An Agricultural Education Outline

Soil Management Practices

Soil Characteristics
- Liming
- Drainage
- Alkali Reclamation
- Irrigation
- Fertilizing
- Crop Rotation

D. Dawson

Oregon State College
Corvallis
July 1957

A School of Agriculture Publication
General Suggestions

Study each step of these units carefully prior to class instruction to familiarize yourself with the methods, information, skills, and materials needed.

Have each boy plan a soil management program for a particular farm, making every effort to give it the status of a functioning program.

Boys who do not live on farms might find neighboring farmers willing to have soil management program planned for their farms. The boy without a home farm who receives supervised farming credit for working on a farm would find this procedure especially advantageous.

Since soil management problems vary widely throughout the State, modify these units to fit the needs of your particular area.

Determine facilities needed for teaching these units several weeks prior to beginning the course. All essential materials should be on hand in suitable condition when teaching starts.

pH test kits obtainable from the Soils Department, Oregon State College, and a soil auger are useful teaching aids.

Two standard textbooks should be on hand.


Several home-farm outline maps will be needed by each boy.

Check availability of references listed at the end of each unit. Those marked with an asterisk (*) are out of print but can be obtained in local libraries. A review list of all literature used in the seven units will be found on page 51.
AN OUTLINE OF
Soil Management Practices

Teaching Units

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Foreword

Teaching soils is often one of the most difficult tasks of the vocational agriculture instructor. Soils is not only quite technical and demands training, but is also sometimes hard to make interesting to students.

Soil judging provides an excellent tool to motivate pupils in their study. It is necessary, however, to learn about the things we look at when we judge soils.

Having learned certain factors important in order to describe a soil, we need to interpret them in terms of soil management. This approach to teaching soils has two advantages. First, we look at the soil as a whole in contrast to discussing say, soil formation. Second, when we have learned to recognize differences among soils due to variations in depth, texture, organic matter, drainage, etc., these differences often suggest management problems. Most successful vocational agriculture instructors teach partly or wholly on the problem basis. They guide or direct students in solving problems rather than teach textbook facts.

This manual, designed primarily for vocational agriculture teachers in Oregon, presents a number of teaching units. It is hoped these may be used as a guide and an aid to promote effective instruction in soils to vocational agriculture pupils. In some cases teachers may wish their pupils to possess this manual also. Since it is the first publication of this type on Oregon soils it will undoubtedly need to be revised and improved. We would appreciate getting suggestions that will be helpful in preparing future revisions.

The units need not be taught in the sequence presented. Nor does each unit apply equally well to a given situation. Unit I could be used to motivate and encourage pupils to further their knowledge about soils. A soil Judging Contest might be equally effective as a means for evaluating student understanding of soils and their management.
Introduction

Oregon presents an almost unique picture of different soils. Indeed it is doubtful whether any state in the United States could rival the soil variability found in the Beaver state.

Climate, vegetation, topography, soil parent material, and age of a given soil vary so much, it is little wonder we possess such striking soil differences. In parts of Eastern Oregon where annual rainfall is 5 inches, the typical natural vegetation consists of big sagebrush, blue-bunch wheatgrass, Shadescale, and bud sage. Coastal Oregon with an annual rainfall of approximately 80 inches is forested in Douglas fir, red cedar, and hemlock. Between these contrasts are many intermediate zones. Some soils are very old like the “red-hill” soils of Western Oregon; others are recent like the first bottomland soils of the Willamette Valley and lowlands close to rivers in Eastern Oregon. Then, too, soils have developed from many kinds of parent material. Some have been deposited by rivers or lakes, others by wind, while still others have developed from bedrocks such as basalt.

Natural drainage among soils even within a short distance is another highly variable factor. In regions of low rainfall poor drainage is often associated with high alkalinity, while in the wetter regions it is associated with a waterlogged condition. Soil depth is another highly variable characteristic. In Central Oregon 2 to 3 feet soil depth is not uncommon while some wind-deposited soils in Eastern Oregon are 30 to 40 feet deep. Texture, color, water permeability, soil pH, organic matter, content, stoniness, and slope are other soil characteristics which differ markedly even within a relatively short distance.

Soil management problems in Oregon, therefore, present a great challenge to agriculturalists, horticulturists, and foresters. These problems vary not only geographically, that is from a high rainfall area to a low rainfall area, but also from farm to farm. Local differences, even on the same farm, pose particular soil management problems, partly due to inherent soil differences and also to differences in past land management. The system of farming on a given piece of land presents its own soil and farm management problems.

The exercises in this manual have been developed with the aim of teaching principles helpful in maintaining or improving soil productivity, using the problem approach.

Drainage, irrigation, fertilization, and choice of crops to be grown are all practices that will affect profitability. Certain economic principles, therefore, must be considered when decisions are made if profit is to be maximized by modifying soil management practice. For example, fertilizer may be applied in various quantities. Yield then will vary, although not always in direct proportion, with the amount of fertilizer applied. This relationship, together with the price of the crop and the cost of the fertilizer, determines the most profitable quantity of fertilizer to apply. A practice is profitable if the added return is greater than the added cost.

Each practice should be subjected to such a practical test before adoption. Fertilizer experiments that relate yields to the amount of fertilizer applied are ideal for making a test of this type. It is possible to estimate the cost of irriga-
tion and drainage quite accurately. Our knowledge of soils permits us to estimate the returns that can be attributed to these practices. Unless they seem likely to pay their way, they will not be adopted, or continued. There is another point to remember: the last dollar spent on (say) fertilizer should return the same income as the last dollar spent on (say) protein feed for livestock.

In planning the crops to be grown, an inventory of the farmer’s resources should be taken. How much land does he have? How much capital does he have, and is he able and willing to borrow? What is the quality of the land? Which resource is most likely to be in short supply? With this inventory the farmer is in a position to select those crops that will yield the highest return to his resources. If all resources can be fully utilized, the farmer has a balanced operation. If some resource such as labor is idle part of the year, the farmer may have a poor balance. Of course, partly idle resources are characteristic of certain types of farming. A wheat farmer may not utilize all his winter labor, and the buildings and machinery on other farms may not have full use during the entire year. In such cases select the resource—land, labor, or capital—that is the most limiting and plan around that particular resource, emphasizing efficiency in its use. If some resources are idle part of the time try to readjust their supply. Full utilization of resources where possible is a good general objective.

Obviously many economic questions cannot be treated in detail here. It is suggested the reader consult the following references for a full treatment of these problems:


**Acknowledgment:** The author wishes to thank Dr. Emery Castle of the Agricultural Economics Department, Oregon State College, for assistance in writing the above section.
UNIT I. Developing Abilities and Skills Helpful in Distinguishing Between Soils

Unit Objectives

- To develop an appreciation of soil differences and the significance of these differences.
- To develop the ability to identify soil characteristics.
- To develop a knowledge of the influence of soil characteristics and soil differences on management practices.

Suggested Unit Analysis

1. What items should I look for when I examine soil?
2. What tests or observations should I make to determine these items?
3. How may I obtain help in evaluating my soil tests and observations?

Suggested Teacher-Pupil Activities

1. What items should I look for when I examine soil?
   A. Show by means of soil profiles or pits dug in adjacent land the difference between topsoil and underlying soil.
   B. List the characteristics that distinguish one soil from another, and topsoil from underlying soil.

2. What tests or observations should I make to determine these items?
   A. Show, by wetting a surface soil sample, how to determine soil texture.
   B. Remove topsoil from a field with a spade, and observe the way the soil is held together—the soil tilth.
   C. Show the effective depth of plant rooting in a soil.
   D. Determine structure of subsurface soil.
   E. Show how to determine the pH of the soil (surface and subsurface), using the pH test kit.
   F. Show, by means of an abney level, the per cent slope of the land.
   G. Determine the degree of erosion, using Soil Judging in Oregon.

3. How may I obtain assistance to evaluate my soil tests and observations?
   A. Check soil tests and observations with Oregon State College or Soil Conservation Service specialists.
   B. Check the soil judging score card (sections A,B,C, and D only) against a master copy previously filled out by soil scientists.
   C. Prepare a checklist of knowledge, skills, and objectives completed and mastered.
LEFT: Dayton silty clay loam—showing gray leached A horizon on columnar B horizon.

RIGHT: Amity silty clay loam with compact, mottled accumulation horizon that impedes drainage and roots.

