Oklahoma Agr. Exp. Sta.

Potential Productivity of Three Key Soils of the Oklahoma Panhandle

Fenton Gray

AGRICULTURAL EXPERIMENT STATION
OKLAHOMA STATE UNIVERSITY

Bulletin B-695

November 1971

Potential Productivity of Three Key Soils of the Oklahoma Panhandle

By
Fenton Gray

The identification, classification and mapping of soil types have been completed for the Oklahoma Panhandle. In order to make the soil maps more useful quantitative data, such a scrop yields, are needed for the development of better yield predictions of adapted crops. The collection of yield data is the first step in the development of potential productivity ratings essential for obtaining good soil management and farm planning practices. It then becomes clear that yield data must be obtained from known soils under defined systems of management. The main sources are farmers field records and the results of experimental plots.

The Agronomic research station at Goodwell does not supply these data for all key soils of the Panhandle area. Therefore, a study was devised in cooperation with the Soil Conservation Service fieldmen to collect yield figures for more of the key soils. The kind of practices utilized by the farmers are needed because crop yields under a specified management system provide information for predicting potential productivity of the soil studies. This information is needed to indicate yields farmers can expect to produce. Land appraisers, land use planners, city planners, tax and loan people and other users have need for these kinds of information.

The major objective of this study was to obtain yield information for wheat and grain sorghum, both irrigated and dryland, for Richfield, Ulysses and Dalhart soils. These results along with some less important crops are reported.

Cooperation with Soil Conservation Service and farmers of the Panhandle is greatly appreciated. Credit is due Mr. Tillman Howell, a student and farmer of the study area, who compiled some of this material in a Problems course in Soils under direction of Fenton Gray, Professor, Department of Agronomy.

Research reported herein was conducted under Oklahoma Station Project No. 1383.

Collection of Data

Many farmers in the three Panhandle counties furnished yield information. Fields approaching similarity were selected from published soil surveys, and farmers contacted. The management and yield information is recorded in tabular form (Table 1). This system provided a random selection of soil types and kinds of management. Five to twenty-year crop yield records were made available for the selected soil types. Yield figures given in the tables represent averages obtained for certain kinds of soil over a period of years. The data provided as much as 50 crop years for a particular soil and crop.

Management Levels

Two management levels were arbitrarily decided upon, utilizing available information and experiences on farming these soils. Consequently, *customary management (A)* was defined as those practices followed by most farmers in the area and which would normally include (1) the use of adapted recommended crop varieties, (2) proper seeding rates, dates of planting and efficient harvesting methods, (3) sufficient control of weeds, insects and diseases to insure plant growth, (4) fertilizers seldom used and (5) residues used only on the most sandy lands in some years.

The *improved management (B)* was defined as those practices that are designed to alleviate the limiting factors of crop production. All soils in the county have certain limiting factors such as inadequate moisture, weeds, insects and pathogens as well as specific limitations unique to themselves. For instance, production can be greatly increased on some of the sandier soils by the use of fertilizers; careful management of sorghum and wheat residues, specified cropping system or by water and soil conservation operations designed to conserve moisture and topsoil. Some of the conservation operations, may include terracing, contouring and special tillage practices.

Normally, the improved management level would include all those practices listed under customary management plus (1) fertilizers required for maximum economic production, especially under irrigation and on some of the sandier soils, (2) contour tillage and terraces where appropriate, (3) management of grain stubble and wheat straw to prevent erosion, increase water infiltration and enhance seedling emergence and (4) some recommended cropping system designed to fit the operator's goal and the specific soil's need.

Soil productivity is the result of interactions between soil characteristics and soil management practices. It is measured in terms of outputs in relation to inputs for a specific kind of soil under physically defined

Table 1. Questionnaire Used in Interviewing Farmers for the Purpose of Assembling Yield and Other Data by Soil Types.

