBACCO

Experiments on Sango Silt Loam at Mericourt Station, Clarksville

By

C. A. Mooers and O. H. Long

KNOXVILLE
THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
KNOXVILLE

JAMES D. HOSKINS, President

AGRICULTURAL COMMITTEE
W. P. COOPER  I. B. TIGRETT  CLYDE B. AUSTIN
W. F. RIDLEY  JAMES T. GRANBERY
O. E. VAN CLEAVE, Commissioner of Agriculture

ADMINISTRATION
C. A. MOOERS, Director
F. S. CHANCE, Assistant Director
E. G. FRIZZELL, Associate Secretary
J. N. ODOM, Gen. Supt. of Farms

AGRONOMY
C. A. MOOERS, Agronomist
J. J. BIRD, Associate Agronomist
E. L. BOHANAN, Asst. Agronomist, Crossville
A. G. BUCK, Asst. Agronomist
HENRY CUMMINS, Farm Supt., Crossville
W. A. CHRISMAN, Plot Assistant
J. G. FAULKNER, Plot Assistant
N. H. LINDSAY, Assoc. Agronomist
O. H. LONG, Asst. Agronomist
R. L. LONG, Plot Assistant, Jackson
J. R. MEYER, Assoc. Agronomist
F. L. RICHARDSON, Assoc. Agronomist (Corn Breeding)
J. K. UNDERWOOD, Assoc. Agronomist
JOHN B. WASHKO, Assoc. Agronomist
W. O. WHITTLER, Asst. in Agronomy
ERIC WINTERS, Assoc. Agronomist

ANIMAL HUSBANDRY
J. C. MILLER, Animal Husbandman
C. E. WYLIE, Dairy Husbandman
H. R. DUNCAN, Assoc. Animal Husbandman
M. C. HERVEY, Assoc. Animal Husbandman
S. A. HINTON, Dairy Husbandman
R. J. McSPADEN, Poultry Husbandman
J. T. MILES, Dairy Herdsman
A. C. TODD, Parasitologist

CHEMISTRY
W. H. MACINTIRE, Soil Chemist
G. A. SHUEY, General Chemist
MARY K. GOOD, Asst. Gen. Chemist
KATHLEEN M. McCOOK, Asst. Gen. Chemist
BROOKS ROBINSON, Asst. Soil Chemist
K. B. SANDERS, Assoc. General Chemist
W. M. SHAW, Assoc. Soil Chemist
S. H. WINTERBERG, Assoc. in Soil Chemistry
J. B. YOUNG, Asst. Soil Chemist

ECONOMICS AND SOCIOLOGY
C. E. ALLRED, Agricultural Economist
H. J. BONNER, Assoc. Agr. Economist
A. H. CHAMBERS, Asst. Agr. Economist
B. H. LIEBKE, Assoc. Agr. Economist
C. C. MANTLE, Asst. Agr. Economist
F. N. MASTERS, Asst. Agr. Economist
W. P. RANNEY, Assoc. Agr. Economist
BEN. D. RASKOFF, Assoc. Agr. Economist

ENGINEERING
M. A. SHARP, Agricultural Engineer
H. A. ARNOLD, Assoc. Agr. Engineer
A. L. KENNEDY, Assoc. Agr. Engineer
ARTHUR H. MORGAN, Mech. Engineer
G. M. PETERSEN, Assoc. Agr. Engineer

ENTOMOLOGY
S. MARCOVITCH, Entomologist
W. W. STANLEY, Assoc. Entomologist

FORESTRY
R. F. KROODSMA, Forester, Greeneville
LLOYD FORD, Asst. in Forestry, Greeneville

HOME ECONOMICS
FLORENCE L. MACLEOD, Home Economist
DOROTHY E. WILLIAMS, Nutrition Chemist
MARY L. DOODS, Assoc. Home Economist
ELISE MORRELL, Asst. Nutrition Chemist
LOYCE L. DUNN, Asst. Home Economist

HORTICULTURE
BROOKS D. DRAIN, Horticulturist
R. H. HANCHEY, Asst. Horticulturist, Jackson
ARTHUR MEYER, Asst. Horticulturist
JOAN W. DEuell, Asst. Horticulturist
N. D. PEACOCK, Assoc. Horticulturist
C. R. SPANGLER, Asst. in Horticulture
A. B. STRAND, Assoc. Hort., Dandridge