References:


UNIT II. Planning a Liming Program

Unit Objectives

- To develop ability to identify and solve problems involved in working out a liming program.
- To encourage class members to work out liming programs for their home farms or farms being studied as a definite part of their supervised farming programs.
- To develop an appreciation of the economic importance of a good liming program.
- To develop skills adequate for reliable soil sampling and pH testing.
- To develop ability to interpret results of pH tests in terms of liming needs.
- To encourage thoroughness, accuracy, and neatness in gathering, arranging, and recording data.
- To develop favorable attitudes toward agencies which help the farmer.

Suggested Unit Analysis

1. What pH goals should I set for my farm?
2. What liming material is the best buy?
3. How much lime is needed to bring about the desired pH changes?
4. How much should my liming program cost?
5. Where should I apply lime in the rotation?
6. When and how should next year's lime supply be applied to selected fields?
7. How can I secure cost-sharing payments for lime through the A.C.P. (Agricultural Conservation Program)?
8. What is the relationship between liming and soil productivity?

Suggested Teacher-Pupil Activities

1. What pH goals should I set for my farm?
   A. What is the pH of my fields now?
      (1) Show the class the film on soil testing.
      (2) Class field trip to a boy's farm or to farm selected as a demonstration farm, to teach method of taking composite sample of a field and testing for pH. (Farm Soils, pages 211-216; How to Take a Sample and Why.)
      (3) Have each boy:
         (a) Take composite samples on fields of home farm or farm he is studying and bring these samples to school for pH testing. (Use Oregon State College pH test-kit.)
         (b) Test composite samples and record average pH. (See Farm Soils, pages 218-219.)
LIMING PAYS by increasing crop yields, and lime increases yields in several ways—by reducing soil acidity, by adding calcium, and by increasing the ability of phosphorus to be used by plants. Lime also increases legume yields by increasing the amount of nitrogen fixed by soil bacteria.

(c) Make a pH map of his farm, showing by dots where topsoil and subsoil samples were taken and depth of sampling each point. If necessary subdivide fields. (See Farm Soils, pages 216-220.)

B. What is the optimum pH range for crops grown on my farm?
(1) Develop a list of crops grown in the community by having each boy tell what crops are grown on his farm.
(2) Group crops in tabular form according to pH ranges given on page 19 of Our Land and Its Care or page 409 of Nature and Property of Soils.

C. What are desirable pH goals for the fields on my farm?
(1) Have each boy:
   (a) Develop a chart of crops to be grown on his farm during the rotation, with optimum pH ranges for each.
(b) Determine for each field the crop requiring the highest pH.
(c) Determine the pH goals for each field.

2. What liming material is the best buy?

A. What liming materials are used on my farm?
   (1) Have each boy report on the kinds of liming materials used.
   (2) Tabulate this data to give a picture of community preference
       for liming materials.

B. What liming materials are available?
   (1) Have class make a survey of availability and price of liming
       materials locally. Choose delegates to confer with County Agents
       and local fertilizer dealers. Find out the siding, hauling, and
       spreading costs. Also determine the lime equivalent of each ma-
       terial available (see quality score card, page 13). Determine
       how to order, when payment is required, and delivery date.
   (2) Have each boy read the following:
       (a) In Western Oregon, Liming Pays.
       (b) Farm Soils, page 225.

C. What liming material is the best buy for my farm?
   (1) Have each boy:
       (a) Determine the total cost for each liming material delivered
           and spread on his farm.
       (b) Determine the cost per ton of calcium carbonate equivalent.
           (See In Western Oregon, Liming Pays.)
       (c) Decide which liming material is the best buy for his farm.
           Record this decision in plan, giving reasons for the deci-
           sion and including availability, ease of application, and
           neutralizing value per dollar invested.

3. How much lime is needed to bring about the desired pH changes?

A. What has been the liming history of the fields?
   (1) Have each boy:
       (a) Determine soil texture of the fields found on his farm from
           a soil map.
       (b) Determine the amount of manure and lime applied to each
           field during the past 4 years, and record this information.

B. How much lime is needed to bring fields up to desired pH levels?
   (1) Have each boy read the following:
       (a) Farm Soils, pages 215-222. (Note similarity of principles,
           but not necessarily the same lime recommendation for Ore-
           gon soils.)
       (b) Nature and Property of Soils, pages 431-443.
       (c) General Guide for the Interpretation of Soil Tests, Section
           B, and lime quality score card, page 13.
(2) Have boys send soil to Soil Testing Laboratory, Oregon State College, for "lime requirement test."
(3) Have each boy record amount of lime now needed on each field, and amount of lime needed on each field as a maintenance application.

4. How much should my liming program cost?
   A. What has been the annual cost of applying lime on my farm?
      (1) Have each boy determine the average annual cost of lime used.
   B. How does the amount of money spent for lime on my farm compare with the amount spent by outstanding farmers?
      (1) Determine the average annual cost of lime per farm represented by members of the class.
      (2) Have each boy compare his farm with the average of farms with similar pH goals.
   C. What will be the annual cost of the liming program I planned?
      (1) Have each boy develop a schedule for his farm to include the following:
          (a) Total amount of lime needed to bring fields to desirable pH levels.
          (b) Total cost of this lime.
          (c) Amount of lime that can be purchased this year.
          (d) Number of years to reach pH goals established.
          (e) Amount of lime needed annually for maintenance of pH goal.

5. Where should I apply lime in the rotation?
   A. What fields have received lime during the past 4 years?
      (1) Have each boy review the liming history of fields as a partial basis for determining the order in which fields are to receive lime.
   B. In what order should fields receive lime?
      (1) Have each boy read the following:
          (b) Lime—100 Questions and Answers, page 27.
          (c) In Western Oregon, Liming Pays.
          (d) Farm Soils, pages 230-235.
   C. What liming program should I follow on my farm?
      (1) Have each boy:
          (a) Record the amount of lime needed to bring fields to desirable pH level, and crop rotations for fields, beginning with current year.
          (b) Decide which fields each year are to receive the year’s quota of lime.
(c) Determine the total amount to be used annually. This total should be in agreement with the plan arrived at in question 3.
(d) Indicate plans for reliming fields to maintain pH level once it has been reached.

6. When and how should next year's lime supply be supplied to selected fields?

A. At what time of year is lime applied to fields?
   (1) Have each boy:
      (a) Make a list of fields that are too wet in fall or spring for bulk spreading.
      (b) Determine those times during spring, summer, or fall when liming would least conflict with other farm jobs.
      (c) Determine time of year that lime applications are made.
      (d) Determine method of applying lime.
   (2) Summarize the practices found on farms of class.

B. What are the recommended practices relative to time and method of applying lime?
   (1) Have each boy read the following:
      (b) Lime—100 Questions and Answers, pages 23-27.
      (c) Farm Soils, pages 230-235.

C. When and how should I apply next year's lime supply to selected fields?
   (1) Record:
      (a) Time of year when lime can best be applied, considering field conditions, labor supply, and availability of equipment.
      (b) Whether to apply lime before or after plowing.
      (c) Method of applying lime with reasons for decisions.

7. How can I secure cost-sharing payments for lime through the A.C.P. (Agricultural Conservation Program)?

A. How is lime secured?
   (1) Have each boy determine agencies through which lime is secured and amounts purchased.
   (2) Tabulate this information on the board and calculate the percentage of lime secured through various channels.

B. How can lime be secured through A.C.P.?
   (1) Have A.C.P. local committeeman meet with the class to discuss this problem.
   (2) Have each boy:
      (a) Consider the annual benefits to his farm through cooperation with the A.C.P.
(b) Study liming features of county and state A.C.P. programs.

C. Shall I secure the needed lime through the A.C.P.?
   (1) Have each boy:
      (a) Calculate the cost of lime for his farm if secured through the A.C.P., and compare with the cost of liming program.
      (b) Record his decision regarding this question, with reasons, in his unit plan.

8. What is the relationship between liming and soil productivity?
   A. What are the reasons for poor growth of many agricultural plants on acid soils?
      (1) Have each boy read the following:
         (a) Farm Soils, pages 208-215.
         (b) Nature and Property of Soils, pages 39-44.

SOIL pH AFFECTS THE AVAILABILITY OF PLANT NUTRIENTS

<table>
<thead>
<tr>
<th>Very Acid</th>
<th>pH</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Bacteria</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nitrogen</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Calcium and Magnesium</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Phosphorus</td>
<td>Potassium</td>
</tr>
<tr>
<td></td>
<td>Sulfur</td>
<td>Boron</td>
</tr>
<tr>
<td></td>
<td>Copper and Zinc</td>
<td>Iron and Manganese</td>
</tr>
<tr>
<td></td>
<td>Molybdenum</td>
<td></td>
</tr>
</tbody>
</table>
(2) Have boys tabulate yields of various crops and respective pH of the fields where grown. (Determine whether the same crop has yielded differently in fields of varying pH levels.)

