Summary of Soil and Water Conservation Research from the Blackland Experiment Station, Temple, Texas 1942-53

TEXAS AGRICULTURAL EXPERIMENT STATION
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IN COOPERATION WITH THE U. S. DEPARTMENT OF AGRICULTURE

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SUMMARY AND CONCLUSIONS

Twenty years of runoff, erosion and related measurements have been completed at the Blackland Experiment Station. The present bulletin includes detailed data covering 12 years, together with enough general information and results to connect it with data summarized in a previous bulletin (18).

Early work with terrace design and spacing, lysimeters (which were not successful because of soil shrinkage), gully surveys, infiltration with an artificial rainmaker and soil movement lines was summarized in the first bulletin (18). Terrace design has been worked out satisfactorily in SCS Operations practices, and is based on research and experience. The Nichols (drainage) type terrace is standard. Gully surveys have demonstrated that a primary function of terraces is to prevent concentration of runoff and gully formation.

Soil movement relative to concrete benchmarks showed total vertical movement of 1 inch during the year, for a benchmark sunk to 5 feet, and 1½ inches for a 3-foot benchmark. The entire soil profile to these depths obviously contracts and expands with varying moisture content. Benchmarks sunk to 8, 10 and 15 feet have moved less than one-fifth inch. Plowing and other mechanical operations, plus soil shrinkage and swelling, have overshadowed mass soil movement by erosion (18).

Infiltration studies showed the effectiveness of straw mulch as well as grass cover in preventing surface soil sealing and early runoff. With water applied at 3.3 inches per hour, runoff rates greater than 80 percent of the applied rate were reached in all cases during wet runs, after a constant infiltration rate was reached. For Austin clay, the constant rates varied from 0.25 to 0.59 inch per hour; and for Houston Black clay, from 0.08 to 0.27 inch (18). Under natural rainfall conditions, the minimum rates for saturated soil probably would be less.

Twenty years of record on small plots and 15 years on field-scale plots show that water and soil losses on an annual basis are related closely to total rainfall on land in row crops. With small grain, clover or grass, the relation is not so well defined. On a seasonal basis, also, heaviest losses correlate with total rainfall, with a peak in May and a smaller peak in September. On row-crop land, losses in March, April and June, as well as May, are heavier than for the September peak. These relations to total rainfall reflect the fact that size and intensity of storms also correlate with total rainfall. Most losses have been caused by rains of more than 1.0 inch in 24 hours, and by intensities of more than 1.0 inch per hour for 30 minutes. It commonly requires rains of 2 inches or more in 24 hours to cause much runoff when the soil is dry and in a reasonably good physical condition. A high percentage of runoff occurs from small rains of 0.5 inch or less when the soil profile is wet. The fact that most rain falls on soil that is dry enough to contain shrinkage cracks is a primary reason for the high percentage of water penetration. The land on the Blackland station, especially that in small plots where heavy machinery has not been used, is more open to water or roots than much of the depleted Blackland on farms.

Twenty years of records on small plots, as well as indirect comparisons with large field-scale plots, indicate that length of slope tends to be a minor factor influencing sheet erosion. Soil and treatment variability, or approximate contouring, normally overshadow slope length effects. Runoff tends to be slightly less on long slopes because of the extra time for infiltration. Soil loss per inch of runoff is higher on long slopes.

Percent of slope has little effect on runoff but a big influence on erosion. Individual field-scale plots of varying slope, from 1.39 to 3.01 percent, provide evidence in general agreement with results from other locations that erosion increases as slope percent to approximately the 1.4 power.

The effect of crops on runoff and erosion depends primarily on the amount of cover provided during critical seasons. No consistent differences between corn and cotton have been shown. Small grains alone or with sweetclover have been effective because their heaviest growth gives maximum protection during March, April and May, the period of maximum rainfall. With ordinary turning of residues, 1 year of corn or cotton following small grain has lost as much soil and water as 1 year of row crop following a row crop. Sweetclovers alone have given good control. Theory and trends in the data favor small grain with sweetclover over either crop grown alone. Untrampled Bermudagrass sod in small plots has given the maximum of water intake and of erosion control. Under pasture conditions, especially with heavy trampling on wet soil, observations indicate that heavy runoff is to be expected even with dense sod that will prevent soil erosion.