INFORMATION
A. J. SIMS, Head of Department
F. H. BROOME, Editor and Secretary
SARAH C. CURELL, Librarian

PHYSICS
K. L. HERTEL, Physicist
JOHN DEANS, Instrument Maker
REBA LAWSON, Asst. in Physics

PLANT PATHOLOGY
C. D. SHERBAKOFF, Plant Pathologist
J. O. ANDRES, Assoc. Plant Pathologist
E. S. BROWN, Asst. in Plant Pathology
JAMES M. EPFS, Assoc. Plant Pathologist, Jackson
DENNIS H. LATHAM, Assoc. Plant Pathologist, Springfield
T. L. SENEY, Asst. Plant Pathologist

SUBSTATIONS
LESTER WEAKLEY, Assistant, Highland Rim Experiment Station, Springfield.
L. R. NEEL, Superintendent, Middle Tennessee Experiment Station, Columbia.
JOHN A. EWING, Asst. Supt., Middle Tennessee Experiment Station, Columbia.
JOHN A. ODOM, Acting Supt., Plateau Experiment Station, Crossville.
J. L. VANDIVER, Assistant Agronomist, Tobacco Experiment Station, Greeneville.
B. P. HAZLEWOOD, Superintendent, West Tennessee Experiment Station, Jackson.

1Cooperative with U. S. Department of Agriculture.
2On military leave.

Bulletins of this Station will be mailed free to any farmer in the State. Write Agricultural Experiment Station, University of Tennessee, Knoxville, Tennessee.
EFFECTS OF LIME, FERTILIZER, AND PRECEDING LEGUMES ON THE YIELDS OF CORN AND TOBACCO

Experiments on Sango Silt Loam at Mericourt Station, Clarksville

By
C. A. Mooers and O. H. Long

SOIL DESCRIPTION

The field experiments discussed in this bulletin were located on the Highland Rim. The soil was a very poor, depleted Sango silt loam known to be much in need of lime and of all the usual fertilizer elements—nitrogen, phosphoric acid, and potash. In other experiments in the same field the need of phosphate had been shown to be so great that without it neither nitrogen nor potash was effective.

This type of soil is of common occurrence in different parts of the Highland Rim. The surface soil is of yellowish-gray color, with a yellow or pale brownish-yellow subsoil. The surface drainage is described as slow, and the internal drainage as impeded by hardpan but sufficient for most farm crops. The hardpan is found at a depth of 20 to 24 inches; it is from 1 to 2 feet thick and of varying degrees of cementation.

RELATED SOILS

Related soil types, especially on level or bottom lands, often form a chain which is differentiated by internal drainage conditions. In this case the chain is Dickson-Sango-Lawrence-Guthrie, beginning with the best internal drainage and ending with the poorest. Guthrie soils are mainly forested or used for pasture. Corn and hay crops are grown only occasionally. The fact that Sango is intermediate between Dickson and Lawrence, and no sharp line of separation exists, indicates that impoverished Dickson and Lawrence soil might behave similarly to the Sango used in the experiments reported. All the types making up this chain belong to the light-colored and poorer soils of the Highland Rim and all are known to be strongly acid, very poor in phosphate, more or less deficient in potash, and as a rule poor in nitrogen.

GENERAL PLAN OF EXPERIMENTS

PHOSPHATE AND POTASH

Because of the great deficiency of phosphate, the entire experimental area was treated to a uniform application of superphosphate amounting to 1000 pounds per acre of 16-percent superphosphate every 5 years. Of this amount, 600 pounds was applied for corn and tobacco, and 400 pounds for wheat. The west half of the area received 100 pounds per acre of sulphate of potash applied for
corn and tobacco and 100 pounds of muriate of potash applied for the wheat, making an average annual application of 40 pounds per acre of a 50-percent potash salt. No potash was applied to the east half.

**LIMING**

Ground limestone at the rate of two tons per acre was applied at the outset to the north half of each of the 100 plots used in the experiments. A like application to the same areas was made about 5 years previously.