B. How does lime affect soil productivity?

(1) Have each boy read the following:
   (a) *Nature and Property of Soils*, pages 435-446.
   (b) *Farm Soils*, pages 230-237.
   (c) *In Western Oregon, Liming Pays*, page 3.
   (d) Slide set, *Benefits from Lime*, Soils Department, Oregon State College.

C. Why should I consider liming to increase productivity?

(1) Have each boy:
   (a) Tabulate the kinds of response that could be expected from various crops after liming.
   (b) Record the place of lime in an efficient fertilizer program.
   (c) Record other management practices influenced by liming fields.

References:


*In Western Oregon, Liming Pays*. Oregon Experiment Station Circular of Information 549, Oregon State College, Corvallis.

*Our Land and Its Care*. American Plant Food Council, 910 17th St., Washington 6, D. C.

*Lime—100 Questions and Answers*, Cornell University Mailing Room, Roberts Hall, Ithaca, N. Y.

pH test kit—Soils Club, Oregon State College, Corvallis.


*Benefits from Lime*, slide set. Soils Department, Oregon State College, Corvallis.


*How to Take a Soil Sample and Why*, Oregon Extension Circular 628, Oregon State College, Corvallis.
Liming Materials Quality Score Card

The "liming materials quality score card" outlined below gives a method for evaluating samples of liming materials with varying percentages of calcium carbonate equivalent that have been ground to different degrees of fineness.

This score card evaluates both the particle size of the liming material and the calcium carbonate equivalent. The guarantee required by the state fertilizer law includes the percentage of the sample passing each of these screens and the calcium carbonate equivalent. The example given below was of a lime having the following analysis: CaCO$_3$ Equivalent 97.7% passing 40 mesh sieve, 58.3%; 20 to 40 mesh, 24.3%; 10 to 20 mesh, 16.6%.

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen size</td>
<td>Particle size separation</td>
<td>Availability within 3 years</td>
<td>Fineness factor</td>
</tr>
<tr>
<td>40 Mesh or smaller (per cent passing mesh)</td>
<td>Per cent</td>
<td>Per cent</td>
<td>Per cent</td>
</tr>
<tr>
<td>58.3</td>
<td>100</td>
<td>58.3</td>
<td></td>
</tr>
<tr>
<td>20 to 40 mesh (per cent passing)</td>
<td>Per cent</td>
<td>Per cent</td>
<td>Per cent</td>
</tr>
<tr>
<td>24.3</td>
<td>60</td>
<td>14.6</td>
<td></td>
</tr>
<tr>
<td>10 to 20 mesh (per cent passing)</td>
<td>Per cent</td>
<td>Per cent</td>
<td>Per cent</td>
</tr>
<tr>
<td>16.6</td>
<td>30</td>
<td>5.0</td>
<td></td>
</tr>
</tbody>
</table>

Fineness score (total columns) ...... 77.9
Calcium carbonate equivalent (purity) ...... 97.7

Available calcium carbonate equivalent ........... = 77.9

\[
\frac{97.7}{76.1}
\]

Score* = 76.1

Multiply column 2 (calculated from column 1) by column 3 to obtain column 4. Total column 4 and multiply by calcium carbonate equivalent to obtain score.

Lime requirement conversion formula is given as:

Recommended application of

\[
100 \text{ score lime tons per acre} \times 100 = \text{Tons per acre of lime application.}
\]

*Score of liming material to be applied (in this case 76.1)

Since lime requirement as given by Oregon State College Soil Testing Laboratory is based on an available calcium carbonate of 100, this formula may be used to convert any limestone of a different calcium carbonate equivalent to this level.
UNIT III. Planning a Drainage Program

Teaching Objectives

- To develop ability to identify and solve problems involved in working out a functioning farm drainage program.
- To develop knowledge and understanding necessary for a sound farm drainage program.
- To encourage class members to work out drainage programs as a definite part of their supervised farming programs.
- To develop an appreciation of the economic importance of a good drainage system.
- To develop skills adequate for determining the need for soil drainage.
- To develop ability to interpret natural drainage of the soil in terms of drainage needs.
- To develop an understanding of the relationship between good drainage and soil productivity.
- To encourage thoroughness, accuracy, and neatness in gathering, arranging, and recording data.

Suggested Unit Analysis

1. What drainage goals should I set?
2. What is the relationship between soil drainage and soil productivity?
3. What kind of drainage is best to install?
4. How much drainage is needed to bring about the desired changes?
5. How much should my drainage program cost?
6. In what order should fields be drained, and when should my program begin?
7. How can I secure partial payment through the A.C.P. for my drainage program?

Suggested Teacher-Pupil Activities

1. What drainage goals should I set?
   A. What is the drainage of my fields now?
      (1) Show class slides or pictures of land poorly drained; contrast them with well drained land.
      (2) Take class field trip to farm of one of the boys or to farm selected as a demonstration to teach method of using soil auger and determining natural drainage. (*Soil Judging in Oregon*, pages 4-6.)
      (3) Have each boy make a soil map of the farm showing different drainage conditions existing in the fields. (See map of the home farm in Record Book.)
B. What is the optimum drainage range for crops grown on the farm being studied?
   (1) Develop a list of crops grown in the community by having each boy tell what crops are grown on his farm.
   (2) Group crops in tabular form according to drainage ranges given on page 17.

C. What are the desirable drainage goals for the fields on the farms being studied?
   (1) Have each boy:
      (a) Develop a chart of crops to be grown on his farm during the rotation, with optimum drainage ranges for each.
      (b) Determine for each field the crop requiring the best drainage.
      (c) Decide the drainage goals for each field.

2. What is the relationship between drainage and productivity?

   A. What are the reasons for poor growth of most crops on soils having poor drainage?
      (1) Have each boy read the following:
         (a) Land Drainage, page 3.
         (b) Drainage Practices in Oregon, page 3.
         (c) Farm Drainage in Ten Easy Lessons, pages 2-3.

   B. What effect does drainage have on productivity?
      (1) Have each boy read the following:
         (a) Nature and Property of Soils, pages 253-258.
         (b) Farm Soils, page 284.
         (c) Drainage Practices in Oregon, pages 17-18.
C. Why should I consider drainage of the soils on my farm to increase productivity?

(1) Have each boy:

(a) Tabulate the kinds of response that could be expected from various crops after drainage. Give reasons for this yield response.

(b) List other operations on the farm that aid drainage (Jobs in Project Record Book).

3. What kind of drainage is best to install?

A. What drainage systems are used on farm being studied?

(1) Have each boy report on the kinds of drainage (surface and subsurface) used on the farm he is studying.

(2) Tabulate this data to give a picture of community preference for drainage systems.

B. What kinds of drainage systems exist?

(1) Have class survey types and costs of different drainage systems used locally. Choose delegates to confer with A.S.C. (Agricultural Stabilization Committee). Determine costs, availability of technical and other assistance.

(2) Have each boy read the following:

(a) *Farm Soils*, pages 285-286.
(c) *Farm Drainage in Ten Easy Lessons*.
(d) *Drainage Practices in Oregon*, pages 9-12.

C. What drainage system is best to install on the farm being studied?

(1) Have each boy:

(a) Determine the approximate total cost of installation of each drainage system.

(b) Decide what drainage system best meets his needs. Record this decision in plan giving reasons for decision including effectiveness of drainage, ease of installation, and cost per foot.

(2) Demonstration of layout by instructor on a farm.

4. How much drainage is needed to bring about the desired changes?

A. What has been the drainage history of the fields?

(1) Have each boy:

(a) Determine the types of drainage found on the fields of the farm being studied.

(b) Determine the amount of drainage on each field.
Drainage Tolerances of Certain Field, Pasture, and Forage Plants

<table>
<thead>
<tr>
<th>Plant</th>
<th>Drainage classification of soil*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td></td>
</tr>
<tr>
<td>Winter barley</td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
</tr>
<tr>
<td>Spring barley</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td></td>
</tr>
<tr>
<td>Winter wheat</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
</tr>
<tr>
<td>Rye</td>
<td></td>
</tr>
<tr>
<td>Buckwheat</td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td></td>
</tr>
<tr>
<td>Sweet clover</td>
<td></td>
</tr>
<tr>
<td>Orchardgrass</td>
<td></td>
</tr>
<tr>
<td>Bromegrass</td>
<td></td>
</tr>
<tr>
<td>Red clover</td>
<td></td>
</tr>
<tr>
<td>Birdsfoot trefoil</td>
<td></td>
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<td>Ladino clover</td>
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<td>Wild white clover</td>
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<td>Kentucky bluegrass</td>
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<td>Timothy</td>
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<td>Alsike clover</td>
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<td>Redtop</td>
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<td>Reed's canary grass</td>
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<td>Sudan grass</td>
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<td>Millet</td>
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*Without artificial drainage—an effective artificial drainage system can make a previously poorly drained soil suitable for a wide range of crop and forage plants.