Desurfaced soil in plots has lost about 2.5 times as much soil and water as normal soil. Erodibility of the desurfaced soil has been slightly less per inch of runoff than normal soil. Crops that have been grown satisfactorily on desurfaced soil are sweetclover and native grasses with no top growth removed. During 20 years, the desurfaced soil growing native grasses and forbs (including a few volunteer native legumes) showed an increase of about 600 pounds of soil organic matter and 30 pounds of N per acre per year. The build-up was limited largely to the surface 6 inches. Earthworms were very active and contributed to a loose, porous soil condition.

Differences in workability, available water-holding capacity and subsoil permeability are recognized between Houston Black clay (SCS Soil Unit 2) and Austin clay (SCS Soil Unit 2X). However, modifications by cropping, and the dominant effect of other factors, such as slope, rainfall or cover, make it difficult to prove any definite relations of inherent soil profile properties to measured runoff or erosion.

Pore space and bulk-density measurements indicate that the soil in all small plots where heavy tools were not used is looser and more permeable than ordinary field soil. Organic matter and water-stable aggregates are much higher with grass sod than with continuous cultivation. There are slight organic matter and aggregation differences favoring crop rotations over continuous row crops, but most rotations have involved enough row crops to prevent any striking effects of soil-improving crops on the soil.

Available moisture is 2 to 5 percent higher by weight with Houston Black clay than with Austin clay. This helps to explain a tendency toward higher yields with Houston Black clay. There is a small difference in available water favoring rotation and grass plots over continuous cultivation on Austin clay but not on Houston Black clay.

Available phosphorus by CO_2 extraction remains low in all plots except Bermudagrass on Austin clay, where a heavy fertilizer application is indicated. Repeated applications of small quantities of soluble phosphate appear to be needed for conservation and production.

Contouring has consistently shown reduced runoff and erosion in small plots. The effect probably is less on large plots or field areas where breaks are likely to occur because of imperfect contouring. A 50-percent reduction in soil and water loss by excellent contouring is suggested on slopes up to 4 percent. Cotton yields have been somewhat higher on contoured plots.

The effectiveness of terraces in the Blackland, where supported by proper cropping, was shown by early work. Terrace maintenance studies proved that excellent cross sections on Nichols-type terraces can be preserved by backfurrowing on the ridge, letting the dead furrow fall in the channel, and turning all furrow slices uphill from the channel to the ridge of the next higher terrace. A satisfactory cross section also can be obtained without turning all furrow slices uphill, by letting a second dead furrow fall somewhere midway between terraces. However, by this method an undesirable low place is formed unless care is taken to move the position of the dead furrows in the channel and between terraces from year to year. An extra backfurrow can be plowed on the ridge when necessary for maintenance of terrace height.

Through 6 years, stripping on field-scale plots, with a 3-year rotation of corn, cotton and oats, reduced both water and soil losses. The effect was greater on 3 percent slopes than on 2 percent. Even so, gully erosion was not stopped on the 3 percent slope, thereby emphasizing one important function of terraces. Alternate strips of cotton and of oats with Hubam in a 2-year rotation are being used as a field practice on the station, but on 3 to 4 percent slopes, rill or small gully erosion has been significant.

In early studies, subsoiling showed little effect on runoff (18). Recently, shallow chiseling has been used to break up dry soil enough to permit subsurface plowing. The tools in use for trash-mulch farming in West Texas and elsewhere, recently have been tested and adapted to Blackland conditions. The surface residues from major crops can be handled effectively, and the influences on water and soil conservation appear favorable. Deep-furrow drilling of small grain into biennial sweetclover and into other hard-ground areas is one of the promising trash-mulch conservation practices for economical production of grazing crops.

High crop yields are an essential aspect of conservation. Cotton yields are highest following oats with Hubam, oats with vetch, or fescuegrass with one of these early-maturing legumes. These rotations save soil and water and give increased yields. Spacing cotton plants 2 to 4 inches apart in the row is another practice that favors yields as well as mechanization. Cotton is best adapted to Class I or Class II Blackland that has been kept in good condition. Yields and conservation depend on proper land selection and use. Proper fertilization of cotton with phosphorus and nitrogen on depleted soil increases yields and soil protection and makes decreased acreages more profitable. On station soils in rotations with phosphated small grain and Hubam, cotton yields have not been increased by extra fertilizer.