**CROP ROTATIONS**

Five crop rotations were grown for comparison under the same fertilizer and liming conditions. The rotations were as follows:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>First year</td>
<td>Soybeans</td>
<td>Wheat</td>
<td>Wheat</td>
<td>Wheat</td>
<td>Wheat</td>
</tr>
<tr>
<td>Second year</td>
<td>Wheat</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean L. (under)</td>
<td>Korean L. (removed)</td>
</tr>
<tr>
<td>Third year</td>
<td>Clover and Grasses</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean L. (under)</td>
<td>Korean L. (removed)</td>
</tr>
<tr>
<td>Fourth year</td>
<td>Clover and Grasses</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean L. (under)</td>
<td>Korean L. (removed)</td>
</tr>
<tr>
<td>Fifth year</td>
<td>Corn and Tobacco</td>
<td>Corn and Tobacco</td>
<td>Corn and Corn and Tobacco</td>
<td>Corn and Tobacco</td>
<td>Tobacco</td>
</tr>
</tbody>
</table>

All crops of all rotations were grown each year. In conformity to the rotational requirements, the crops were shifted annually to a different range, so that the corn and tobacco were grown only twice on the same range during the 10-year period. Both of these crops, after the first year, always followed the clover and grass of rotation 1, the alfalfa of rotation 2, the sericea of rotation 3, and the Korean lespedeza of rotations 4 and 5. For the field layout, see figure 1.

Attention is called to the fact that crimson clover for green manure was sown after both corn and tobacco of rotation 1. Fair stands and growth were obtained in nearly 3 years out of 5 and assisted materially in the soil upbuilding of that rotation.

**RESULTS**

**EFFECTS OF LIMING**

Table 1 gives the average yields obtained under both limed and unlimed conditions for the 10-year period for the various hay crops, and table 2 gives the same information for wheat. Table 3 gives the average yields of corn for the first and second 5-year periods separately. Table 4 gives the total yields of tobacco for each of the 5-year periods.
Fig. 1—Plot arrangement, showing fertilizer and lime treatments, and crops as grown in 1934.
Fig. 2—The 1939 crop of tobacco following 4 years of wheat and Korean lespedeza, the latter turned under each year. Phosphate and potash added.

The acre yield for 1939 was 930 pounds, valued at $119.00; the 10-year averages were 854 pounds and $114.00.

Fig. 3—The 1939 crop of tobacco following wheat and sericea, the latter removed as hay for 3 years. Phosphate, potash, and lime treatments same as in figure 2.

The acre yield for 1939 was 1188 pounds, valued at $153.00; the 10-year averages were 1134 pounds and $154.00.
Table 1—Hay crops—average yields per acre for ten-year period.

<table>
<thead>
<tr>
<th>Fertilizer and lime treatments</th>
<th>Rotation 1 Clover and grass</th>
<th>Rotation 1 Soybeans</th>
<th>Rotation 2 Alfalfa</th>
<th>Rotation 3 Sericea</th>
<th>Rotation 5 Korean lespedeza</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons</td>
<td>Tons</td>
<td>Tons</td>
<td>Tons</td>
<td>Tons</td>
</tr>
<tr>
<td>Phosphate, potash, and lime.</td>
<td>1.59</td>
<td>2.95</td>
<td>2.00</td>
<td>2.91</td>
<td>1.30</td>
</tr>
<tr>
<td>Phosphate and potash.</td>
<td>0.71</td>
<td>2.37</td>
<td>0.00</td>
<td>2.05</td>
<td>0.63</td>
</tr>
<tr>
<td>Phosphate and lime.</td>
<td>0.69</td>
<td>2.29</td>
<td>1.30</td>
<td>2.40</td>
<td>1.06</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.33</td>
<td>1.57</td>
<td>0.00</td>
<td>1.81</td>
<td>0.58</td>
</tr>
</tbody>
</table>

The effect of liming was, in general, very striking, but varied greatly with the kind of crop. As indicated in table 5, practically no alfalfa was obtained where lime was withheld. Liming increased the yield of clover-and-grass hay 117 percent. Korean lespedeza came next, with an increase of 94 percent. Sericea and soybean hay were increased 38 and 35 percent respectively. Wheat and corn were increased 39 and 29 percent.

Tobacco did not show any gains from liming as an average of all rotations, but did show good indirect effects from the liming of alfalfa and sericea in rotations 2 and 3, the gain attributable to lime being 18 and 12 percent respectively. Liming, where potash was withheld, was particularly unfavorable to the tobacco after Korean lespedeza both where this legume was turned under and where it was removed.