B. What is the recommended drainage needed to bring the fields to the desired drainage conditions?

(1) Have each boy read the following:
   (b) *Land Drainage*, pages 1-6.
   (c) *Farm Soils*, pages 285-286.
   (e) *Land Drainage for Conservation.*
C. How much drainage do I need to bring about the desired drainage on the fields selected?
   (1) Have each boy record the kind and amount of drainage needed for each field.

5. How much should my drainage program cost?
   A. What has been the cost for drainage practices on the farm being studied?
      (1) Have each boy determine the drainage cost.
   B. How does the amount of money spent on drainage on the farm being studied compare with the amount spent by outstanding farmers?
      (1) Determine the average cost of drainage per acre or per farm represented by class members.
      (2) Have each boy compare his farm with the average of farms with similar drainage goals.
   C. What will be the cost of my drainage program as planned?
      (1) Have each boy develop a schedule to include the following:
         (a) Amount of drainage needed to bring fields to desirable drainage conditions.
         (b) Total costs of drainage.
         (c) Amount of drainage that can be installed this year.
         (d) Number of years to reach the drainage goals established.

6. In what order should my fields be drained, and when should my program begin?
   A. At what time of year is the drainage program carried out on the farm being studied?
      (1) Have each boy:
         (a) Make a list of fields which have poor drainage (see map of Home Farm and Survey in Record Book).
         (b) Determine those times during spring, summer, or fall when carrying out a drainage program least conflicts with other jobs.
         (c) Determine time of year when a drainage program has been carried out on the home farm. (Seasonal Calendar for Record Book.)
   B. What are the recommended practices concerned with deciding where and when my drainage program should begin?
      (1) Have each boy read the following:
         (a) Farm Drainage in Ten Easy Lessons, pages 4-14.
         (c) Farm Soils, pages 283-284.
         (d) Land Drainage.
C. Where and when should I begin my drainage program on the fields selected to be drained?

(1) Record:

(a) Time of year when drainage can best be carried out considering field conditions, labor supply, and availability of equipment and specialist advice. (See practices in Record Book.)

(b) Method of drainage I plan to install including surface inlet, laying or backfilling depth, and spacing (tile) slope and outlet. Give reasons for each decision.

(c) Which field(s) I plan to drain first and reasons for my decision.

(d) How I plan to maintain my drainage system.

A BUCKEYE trencher ditcher in action. This type of trenching machine used for farm drainage has a rotary cutting wheel driven by a gasoline engine and is mounted on caterpillar tracks. It can be set to cut to an established grade.
7. How can I secure partial payment for my drainage program through A.C.P.?

A. Have the costs of drainage in the past been partly financed by a government agency?
   (1) Determine where drainage material and/or equipment is secured and amount this costs.
   (2) Tabulate this information on the board and calculate the percentage secured through various channels.

B. How can drainage be secured through A. C. P.?
   (1) Have an A.C.P. local committeeman meet with the class to discuss this problem.
   (2) Have each boy:
      (a) Consider the annual benefits to his farm through participation with A.C.P.
      (b) Study drainage features of county A.C.P. program.

C. Shall I secure the drainage benefits provided by A.C.P. for the fields which need drainage on the farm?
   (1) Have each boy:
      (a) Calculate the cost of drainage for his farm if secured with A.C.P., and compare with the cost of drainage.
      (b) Record his decision regarding this question.

References:


Farm Drainage in Ten Easy Lessons. Indiana Extension Bulletin 269, Purdue University, Lafayette, Indiana.

Land Drainage. California Experiment Station Circular 391, 1949, University of California, Berkeley, California.


INTERCEPTING DRAIN, Sand Lake district. The foothill drain intercepts seepage and checks encroachment of course vegetation or wild animals.

DRAINAGE SYSTEM in Upper Klamath peat, showing open drains and intercepting main drain.
UNIT IV. Planning an Alkali Reclamation Program

Teaching Objectives

- To develop ability to identify and solve problems in working out a functioning saline or alkali reclamation plan for the farm.
- To develop knowledge and understanding necessary for a sound reclamation program on the farm.
- To encourage class members to work out reclamation programs for their farms as a definite part of their supervised farming programs.
- To develop an appreciation of the economic importance of a good reclamation program.
- To develop skills adequate for reliable soil sampling and pH testing.
- To develop ability to interpret results of soil tests and pH tests in terms of the alkali-reclamation needs.
- To encourage thoroughness, accuracy, and neatness in gathering, arranging, and recording data.
- To develop favorable attitudes toward agencies which help the farmers.

Suggested Analysis of Unit

1. What pH and total salt goals in the soil should I set for the farm being studied?
2. What is the relationship between alkali reclamation and soil productivity?
3. What drainage and irrigation systems should I consider for reclaiming my alkali soils?
4. What soil corrective (if any) is best to buy?
5. How much additive is needed (if any) to bring about the desired pH changes, soil tilth, and reduction in total sodium on the fields?
6. How much should my reclamation program cost?
7. When and how should next year's reclamation program be carried out on the selected fields?

Suggested Teacher-Pupil Activities

1. What pH and total salt goals should I set for the soil on my farm?
   A. What is the pH, total salt, and sodium content of my fields now?
      (1) Show film, Soil Testing in Oregon.
      (2) Take class on field trip to farm of one of the boys or farm selected as a demonstration farm to teach method of taking a sample and testing for pH. Take special care to include in soil sample those areas which visibly indicate alkalinity problems.
BOTH FIELDS were irrigated the same length of time. Cross wetting or “sub-bing” is completed sooner with close corrugation spacings. Top: 24-inch spacing. Lower: 12-inch spacing.

(3) Have each boy:
(a) Take composite samples from the fields of the farm being studied. Record pH of each; then composite samples and send to Oregon State College testing laboratory for pH, total salts, and sodium analysis gypsum requirement. (See Farm Soils, pages 218-219, and How to Take a Soil Sample and Why.)
(b) Make a pH map of farm showing by dots where topsoil and subsoil samples were taken, and depth of sampling at each point.
B. What is the optimum pH range and salt tolerance for crops grown on the farm being studied?
   (1) Develop a list of crops grown in the community by having each boy tell what crops are grown on his farm.
   (2) Group crops in tabular form according to pH ranges and salt tolerances given on page 19 of *Our Land and Its Care*, also pages 409 and 417 of *Nature and Property of Soils*.

C. What are desirable pH and total salt goals for the fields on the farm being studied?
   (1) Have each boy:
      (a) Develop a chart of crops to be grown on farm during the rotation with optimum pH ranges and salt tolerance ranges for each.
      (b) Determine for each field the crop requiring the lowest pH and lowest salt tolerance.
      (c) Determine the pH and total salts goals for each field. (Record on map of Home Farm in Record Book.)

2 What is the relationship between alkali reclamation and soil productivity?
   (1) Have each boy read the following:
      (a) *The Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments*, pages 25-32.
      (b) *Irrigation Management Investigations on Nonsaline Soils*.
      (c) *Irrigated Soils*, pages 186-190.
      (d) *Improving Irrigation in Eastern Oregon*, pages 2-10.

3. What drainage and irrigation systems should I consider for reclaiming my alkali soils?
   A. Classroom demonstration. How a sandy loam packed in a 3-inch diameter, 1-foot long glass tube placed in a saturated CuSO₄ solution results in “salt crusting” at surface. (This is equivalent to a field with high water table and subsequent precipitation of salts at surface.)

   B. What kind of drainage and irrigation exists on farm being studied?
      (1) Have each boy:
         (a) Report on the natural drainage of the soils on farm.
         (b) Report on the kinds of artificial drainage and irrigation systems present on the farm.
      (2) Tabulate this data to give a community picture of the drainage problem in the area.

   C. What drainage and irrigation systems are available?
      (1) Class survey of the kinds and costs of drainage and irrigation found locally. Choose delegate to confer with Agricultural Stabilization Committee and Soil Conservation Service representatives.
(2) Have each boy read:
(b) *Irrigated Soils*, pages 185-190.
(c) *The Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments*, pages 12-15.
(d) *Irrigation Management Investigations on Non-saline Soils*.

D. What drainage and irrigation systems are best to install on the farm?
(1) Have each boy:
(a) Determine the approximate cost of drainage and irrigation for the farm being studied.
(b) Decide on the best drainage and irrigation systems suitable for the farm being studied. Record this decision in plan giving reasons for decision, including ease of availability of water, ease of application, and installation.