1. Information that should be acquired before contacting farmers
   (a) Soil type, slope, degree of erosion, phase

   ____________ ____________ ____________ ____________ ____________

   (b) Crop____________________________

   (c) Location (legal description)

   ____

   (d) Kind of experiment (field yields by soil type)

   ____

   (e) Farmer's name______________________________________

2. Information acquired from farmer's records
   (a) Size of yield area (this information may be checked with Agricultural Stabilization Committee records for allotted crops)______________________________

   ____

   (b) Yield (past, present, future)
      1. records
         (check one or both)
      2. farmer's memory

   ____

   ____

   ____

   ____

   ____

   (c) System of management as accurate as farmer can furnish either from his records or memory.
      1. Rotations or continuous cropping (cropping history)

      ____

      2. Tillage practices

      ____

      3. Planting dates and rates; harvesting dates

      ____

      4. Fertilizers (commercial, barnyard or green manures)

      ____

      5. Varieties used

      ____

      6. Degree of damage to crop (hail, freeze, flood, wind, insects and other). Use insurance adjusters appraisal if available

      ____

      7. Rainfall

      ____

      8. Other soil and water conserving practices

      ____

systems of management. Productivity also varies with past management. However, potential productivity can be predicted in terms of crop yields under a specified management system.

Description of Soils

The soils developed under the influence of short grasses and a semiarid climate. Average annual rainfall varies from 16 to 20 inches.

More information about soils of the Panhandle can be obtained from the detailed soil surveys for Cimarron, Texas and Beaver counties. Also, M. P. 56, a bulletin of the Oklahoma Agricultural Experiment Station on Soils of Oklahoma, contains some general information about the soils in this study.

Reliable interpretations can result only from a synthesis of basic data about the soils themselves, obtained from the field and laboratory research, data from field experiments and the experience of users of soils, especially farmers.

Descriptions of typical (key) soils for the area, Richfield, Dalhart and Ulysses, follows:

Richfield Soils

The Richfield soils consist of deep, dark, clayey soils that are well-drained. Locally, the soils are called hardlands. They are nearly level and occupy large areas on uplands in all parts of the counties. The soils are the most extensive of any in the area.

The surface soil is dark grayish-brown silt loam or clay loam and is generally about 6 inches thick. Beneath the surface soil is dark grayish-brown, compact clay 6 to 20 inches thick. The clay grades to light colored, highly calcareous parent material of wind-laid silt (loess). The soils developed under short grasses.

The Richfield soils are similar to Pullman soils but have a less compact, clayey subsoil. They have a more compact, clayey subsoil and are deeper to free lime than the Ulysses soils with which they are associated. They are less sandy than the Dalhart soils.

The surface soil ranges in texture from heavy clay loam to loam, and in thickness, from 5 to 16 inches. The subsoil is clay loam, 6 to 20 inches thick, with a subangular blocky to granular structure. Depth to calcareous material ranges from 12 to 25 inches.

The Richfield soils slowly adsorbs and store large quantities of water. They are well-supplied with organic matter and with the minerals needed by crops. The soils are well-suited to dryland wheat and to all the irrigated crops that grow well in the area. They offer more resistance to wind erosion because of their cloddy nature.

Richfield Description:

Ap 0 to 6 inches, dark grayish-brown (10YR 4/2, 2/2M) clay loam; granular structure; friable when moist; noncalcareous; clear boundary.

B2t 6 to 15 inches, dark grayish-brown (10YR 4/2, 3/2M) clay loam; moderate, fine subangular blocky structure; firm when moist; prominent clay skins; noncalcareous; gradual boundary.

B3ca 15 to 30 inches, pale brown (10YR 6/3, 5/3M) clay loam; moderate medium, granular structure; friable when moist; small, soft lime concretions, very strongly calcareous; gradual boundary.

C 30 to 68 inches, brown (7.5YR 5/4, 4/4M) clay loam; weak fine, granular structure (nearly massive, but porous and permeable); friable when moist; calcareous.

Ulysses Soils

The Ulysses soils are deep, moderately fine textured, calcareous soils. They are well-drained and occur on upland in all parts of the area.

The surface soil is grayish-brown to brown clay loam to loam that is about 7 inches thick. The layer underlying it has the same texture as the surface soil but is brown to pale brown. Under this is a less clayery layer of light yellowish-brown to very pale brown soil material.