EFFECTS OF POTASH

The effects of the potash applications, as of liming, were very striking and widely different for different crops. As shown in table 5, the yield of clover-and-grass hay was increased, on the average, 123 percent; alfalfa hay, 54 percent; and tobacco, 36 percent; while sericea hay was increased only 17 percent and Korean hay only 16 percent. Of the two grain crops, wheat was unaffected and corn showed an increase of only 6 percent.

EFFECTS OF PRECEDING LEGUMES

The comparative effects of preceding legumes on the production of both corn and tobacco are a prominent feature of the experimental series (Figs. 2, 3, and 4). In the analysis of the data, consideration should be given to certain conditions which undoubtedly influenced the outcome. The alfalfa was sown in the fall, and on the limed plots made good growth the following year. Sericea, on the other hand, was sown in the spring and made little growth the first
Table 3—Corn—average yields per acre, by five-year periods.

<table>
<thead>
<tr>
<th>Five-year period</th>
<th>Fertilizer</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1—Clover and grass</td>
</tr>
<tr>
<td></td>
<td>Grain Bushels</td>
<td>Tons</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate, potash, and lime</td>
<td>42.4</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate, potash, and lime</td>
<td>40.9</td>
</tr>
<tr>
<td>Increase</td>
<td>18.5</td>
<td>0.49</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate and potash</td>
<td>34.6</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate and potash</td>
<td>47.1</td>
</tr>
<tr>
<td>Increase</td>
<td>12.5</td>
<td>0.39</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate and lime</td>
<td>42.3</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate and lime</td>
<td>51.0</td>
</tr>
<tr>
<td>Increase</td>
<td>8.7</td>
<td>0.17</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate</td>
<td>27.2</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate</td>
<td>40.2</td>
</tr>
<tr>
<td>Increase</td>
<td>13.0</td>
<td>0.18</td>
</tr>
</tbody>
</table>

1 Minus sign indicates decrease for second 5-year period.

Table 4—Tobacco—average yields per acre, by five-year periods.

<table>
<thead>
<tr>
<th>Five-year period</th>
<th>Fertilizer</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1—Clover and grass</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate, potash, and lime</td>
<td>1085</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate, potash, and lime</td>
<td>1041</td>
</tr>
<tr>
<td>Increase</td>
<td>1-222</td>
<td>346</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate and potash</td>
<td>900</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate and potash</td>
<td>908</td>
</tr>
<tr>
<td>Increase</td>
<td>1-14</td>
<td>292</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate and lime</td>
<td>724</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate and lime</td>
<td>825</td>
</tr>
<tr>
<td>Increase</td>
<td>1-99</td>
<td>400</td>
</tr>
<tr>
<td>1934-1938</td>
<td>Phosphate</td>
<td>765</td>
</tr>
<tr>
<td>1939-1943</td>
<td>Phosphate</td>
<td>765</td>
</tr>
<tr>
<td>Increase</td>
<td>0</td>
<td>265</td>
</tr>
</tbody>
</table>

1 Minus sign indicates decrease for second 5-year period.
year. In fact, it usually does not make maximum growth until the third year. Alfalfa, therefore, has the advantage as a soil-improving crop by reason of its quick arrival at a full-crop status, and hence would be expected to affect in particular the results obtained in the earlier years of rotation establishment.

Like the alfalfa, the red clover of rotation 1 made little or no growth except on the limed plots. Even where limed, it produced and maintained good stands with increasing difficulty. This was partly offset by the crimson clover.

The Korean lespedeza soon became self-seeding, and in time spread from the plots of rotation 4 to the sericea plots of rotation 3, to the ultimate detriment of the sericea.

**EFFECTS ON CORN**

During the first 5 years the effects of the different legumes on the yield of corn were decidedly mixed, in that the order of yield lacked much of being consistent with the kind of legume. Table 6-A depicts the results obtained from the 5-year average. Some consistency appears in the case of Korean lespedeza. Where turned under, it is at the top twice—once with the phosphate treatment and once with the phosphate-potash-lime treatment. With the phosphate-potash treatment it ranked second once, and with the phosphate-lime treatment it ranked third once. On the other hand, where the Korean was removed as hay the yields of corn ranked appreciably less, occupying fifth place twice and third place twice.