4. What soil corrective (if any) is best to buy?
A. Classroom demonstration. The effect gypsum has in increasing permeability of an alkali soil. This may be done by pouring water through an alkali soil to which gypsum has been added, and comparing it with an untreated alkali soil.

B. What soil correctives are used on the farms being studied?
(1) Have each boy report the kinds of soil correctives used on his farm.
(2) Tabulate this data to give a picture of community preference for soil correctives. (Compare with Job and Practices of Record Book.)

C. What soil correctives are available?
(1) Have class make an inventory (with prices) of soil correctives used locally.
(2) Have boys read the following:
(a) *The Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments*, pages 11-24.
(b) *Nature and Property of Soils*, pages 418-419.
(c) *Irrigated Soils*, pages 191-195.
(d) *Irrigation Management Investigations on Non-saline Soils*.

D. What soil corrective is the best buy for the farm being studied?
(1) Have each boy:
(a) Determine the total cost of each soil corrective.
(b) Decide what soil corrective (if any) is best buy for his farm.
(c) Record this decision in plan giving reasons and including availability of material, ease of application, and effectiveness of the soil corrective on subsequent yield of crop compared with dollars invested.
Land Capabilities
(See Unit VII)
5. How much additive is needed (if any) to bring about the desired pH changes, soil tilth, and reduction in total sodium on the fields?

A. What has been the soil corrective history of the fields?
   (1) Have each boy:
      (a) Determine soil texture of the fields on his farm.
      (b) Determine the amount of manure and soil corrective applied to each field during the past 4 years.
      (c) Record this information.

B. What is the recommended amount of soil corrective needed to bring fields to desired sodium status, pH, and tilth?
   (1) Have each boy read the following:
      (a) The Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments.
      (b) Irrigation Management Investigations on Nonsaline Soils.
      (c) Irrigated Soils, pages 191-195.
   (2) Have each boy record gypsum requirement obtained from (A), page 37.

6. How much should my reclamation program cost?

A. What has been the cost of applying soil correctives on the farm being studied?
   (1) Have each boy determine the cost on farm studied.

B. How does the amount of money spent on soil correctives on home farms compare with the amount spent by farmers who have successfully reclaimed their land?
   (1) Determine the average cost per farm of soil correctives in the area.
   (2) Have each boy compare his cost with the average of farms with similar reclamation goals.

7. When and how should next year's reclamation program be carried out on the selected fields?

A. At what time of year is reclamation of alkali soils carried out?
   (1) Have each boy:
      (a) Make a list of fields of farm being studied.
      (b) Determine those times during spring, summer, or fall when reclamation would least conflict with other farm jobs.
      (c) Determine time of year that soil corrective applications are made on the farm.
      (d) Determine method of applying soil corrective.
   (2) Summarize the practices found in use on farms of class and community. (Include yours on Jobs Planned in Record Book.)
B. What are the recommended practices relative to time and method of carrying out reclamation?

(1) Have each boy read the following:

(a) *Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments*, pages 11-14.

(b) *Irrigation Management Investigations on Nonsaline Soils*.

(c) *Irrigated Soils*, pages 185-195.

C. When and how should I carry out my reclamation program on the fields selected to be reclaimed?

(1) Record:

(a) Time of year when reclamation can best be carried out considering field conditions, labor supply, and availability of equipment.

(b) Methods to use with reasons for decision. (Add these to Jobs Planned in Record Book.)

References:


*The Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments*. Oregon Experiment Station Technical Bulletin 22, 1951, Oregon State College, Corvallis.


*Our Land and Its Care*. American Plant Food Council, 910 17th St., Washington 6, D.C.


UNIT V. Planning an Irrigation Program*

Teaching Objectives

- To develop ability to identify and solve problems involved in working out a functioning irrigation program for the farm.
- To develop knowledge and understanding necessary for a sound irrigation program on the farm.
- To encourage class members to work out irrigation programs for their farms as a definite part of their supervised farming programs.
- To develop an appreciation of the economic importance of a good irrigation system.
- To develop skills adequate for reliable soil moisture readings.
- To develop ability to interpret results of soil moisture readings in terms of irrigation needs.
- To encourage thoroughness, accuracy, and neatness in gathering, arranging, and recording data.

Suggested Unit Analysis

1. What kinds of crops will I grow and what yields do I expect to obtain?
2. Which method best suits my available water supply?
3. Which method of irrigation best suits the soil, topography, climate, and size of my farm?
4. How much water should be supplied to achieve the expected yields?
5. When should I apply water to selected fields?
6. What is the relationship between irrigation management and soil productivity on my farm?

Suggested Teacher-Pupil Activities

1. What kinds of crops will I grow and what yields do I expect to obtain?
   A. (1) Develop a list of crops grown in the community by having each boy tell what crops are grown on his farm.
   (2) Group different crops in tabular form showing yields obtained under irrigation, and without irrigation, on various soils.
   B. What is the optimum soil moisture range for highest crop yields?
      (1) Have each boy read:
         (a) Nature and Property of Soils, pages 184-197.
         (b) Farm Soils, pages 255-260.
         (c) Buying a Sprinkler System? Here's How! pages 4-5.
         (d) Improving Irrigation in Eastern Oregon.

* This unit may be of considerable help also on farms where pupils already have an irrigation program capable of further development.
C. What is the desirable soil moisture range in soils for the fields on the farm being studied?
   (1) Have each boy:
      (a) Record, with reasons, the moisture range that is optimum for plant growth. (See Record Book, Practices.)
      (b) Indicate why the available water to plants varies in different soils.

2. Which method best suits my available water supply?
   A. What water is being used on the farm?
      (1) Have each boy:
         (a) Survey the area near the farm to determine water supply including the presence of a high or low reservoir, lake, or river.
         (b) Determine how and where to apply for water rights.
         (c) Determine how the water that is on demand or delivered on rotation will be applied.
   B. What water is available?
      (1) Have class make a list of the different ways water may be supplied on the farm.
      (2) Have each boy:
         (a) Determine the quality of water by sending for analysis to Oregon State College. (See Analysis of Quality of Water for Irrigation and Water Analysis Report.)
(b) Determine source of power (if any) required to obtain irrigation water.
(c) Consider the legal procedures important in acquiring water rights. (Obtain information from the State Engineer’s Office.)

3) Have each boy read the following:
   (b) *Irrigated Soils*, pages 105-114.
   (c) *Irrigation, 20 Questions and Answers*, pages 2-3.
   (d) *Buying a Sprinkler System? Here’s How!*

C. What is the source of water and method of conveyance best suited for my farm?
   (1) Have boys record on plan the best source of water available, method of water conveyance, with reasons.

3. Which method of irrigation best suits the soil, topography, climate, and size of my farm?
   A. What is the soil’s field topography on my farm? The size? Prevailing climatic conditions?
      (1) Have each boy survey the soils on his farm to determine depth, texture and permeability, and topography. (Include in map of home farm.)
      (2) Have the class collect climatic data on the area including rainfall, length of growing season, etc.
      (3) Have each student record this information on his plan (Record Book).
   B. What kinds of irrigation systems are available?
      (1) Have class survey the kinds of irrigation systems and costs of irrigation found on local farms, and the experiences of the irrigators.
      (2) Have each boy read the following:
         (a) *Nature and Property of Soils*, page 235.
         (b) *Farm Soils*, pages 289-290.
         (c) *Irrigated Soils*, pages 141-143.
         (e) *Buying a Sprinkler System? Here’s How!*
   C. What irrigation system is best to install on the farm?
      (1) Have each boy:
         (a) Determine the approximate cost for the irrigation systems.
         (b) Read *Sprinkler Irrigation Costs for Vegetable Crops*, pages 3-17.
         (c) Decide on the best irrigation system for his farm.
(d) Record this decision on plan giving reasons for decision, including texture and permeability of soil, kind of crops to be grown, and climatic data.

(2) Have each boy draw a sketch of his farm showing the locations of water supply or conveyance bringing water to farm, the arrangement of fields, farm ditches, take-out boxes, headgates, pumps, etc., and the arrangement of his method of irrigation. (Include in Record Book.)