The parent material consists of wind-laid silt (loess) that contains varying amounts of fine sand. The soils developed under short grasses.

The subsoil of the Ulysses soils is less clayey and more friable than that of the Richfield soils, and the Ulysses soils are calcareous at shallower depth. They are less friable and have weaker structure than the Berthoud soils and are not so strongly granulated as the Mansker soils.

The surface soil ranges from loam to clay loam in texture. It is grayish brown, or dark grayish brown in color and is 4 to 15 inches thick. These soils are generally calcareous throughout, but in places they are noncalcareous in the uppermost 12 inches. The B horizon is very weakly developed or is absent. In some places the profile has alternating layers of silty and sandy soil materials; in others, the profile is silty and has a surface layer of sandy loam or vice versa. Hard concretions of calcium carbonate occurs in the uppermost 6 inches in some places.

These soils absorb water readily. They have a moderate capacity to store water and are moderately productive. The soils are well suited to dryland wheat and to all irrigated crops commonly grown in the area.

Ulysses Description:

Alp 0 to 5 inches, grayish-brown (10YR 5/2, 3.5/2M) silty clay loam; weak, very fine, granular structure; friable when moist; calcareous; clear boundary.

B2 5 to 22 inches, pale-brown (10YR 6/3, 4.5M) silty clay loam that has about 2 percent of soft to semi-indurated, whitish concretions of calcium carbonate; moderately weak, fine and very fine subangular blocky and weak, prismatic structure; friable to slightly firm when moist; strongly calcareous; gradual boundary.

Cca 22 to 33 inches, light yellowish-brown (10YR 6/4) silt loam; weak, very fine, granular structure; friable when moist; many fine root holes; calcareous.

Dalhart Soils

The Dalhart soils consist of deep friable, sandy soils that are well drained. The soils occur on uplands in parts of the three counties.

The surface soil is brown to dark-brown fine sandy loam or loamy fine sand and is generally about 8 inches thick. The layer beneath is dark yellowish-brown sandy clay loam, 10 to 20 inches thick, that grades to yellowish-brown, calcareous, sandy material.

The parent material of these soils is wind-laid sand that was deposited as a mantle on the uplands. The soils developed under short grasses.

These soils are fairly uniform. In places, however, the lime carbonate is leached only to a depth of 10 inches and the B2 horizon is less than 10 inches thick. In some places these soils grade to the nearby Vona and Otero soils. In others they grade to Richfield soils. Fine sandy loam and loamy fine sand are the main soil types.

Dalhart soils absorb water readily. They have a moderately high capacity to store water. As a result, crops can be grown consistently, even in dry years. The soils are well suited to sorghum. They have a high susceptibility to wind erosion; so, living or dead plant covers must be maintained.

Dalhart Description:

Alp 0 to 5 inches, brown to dark-brown (10YR 5/3, 3/3M) fine sandy loam; strong, fine, granular structure; very friable when moist; noncalcareous; abrupt boundary.

A1 5 to 10 inches, dark grayish-brown (10YR 4/2, 2.5/2M) fine sandy loam; moderate to weak, fine, granular structure; friable when moist, noncalcareous; gradual boundary.

B2t 10 to 28 inches, dark yellowish-brown (10YR 4/4, 3/4M) sandy clay loam; compound, strong, coarse, prismatic and weak, fine, granular structure; hard when dry, and firm when moist; noncalcareous; gradual boundary.

Cca 28 to 70 inches, yellowish-brown (10YR 5/4, 4/4M) sandy loam; moderate, very fine, granular structure; soft to slightly hard when dry, but very friable when moist; thin films and threads of segregated lime; calcareous; grades to loamy sand.

Yields of Wheat and Grain Sorghum

Yield records from important crops were obtained from the farmers in the Panhandle area. Yields averages for wheat and grain sorghum is shown in Table 2. Wheat yields under dryland will need to be divided by 2, or approximately that depending on the percent of land in fallow, in order to determine the yield per acre. The land is usually in fallow preceeding wheat under the present allotted acres system.