Table 6-B shows that during the second 5 years a decided change has taken place, with consistent standing the rule. Alfalfa ranks first, clover and grass second, sericea third, Korean-under fourth, and Korean-removed fifth.

**EFFECTS ON TOBACCO**

The effects of the preceding legumes on the production of tobacco, as shown in table 7, are similar to those found for corn, in that for the first round of the rotation there was little consistent relationship between the preceding legumes and the comparative rank of the tobacco crop which followed.
Table 6—Order of yields of corn as affected by the preceding legume.

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>A. Rank first 5 years</th>
<th></th>
<th></th>
<th></th>
<th>B. Rank second 5 years</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>4th</td>
<td>5th</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
</tr>
<tr>
<td>Phosphate, potash, and lime</td>
<td>Korean under</td>
<td>Alfalfa</td>
<td>Korean removed</td>
<td>Sericea</td>
<td>Clover and grass</td>
<td>Korean under</td>
<td>Alfalfa</td>
<td>Sericea</td>
</tr>
<tr>
<td>Phosphate and potash</td>
<td>Clover and grass</td>
<td>Korean under</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean removed</td>
<td>Alfalfa</td>
<td>Clover and grass</td>
<td>Sericea</td>
</tr>
<tr>
<td>Phosphate and lime</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean under</td>
<td>Clover and grass</td>
<td>Korean removed</td>
<td>Alfalfa</td>
<td>Clover and grass</td>
<td>Sericea</td>
</tr>
<tr>
<td>Phosphate</td>
<td>Korean under</td>
<td>Sericea</td>
<td>Korean removed</td>
<td>Alfalfa</td>
<td>Clover and grass</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean under</td>
</tr>
</tbody>
</table>

Table 7—Order of yields of tobacco as affected by the preceding legume.

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>A. Rank first 5 years</th>
<th></th>
<th></th>
<th></th>
<th>B. Rank second 5 years</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>4th</td>
<td>5th</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
</tr>
<tr>
<td>Phosphate, potash, and lime</td>
<td>Clover and grass</td>
<td>Alfalfa</td>
<td>Korean removed</td>
<td>Korean under</td>
<td>Sericea</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Korean under</td>
</tr>
<tr>
<td>Phosphate and potash</td>
<td>Clover and grass</td>
<td>Korean under</td>
<td>Alfalfa</td>
<td>Korean removed</td>
<td>Sericea</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Clover and grass</td>
</tr>
<tr>
<td>Phosphate and lime</td>
<td>Alfalfa</td>
<td>Clover and grass</td>
<td>Sericea</td>
<td>Korean under</td>
<td>Clover and grass</td>
<td>Sericea</td>
<td>Clover and grass</td>
<td>Korean removed</td>
</tr>
<tr>
<td>Phosphate</td>
<td>Korean under</td>
<td>Clover and grass</td>
<td>Alfalfa</td>
<td>Korean removed</td>
<td>Sericea</td>
<td>Alfalfa</td>
<td>Sericea</td>
<td>Clover and grass</td>
</tr>
</tbody>
</table>
Fig. 4—Corn and tobacco. 1941 crop, after legumes as follows: A. alfalfa removed as hay; B. Korean lespedeza turned under; C. sericea removed as hay; D. Korean removed as hay.
It is noticeable, however, that under three of the four fertilizer and lime conditions sericea ranked in only fifth place. Korean removed as hay never ranked above third place; where turned under for green manure it was in first place only once, and elsewhere was in either third or fourth place.

In the second round of the rotation, or the second 5 years, a decided change took place in the rating of the legumes. Alfalfa ranked first under all four conditions, sericea was second under all conditions, and clover and grass came third in three of the four conditions. Korean turned under was third once and fourth three times, and where removed as hay it was in fifth place under all conditions.

The evidence from both corn and tobacco gives a very low rating to Korean lespedeza as a soil-improving crop. This was especially noticeable where it was removed as hay. Even where turned under, its rank for the second 5 years of the trials was below the other legumes, all of which had been removed for hay.

Sericea made an excellent showing, producing good crops under all the fertilizer and liming conditions, and giving a good account of itself as a preceding crop for either corn or tobacco.