4. How much water should be applied to achieve the expected yields?
   A. What has been the irrigation practices on the fields?
      (1) Have each boy:
         (a) Determine the amount and frequency of irrigation on each field for the past years, and record this information.
         (b) Review the texture, depth, and permeability of the soils on the farm being studied.
   B. What are the optimum irrigation requirements for crops grown on the farm being studied?
      (1) Have each boy read the following:
         (c) *Irrigation for Willamette Valley*, pages 9-11.
         (d) *Buying a Sprinkler System? Here's How!*, pages 4-5.
         (e) *Improving Irrigation in Eastern Oregon*.
      (2) Have boys select representatives to visit County Agent for information on local irrigation requirements.
   C. What are the desirable irrigation requirements for my fields?
      (1) Have each boy read:
         (a) *Buying a Sprinkler System? Here's How!*, pages 6-10
         (b) *Improving Irrigation in Eastern Oregon*, pages 3-8.
      (2) Have each boy:
         (a) Develop a chart of crops to be grown on farm during rotation, with irrigation requirements for each crop.
         (b) Determine for each field the crops with the highest irrigation requirements.
         (c) Determine the irrigation requirements for each field.

5. When should I apply water to selected fields?
   A. At what time of the year is water applied to fields on the farm being studied?
      (1) Have each boy:
         (a) Determine those times in which water is available.
(b) Determine time of year that irrigations are made on the various fields on the farm being studied.

(2) Summarize the practices found in use on all farms in class.

B. What are the recommended practices relative to timeliness of irrigation?

(1) Have each boy read:
   (a) Farm Soils, pages 287-288.
   (b) Sprinkler Irrigation Costs for Vegetable Crops, pages 16-17.
   (c) Irrigation Requirements of Arable Oregon Soils, pages 20-29.
   (d) Irrigated Soils, pages 160-166.

(2) If possible, have a representative from class contact an industry manufacturing instruments designed to measure soil moisture to predict irrigation needs.

(3) Send soil sample to Oregon State College Soil Physics Laboratory, Agriculture 109, for moisture determination. (See Oregon State College Soils Department mimeographs S-45, S-46, S-47, and S-48.)

C. When should I apply irrigation water to selected fields?

(1) Record:
   (a) Time of year desirable to irrigate each field on the farm.
   (b) Whether you plan to apply one, two, or several irrigations during the season.
   (c) Give reasons for (a) and (b) above.

6. What is the relationship between irrigation and soil productivity on my farm?

A. What are the reasons for low yields of crops growing in soils of good drainage and with ample plant nutrients?

(1) Have boys list possible reasons for low yields under such conditions.

(2) Have boys read the following:
   (a) Irrigation Requirements of Arable Oregon Soils, pages 13-37.
   (b) Irrigation for Willamette Valley, pages 7-14.
   (c) Irrigation Requirements, Estimates for Oregon, pages 14-72.
   (d) Irrigated Soils, pages 45-55.
   (e) Improving Irrigation in Eastern Oregon.

(3) Have boys tabulate yields of various crops grown with and without supplemental irrigation on various farms in the area. (Compare with Survey of Home Farm in Record Book.)
B. What effect will irrigation have on other soil management considerations on the home farm?

(1) Have boys read the following:
   (b) *Farm Soils*, pages 286-290.
   (c) *Irrigated Soils*, pages 118-119 and 151-152.
   (d) *Improving Irrigation in Eastern Oregon*, pages 6-10.

(2) Have boys record soil management practices requiring consideration under an irrigation system of farming. (See Record Book.)

C. Why would irrigating the soil on my farm increase productivity?

(1) Have each boy:
   (a) Indicate with reasons why he has decided to develop an irrigation system on the farm.
   (b) Indicate ways and means by which his present irrigation-management program may be improved (if he already has an irrigation program.)
References:


Sprinkler Irrigation Costs for Vegetable Crops. Oregon Experiment Station Bulletin 463, 1949, Oregon State College.


UNIT VI. Planning a Fertilizer Program

Teaching Objectives

- To develop ability to identify and solve problems involved in working out a functioning fertilizer program for the home farm.
- To encourage members of the class to work out fertilizer programs for their farms as a definite part of their supervised farming programs.
- To develop knowledge for the need of fertilizing, especially an appreciation of the economic importance of a good liming program.
- To develop skills adequate for reliable sampling for soil tests.
- To develop ability to understand interpretation of soil test results in terms of fertilizer needs.
- To encourage thoroughness, accuracy, and neatness in gathering, arranging, and recording data (Record Book).
- To develop favorable attitudes toward agencies which help the farmer.

Suggested Unit Analysis

1. What fertility goals should I set for my fields?
2. What fertilizer product is best to buy?
3. How much fertilizer is needed to bring about the desired fertility on my farm?
4. How much should my fertilizer program cost?
5. Where should I apply fertilizer in the rotation of the farm being studied?
6. When and how should next year's fertilizer supply be applied to the fields selected to receive it?
7. What is the relationship between efficient fertilizing and soil productivity?

Suggested Teacher-Pupil Activities

1. What fertility goals should I set for my fields?
   A. What is the fertility status of my fields now?
      (1) Show class film on soil testing referred to in the list of references.
      (2) Class field trip to farm of one of the boys or farm selected as a demonstration farm to teach method of making a composite sample of the field for a soil test (see Liming Unit II).
      (3) Have each boy:
         (a) Take composite samples on the fields of the farm he is studying, and send these samples in appropriate containers (obtained from County Agent) to Soil Testing Laboratory, Oregon State College.
         (b) Learn to recognize nutrient deficiency symptoms in various plants. (References: Farm Soils, pages 55, 87, and 135, and Our Land and Its Care, pages 41-43.)
B. What is the recommended fertilizer application for the crops grown on various fields on my farm?

(1) Develop a list of crops grown in the community by having each boy tell what crops are grown on his home farm.

(2) Group crops in tabular form showing the approximate amounts in pounds per acre of common plant foods removed by various crops (Our Land and Its Care, page 24). Relate this to the boys' records and farming programs.

(3) Have boys read Farm Soils, pages 149-157. Stress again the limitation of soil tests alone as an adequate guide for fertilizer recommendations.

C. What are desirable fertility goals (plant nutrients goals) for the fields on my farm? (See Survey of the Home Farm in Record Book.)

(1) Have each boy:
   (a) Develop a chart of crops to be grown on his farm during the rotation, with approximate plant nutrient removal for each.
   (b) Determine for each field the crop requiring highest plant nutrient demands on the soil. (Remember legumes obtain their nitrogen from the atmosphere. See Farm Soils, pages 126-127).
   (c) Determine and record the plant nutrients essential for plant growth.

(2) Have each boy read the following:
   (a) Our Land and Its Care, pages 26-33.
   (b) Farm Soils, pages 121-122.
   (c) Nature and Property of Soils, pages 21-25.

2. What Fertilizer product is best to buy?

A. What fertilizers are used on the farms being studied?

(1) Have each boy report on the kinds of fertilizer used on his farm.

(2) Tabulate this data to give a picture of community preferences for fertilizers.

B. What fertilizers are available?

(1) Class to make a survey of availability and price per pound of nutrient (N, P₂O₅, K₂O, etc.) locally. Choose delegates to confer with local fertilizer dealers and the County Agent. Determine the guaranteed chemical analysis of the fertilizer and the actual chemical compounds in it. Determine how to order it, when payment is required, and delivery date expected.

(2) Have each boy read the following:
   (a) Farm Soils, pages 129-148.
   (b) Nature and Property of Soils, pages 495-515.
   (c) Our Land and Its Care, pages 34-39.
Fertilize For Higher Yields

NITROGEN ups wheat yields in the Columbia Basin.

NITROGEN ups barley yields in Benton County.

PHOSPHORUS ups oat yields in Linn County.

SULFUR ups barley yields in Benton County.
C. What fertilizer material is the best buy for the farm being studied?
   (1) Have each boy:
      (a) Determine the total cost of the fertilizer materials.
      (b) Determine the cost per pound of nutrient.
      (c) Decide what fertilizer material is the best buy for his farm.
      (d) Record this decision in a plan giving reasons for the decision including availability, cost, ease of handling, acid residue, crop and soil nutrient status.

3. How much fertilizer is needed to bring about the desired fertility on my farm?
   A. What has been the fertilizer history of the fields?
      (1) Have each boy determine the amount of manure, fertilizer, and lime applied to each field during the past four years, and record this information.
   B. What is the recommended type and amount of fertilizer (in pounds of plant nutrients) needed to give optimum efficient production on the fields being studied?
      (1) Have boys discuss the results of their soil tests with teacher and county agent.
      (2) Have boys read the following:
         (b) *Farm Soils*, pages 149-156 and page 163.
         (c) *Fertilizer Requirements for Particular Crops*, S-36.
         (d) *Progress Reports of Fertilizer Research*, S-25.
   C. What kind and how much fertilizer do I need to raise the fertility level to the goals established for the crops on each field?
      (1) Have each boy:
         (a) Record the type and amount of fertilizer needed for each field.
         (b) Record how he plans to maintain soil fertility. (Include in Record Book.)