Corn and grain sorghum yields with the best adapted varieties depend upon nitrogen, phosphorus and water. Houston *Black clay yields* more than Austin clay, on the average, because it holds more available water. Crop rotations and practices that put more water in the soil also tend to increase grain yields. Closer plant spacing in the row, with corn or grain sorghum, has paid consistently and is good conservation. Organic matter and nitrogen maintenance with legumes, grasses, fertilization and heavy residues help assure high corn and grain sorghum yields and soil conservation. Organic matter levels and trends provide one of the best indexes of soil improvement known for the Blackland. Deep distribution in soil profiles is an important normal feature of heavy Blackland soils.

Small grains, especially oats and barley, are key conservation and production crops in the Blackland. Improved varieties have increased the yield and quality of grain and helped avoid winter-kill. During the past 4 years, the average acre yields of improved varieties of small grain have been profitable: Mustang oats, 62 bushels, and Cordova barley, 38 bushels. In addition, these crops are the key to cool-season grazing in balanced livestock production programs. They also appear important for proper conservation rotations with row crops. Sweetclovers, the main legumes used in the Blackland, are excellent for growing with fall-drilled small grain.

Other soil-conserving crops for grazing include Bermudagrass on wet land, buffalograss and KR bluestem with cool-season clovers on closely grazed or poor upland soils. Sweetclover with Johnsongrass also has wide usefulness. Mixed native tall grasses, managed for permanence of stand, give good results. Sudangrass for hot summer grazing is outstanding among cultivated crops. The success of grazing enterprises depends upon putting these several crops together into a well-balanced sequence that provides good pasturage throughout the year. Grains and hay are a major part of success with livestock. The Blackland can well produce what is needed for wintering to supplement grazing crops and to fatten livestock to profitable market finish.

Apparently, Class IV Blackland should seldom, if ever, be used for row crops. It is profitably used for Johnsongrass and sweetclover, continuous small grain with sweetclover, or permanent grasses and legumes.

Class III land can continue permanently to grow 1 year of row crop for every 2 years of protection and improvement with small grain and sweetclover, or grass with clover. Improved residue management may permit a higher percentage of row crops.

Class II land, with present farming methods, profits from the improvement of 1 year of small grain with sweetclover, or equivalent, for every year of row crop.

Class I land can be used for row crops each year without severe damage by erosion. But the soil may deteriorate under such cropping unless improved practices are introduced and intensified. These practices include trash-mulch methods, working the soil only when it is dry enough to be firm, adequate fertilization, close plant spacing of the best varieties and minimum cultivation. With conventional management, 1 year of small grain with sweetclover or alfalfa for each year of row crop maintains high yields on a longtime basis.

The foregoing estimates for Land Classes II, III and IV are based on an average annual soil loss of not more than 2 tons per acre. With higher losses, it is believed that the soil is likely to deteriorate and that stands or growth will be damaged too often for maximum profit. On Class I land the estimate is based upon maintenance of surface soil organic matter above 2.0 percent, since favorable physical properties are possible with 2.0 percent of organic matter.