Yields of Forage Crops

Forage crops were harvested and yields were determined under irrigation with improved management. Grain sorghum silage averaged from

Table 2. Average Crops Yields for Key Soils of Oklahoma Panhandle.

	Soil Unit Name	Wheat bu/A		Grain Sorghum lbs/A	
DRYLAND		A	B	A	B
	Ulysses silt loam, 3 to 5% slope	15	20	—	—
	Ulysses clay loam, 0 to 1%	23[1]	28	1250	2100
	Dalhart loamy fine sand, 1 to 3% slope	19	21	970	2250
	Dalhart fine sandy loam 0 to 1% slope	20	24	1680	2300
	Richfield clay loam, 1 to 2% slope	21[2]	27	—	1925
IRRIGATION					
	Ulysses clay loam, 0 to 1% slope	35	42	3640	5830
	Dalhart fine sandy loam, 0 to 1% slope	32	40	3690	4300
	Richfield loam, 0 to 1% slope	38	44	3660	4900
	Richfield clay loam, 1 to 2% slope	34	44[3]	4830	6370[4]

[1]Includes 3 years of good rainfall years which averaged 26 bu/A.
[2]Harvested acre yields. If fallow was used divide by 2 or what portion in fallow for each acre of land.
[3]Maximum yield of wheat harvested was 49 bu/A.
[4]Maximum grain sorghum yields were 7280 lbs/A.
Note. Blank spaces indicate insufficient data.

7 to 8 tons per acre on the Richfield loam. Also corn silage produced 15 tons per acre of green or fresh materials on Ulysses soils as compared to 21 tons for Dalhart and 18 tons for Richfield clay loam. Alfalfa produced nearly 7 tons per acre on Richfield under customary management and 8 tons per acre with improved management.

Broomcorn Yields

Broomcorn is mostly confined to the more sandy soils, the Dalhart loamy fine sand and Darhart fine sandy loams.

Fertilizers under dryland conditions appear to decrease broomcorn yields in the Dalhart loamy fine sand, causing a drop from 319 pounds per acre to 276. With more clay and organic matter the Dalhart fine sandy loam produces 250 under average treatment but increases to 388 under moisture conservation, tillage and fertilizer treatments. The yields obtained compare favorably with those presented in Bulletin B-650 of the Oklahoma Agricultural Experiment Station was published in 1966. These yields include estimates and results from research plots in the Panhandle area.

Maximum Production

Research records indicate potential wheat yields, when utilizing all good practices with irrigation, reach 52 bushels per acre. Grain sorghums can average slightly over 8,000 pounds per acre on the better soils utilizing new varieties of seed.

Irrigation nearly doubles the wheat and triples the grain sorghum yields. The lack of moisture conservation practices and increased slope greatly decreased the potential production of wheat. Grain sorghums produce more on the sandy Dalhart soils than on the tighter soils.

Summary

The soils of the Panhandle area were more sensitive to inputs of management under irrigation than under dryland conditions. When comparing against check areas, fertilizers gave little or even negative response under dryland. However, 30 to 100 pounds of N may be used under irrigation depending upon soil, soil test, crop yield desired and amount of crop residues. Up to 50 pounds of P may be used on the Dalhart soils and some of the other soils where soil tests show deficiency.

Any good moisture conservation practice such as contour farming, management of stubble, planting in stubble, prevention of overgrazing of sorghum stubbles, leaving of soil surface in condition to increase infiltration of water and to decrease evaporation of moisture and terracing to decrease runoff appearing to have a beneficial effect on the yields.

The results of this study may form the backbone of many interpretations of land use relative to loans, tax assesments, and act as a guideline to agricultural uses in the Panhandle area.

These yield figures supplement those obtained from experimental plots at Goodwell. These two methods are the main sources of quantitative data necessary for a good interpretation of soil maps.

A good farm manager, following the same defined practices as the experimental station, can expect most of the time about 80 percent of the yield because the station demands perfect stands and a complete harvest of the crop. Exceptions may occur where the farmer may harvest higher yields because of the type experiment and crop.

From 10 to 20 years of data result, including the variations in weather and other influences, are necessary for making reliable predictions on potential soil productivity.