4. Where should I apply fertilizer in the rotation of my farm?
   A. What fields have received lime, manure, and fertilizer in the past few years?
      (1) Have each boy review the fertility history of fields as a partial basis for determining the order in which fields are to receive fertilizer.
   B. In what order should fields receive fertilizer?
      (1) Have each boy read the following:
         (a) *Nature and Property of Soils*, pages 524-525.
         (b) *Farm Soils*, page 163.
         (c) *Our Land and Its Care*, page 38.
C. What fertilizer program should I follow up on the farm being studied?
   (1) Have each boy:
      (a) Record the amount of fertilizer needed for each crop on each field for the current year.
      (b) Decide on which crop and fields the fertilizer is to be used.
      (c) Determine the total amount to be used this year. (Refer to question 3.)

5. How much should my fertilizer program cost?
   A. What has been the annual cost of applying fertilizer on my farm?
      (1) Have each boy determine the average annual cost of fertilizer used on his farm.
   B. How does the amount of money spent for fertilizer on my farm compare with the amount spent by outstanding farmers?
      (1) Determine the average annual cost of fertilizer per farm (or per acre) represented by members of the class.
      (2) Have each boy compare his farm with the average of farms with similar soils and crop yields goals.
   C. What will be the annual cost of my fertilizer program as planned?
      (1) Have each boy develop a schedule for his farm to include the following:
         (a) Total amount of fertilizer needed to supply soils with the desired fertility.
         (b) Total cost of this fertilizer.
         (c) Amount of fertilizer that can be purchased this year.
         (d) Estimated number of years to reach the fertility goals established.
         (e) Estimated costs involved to maintain soil fertility.

6. When and how should next year’s fertilizer supply be applied to the selected fields?
   A. At what time of the year and how is fertilizer applied to the fields on the farm being studied?
      (1) Have each boy determine:
         (a) Those times of the year fertilizer is applied to the various crops. (Include in Jobs in Record Book.)
         (b) The method of applying fertilizer to each crop.
      (2) Summarize the practices found on farms of class.
   B. What are the recommended time and method practices of applying fertilizer to various crops?
      (1) Have each boy read the following:
         (a) *Our Land and Its Care*, pages 44-45.
         (b) *Nature and Property of Soils*, pages 520-523.
         (c) *Farm Soils*, pages 164-170.
(2) Discuss problem of time and method of application with fertilizer fieldman and county agent.

C. When and how should I apply next year's fertilizer supply to fields selected to receive it?

(1) Record:
   (a) Time of year when fertilizer can best be applied considering crop, field conditions, and feasibility of using equipment. Give reasons for decision.
   (b) Method of applying fertilizer with reasons for decision.

7. What is the relationship between efficient fertilizing and soil productivity?

A. Why is the productivity of many soils increased by use of fertilizer?
   (1) Show film Making Most of a Miracle.
   (2) Have each boy read the following:
      (a) Farm Soils, pages 121-122.
      (b) Nature and Property of Soils, pages 21-29.

B. What effect do the plant nutrients supplied by fertilizers have on plant growth?
   (1) Review film Making Most of a Miracle.
   (2) Have each boy read the following:
      (a) Farm Soils, pages 123, 134, 138, 144, 146-148.
      (b) Our Land and Its Care, pages 25-33.
      (c) Nature and Property of Soils, pages 447,471.

C. Why should I consider fertilizing the soils on my farm?
   (1) Have each boy:
      (a) Tabulate the kinds of response (yield and chemical composition of plant) that could be expected from fertilizing various crops.
      (b) Record other soil management practices often necessary before an efficient fertilizer program can be effectively carried out (Jobs in Record Book).

References:

Film Making Most of a Miracle. Visual Aids Department, Coliseum, Oregon State College.


Fertilizer Requirements for Particular Crops. mimeograph S-36. Oregon State College, Soils Department.
AVOID taking soil from unusual areas.

SAMPLE to plow depth—or about 6 or 8 inches.

MAKE up each sample with soil taken from 15 to 20 locations within the sampling area.
UNIT VII. Planning a Crop Rotation and Soil Management Program*

Teaching Objectives

- To develop ability to identify and solve problems involved in working out a functioning crop rotation for fields on the farm.
- To encourage members of the class to work out crop rotations for their fields as a part of their supervised farming program.
- To develop understanding for the need of a sound crop rotation program based on land capability.
- To develop an understanding of the relationship of intensity of the crop rotation system with soil fertility, productivity, and conservation.
- To develop an appreciation of some of the important economic considerations necessary for good crop rotation system.
- To encourage thoroughness, accuracy, and neatness in gathering, arranging, and recording data (Record Book).

Suggested Unit Analysis

1. What crop rotation goals suit the land capabilities on my farm?
2. What benefits do I hope to achieve by a sound crop rotation and/or good land utilization program, and what relationship has it to soil management?
3. What sequence of crops shall I use in the rotations for my fields?
4. How will my available labor supply affect my crop rotation program?
5. How will markets and prices of harvested crops affect my crop rotation program?
6. When and how should I begin my crop rotation program?

Suggested Teacher-Pupil Activities

1. What crop rotation goals suit the land capabilities on my farm?
   A. What are the present land capabilities of the fields?
      (1) Discuss land capability for soil and water conservation in Oregon. Each boy should have a copy of Land Capabilities for Soil and Water Conservation in Oregon. Stress the following:
         (a) Factors which affect capability and land use.
         (b) Use of land classification.
         (c) Land-use capability resources in Oregon.
      (2) Class field trip to farm of one of the boys or farm selected as a demonstration farm (see Soil Conservation Service personnel) to teach methods and techniques used in classifying land.

* This Unit attempts to integrate all phases of soil management including soil mapping.
(3) Have each boy make an inventory of the fields on farm he is studying and record (refer to S-49, *Soil Judging in Oregon*).

(a) Topography and per cent slope (include length of slope) of fields.

(b) Texture and depth of soil.

(c) Evidence of erosion damage.

(d) Organic matter content of soil.

(e) Drainage and water holding capacity of soil.

(f) Stoniness and fertility of field.

(4) On the basis of the above information and by using appropriate references determine the land subclass capabilities of the fields.

B. What is the recommended intensity of cropping for the various fields?

(1) Develop a list of crops grown in the community by having each boy report what crops are grown on the home farm.

(2) Have each boy:

(a) Determine the soil productivity index for the crops grown on the farm being studied. (Refer to pages 372-374, *Farm Soils.*) From this data the boy may determine the annual soil productivity balance.

(b) Determine the crop rotation and other soil management practices necessary to increase productivity and conserve the soil on his fields. (Refer to pages 14-17, *Land Capability for Soil and Water Conservation in Oregon.*)

C. What crop rotation goals suit the land capabilities for the fields on my farm?

(1) Have each boy:

(a) Calculate for each field the soil productivity balance by determining productivity indexes of the crops he will grow (*Farm Soils*, page 373).

(b) Determine the maximum intensity of cropping for each field on the farm.

(c) Indicate the kind and sequence of crops suited to each field.

2. What benefits do I hope to achieve by a sound crop rotation and/or good land utilization program, and what relationship has it to soil management?

A. Why is soil productivity increased by a sound crop rotation program?

(1) Have each boy read the following:

(a) *Farm Soils*, pages 364-370.

(b) *Our Land and Its Care*, page 17.

(c) *Nature and Property of Soils*, pages 567-568.

(d) *Elements of Soil Conservation*, pages 154-158.
B. In what ways do legumes and organic matter contribute to the soil when included in a crop rotation program?

(1) Discuss the importance of all forms of organic matter in soils. (Stress both the effect on tilth and fertility and the influence of livestock on same.) Refer to film, *World at your Feet*.

(2) Carry out a small demonstration using two contrasting soils (one high in humus and well aggregated, the other low in humus, clayey, and of poor structure).* Place soils in two glass funnels. Pour water through. Note ease of percolation and color of filtrates. Or, drop clods from the two soils into a beaker of water and observe their relative stability.

(3) Have each boy read the following:
(a) *Farm Soils*, pages 127-128, 194-207.
(b) *Our Land and Its Care*, page 16.
(c) *Nature and Property of Soils*, pages 540-551.

C. Why would I expect a sound crop rotation program to increase my soil's productivity?

(1) Have each boy:
(a) Tabulate the kinds of response and effects obtained by a sound crop rotation system.
(b) Record other soil management practices often necessary before the best results are obtained from a sound crop rotation program.
(c) Read *Farm Soils*, pages 370-372.
(d) Read *Longtime Tillage Experiments on Wheat Land in Eastern Oregon*.

3. What sequence of crops shall I use in the rotations for my fields?

A. What sequence of crops is currently being carried out?

(1) Have each boy record the sequence of crops on the fields on his farm.

B. What is the recommended type of crop sequence?

(1) Discuss the importance of the order in which crops are grown. Stress the following:
(a) Possible lodging of grain after heavy legume-green manure crops.
(b) Growing grain after annual crop in dryland areas on droughty soils.
(c) Potatoes following grass, and possible wire-worm.
(d) Perpetuation of disease by growing crops in wrong order.
(e) Cashing in on fertilizer residue from previous crop.
(f) Saving of labor and cost of production.

*Select soil samples from contrasting sites such as cultivated field, adjacent forest, or permanent pasture area of similar soil type.*
Three Steps in Stubble Mulching

WORK heavy stubble with sweep low at 5-inch depth.

SCATTER and work down with skew treader.

WEED, add nitrogen, and plant in the fall.
(2) Have each boy read the following:
   (a) *Farm Soils*, pages 302-349.
   (b) *Review and Discussion of Literature Pertinent to Crop Rotations for Erodible Soils*, pages 13-16.

C. What crop sequence shall I attempt to follow?
   (1) Have each boy:
      (a) Prepare a long term program on the crop sequence he plans to follow on each field.
      (b) Give reasons for his decision in (a) above, making sure he stresses all factors that influence productivity.

4. How will available labor supply affect my crop rotation program?
   A. What labor is presently needed for the crop rotation used on the farm?
      (1) Have each boy refer to his Home Farm Record Book to:
         (a) Determine approximate amount of labor for each crop.
         (b) Determine distribution of labor throughout year for various crops.
         (c) Determine whether in any periods of the year labor is not being used most efficiently.
      (2) Have each boy determine the relationship livestock has to the present crop rotation from labor management viewpoint.

B. What is the most desirable and efficient labor management of the farm?
   (1) Discuss labor efficiency under the following headings:
      (a) Selection and combination of the most profitable enterprises that make full use of the available labor supply.
      (b) Increasing the amount of productive work accomplished per hour by improving the farm layout, planning work, timing work, using equipment efficiently.
      (c) Effects of labor efficiency on size of business, rates of crop and animal production, and choice of enterprises.

C. How will available labor supply affect the crop rotations established on the farm?
   (1) Discuss the distribution of labor for the proposed crop rotations.
   (2) Have boys record the labor required for each crop, peak labor demands, and need for labor management of specific crops.

5. How will markets and prices of harvested crops affect my crop rotation program?
   A. Where are the markets and what are prices of crop and livestock products on the farm being studied?
      (1) Have the class determine the markets that receive the farm products from each boy's farm.
(2) Have each boy:
   (a) Determine the approximate prices received from the crops grown on his farm.
   (b) Tabulate these data on the board.

B. What is the market and price potential of other crops that can be grown in the area?
   (1) Appoint a delegation to determine from different commercial companies (canneries, fertilizer dealers, seed dealers, co-ops, etc.) possible markets and prices of various farm products.
   (2) Discuss these data with the class. Stress management problems associated with production of each crop listed.

C. How will my proposed crop rotation program be modified by markets and price?
   (1) Have each boy record with reasons why his proposed crop rotation may be sufficiently flexible to take care of market and price variations. Make sure the student realizes the necessity of organic maintenance, high productivity, and resultant soil conservation attained by a sound rotation.

6. When and how should I begin my crop rotation program?
A. At what time of year and on what fields does establishment of the various crops grown on the farm take place?
   (1) Have each boy:
      (a) Determine those times of the year crops are established. (Include Jobs in Record Book.)
      (b) Determine the method of seedbed preparation for each crop.
   (2) Summarize the practices found on farms of class.

B. What are the recommended practices relative to seedbed preparation, time and method of crop establishment?
   (1) Have each boy read the following:
      (a) Farm Soils, pages 85-120.
      (b) Nature and Property of Soils, pages 72-78.
      (c) Longtime Tillage Experiments on Wheat Land in Eastern Oregon, pages 24-32.
   (2) Take class on a field trip to a farm recognized as an excellent place to demonstrate good seedbed preparation and subsequent timeliness of planting.
   (3) Discuss with County Agent the recommended practices relative to seedbed preparation, and time and method of crop establishment.

C. When and how should I begin my crop rotation program?
   (1) Record:
      (a) Time of year when crops to be grown on the farm can best be established.
(b) Seedbed preparation required for each crop, and method for preparing that seedbed.

(c) Fields that will be first put into my proposed crop rotation program. Reasons.

(2) Prepare series of maps, one for each year, showing crops to be grown during one complete cycle of the longest rotation planned for your farm.

References:


Humus for Oregon Soils. R. E. Stephenson, Oregon Experiment Station Circular 143, 1948.


Film, World at Your Feet. Visual Aids Department, Oregon State College.

Longtime Tillage Experiments on Wheat Land in Eastern Oregon. Oregon Experiment Station Technical Bulletin 39, 1957, Oregon State College,
Review List of Literature


*Benefits from Lime.* Slide set. Oregon State College Soils Department, Corvallis.


*Fertilizer Requirements for Particular Crops.* Mimeograph S-36. H. B. Cheney, T. L. Jackson, Oregon State College Soils Department, Corvallis.

*Field Data for Water Samples.* Mimeograph S-23. L. A. Alban, Oregon State College Soils Department, Corvallis.


*Humus for Oregon Soils.* R. E. Stephenson, Oregon Experiment Station Circular 143, 1948, Oregon State College, Corvallis.


*The Improvement of an Alkali Soil by Treatment with Manure and Chemical Amendments.* Oregon Experiment Station Technical Bulletin 22, 1951, Oregon State College, Corvallis.

*Improving Irrigation in Eastern Oregon.* Oregon Experiment Station Bulletin 558, 1956, Oregon State College, Corvallis.

*In Western Oregon, Liming Pays.* Oregon Experiment Station Circular of Information 549, Oregon State College, 1955, Corvallis.

*Information to Accompany Soil Moisture Tension Samples.* Mimeograph S-47. M. N. Shearer, Oregon State College Soils Department, Corvallis.


*Irrigation Requirements, Estimates for Oregon.* Oregon Experiment Station Bulletin 500, 1951, Oregon State College, Corvallis.


*Out of print but may be found in local libraries.*

Land Drainage. California Experiment Station Circular 391, 1949, University of California, Berkeley.


Lime—100 Questions and Answers. Mailing Room Cornell University, Roberts Hall, Ithaca, N. Y.


Making Most of a Miracle, film. Visual Aids Department, Coliseum, Oregon State College, Corvallis.


Our Land and Its Care. American Plant Food Council, 910 17th St., Washington 6, D.C.

pH test kit—Soils Club, Oregon State College.


Sprinkler Irrigation Costs for Vegetable Crops. Oregon Experiment Station Bulletin 463, 1949, Oregon State College, Corvallis.

Uses of Soil Moisture Tension Values. Mimeograph S-46. M. N. Shearer, Oregon State College Soils Department, Corvallis.


World at Your Feet, film. Visual Aids Department, Coliseum, Oregon State College, Corvallis.
Suggested Evaluation of Soil Management Units

1. Does each pupil’s plan contain the following?
   A. A field map of home farm or farm being studied showing by dots where
topsoil and subsoil samples were taken for various soil tests.
   B. Three tables of crops to be grown during the rotation with optimum pH
   range, drainage, tolerance, and fertility requirement for each group.
   C. Worksheet with a decision on the amount of money that can be budgeted
   for lime, drainage, fertility, irrigation, reclamation, etc., and the ways
   and means of reaching established goals.
   D. A soil management program to extend over one crop rotation period.
   (Worksheet.)
   E. A decision as to time of year when lime, drainage, fertilizer, or irrigation,
etc. can best be applied on fields selected, considering moisture condi-
tions, labor supply, and available equipment.
   F. A decision whether soil additive (fertilizer, lime, gypsum, sulfur, manure)
   will be applied before or after plowing.
   G. A decision as to method of application to be used with reasons for de-
cision.
   H. A decision, with reasons, regarding A.C.P. assistance.

2. A. Has each member of the class developed an appreciation of the economic
importance of a good soil management program?
   B. Has each member of the class developed the knowledge and skills to:
      (1) Sample soil and make accurate pH tests and obtain samples of soil
      for tests for available nutrients.
      (2) Intelligently interpret the results of the test?
      (3) Apply this knowledge to the solution of the soil problems on the
farm.