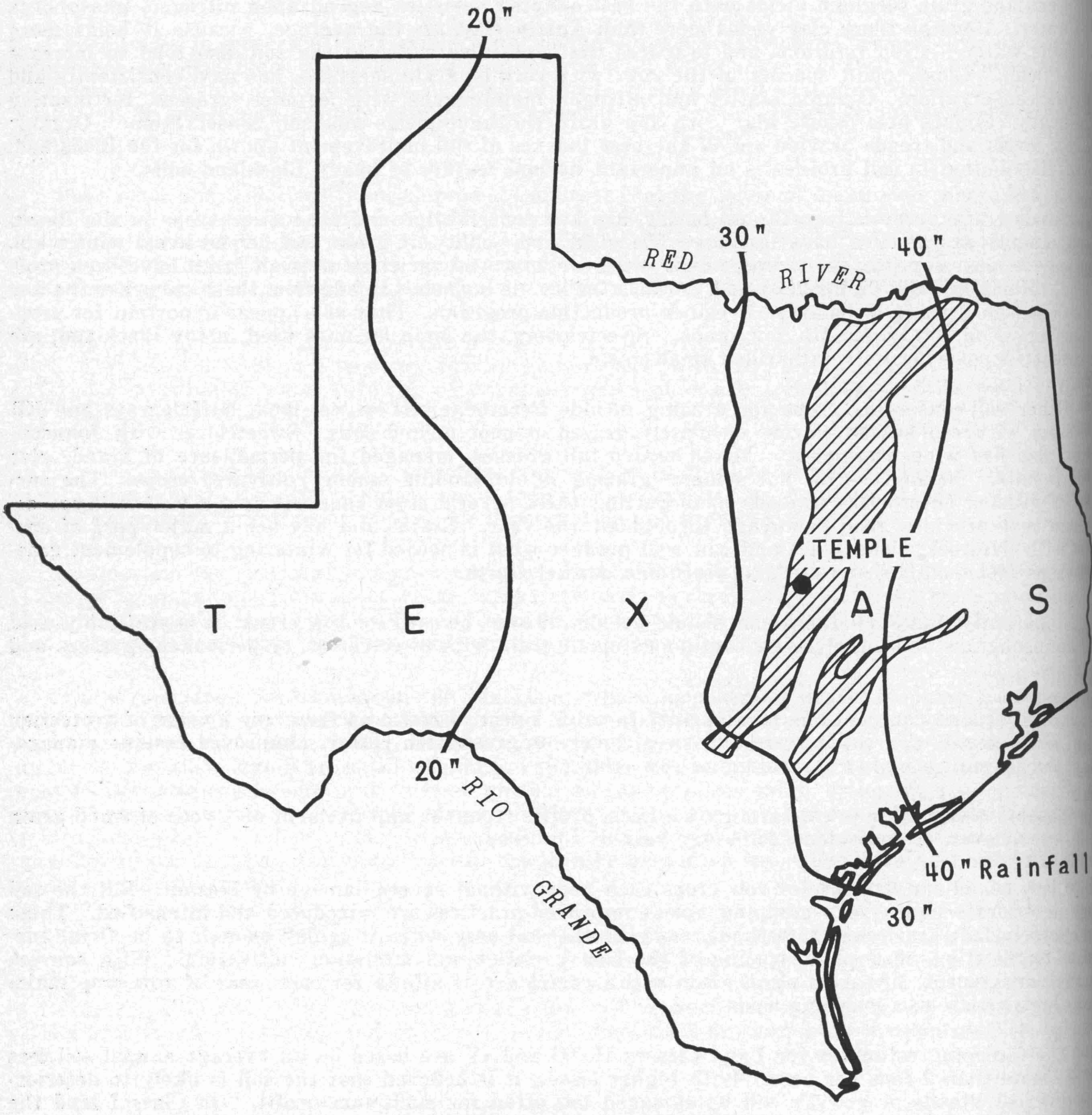

Figure 1. The Blackland Prairie of Texas.

Summary of Soil and Water Conservation Research from the Blackland Experiment Station, Temple, Texas, 1942-53

R. M. SMITH, R. C. HENDERSON and O. J. TIPPIT*

A TECHNICAL BULLETIN WAS PUBLISHED in 1944 summarizing erosion, reclamation and related information obtained at the Blackland Experiment Station at Temple from 1931 to 1941 (18). The present publication is a sequel to the earlier summary. Background information and detailed descriptions of methods were given in the former bulletin.

BLACKLAND AGRICULTURAL AREA

As shown in Figure 1, the main Blackland Prairie extends through Central Texas from the Red River bottomland on the north and northeast to the Rio Grande Plain in the San Antonio area on the southwest. The distance from north to south is slightly more than 300 airline miles. The area includes about 10,000,000 acres. There also are 2,000,000 acres of Blackland to the southeast, separated from the main Prairie by the forested Coastal Plain.

The Blackland Prairie is a rather clearly defined agricultural area. On the east and north are the acid, sandy, brown or yellow soils of the forested Coastal Plain. In addition to different soil characteristics in the Coastal Plain, the mixed oak timber in native habitats emphasizes the distinction from the Blackland Prairie. Sparse trees of introduced species mark the Blackland Prairie as an area of native grasses, unlike the acid Coastal Plain.

On the west, the Blackland is bordered by the Grand Prairie and the Edwards Plateau. Much of the western boundary is less sharp than the eastern border. Yet there are distinct differences of soil, climate and land use. The outstanding, practical soil difference is depth to rock. In the Blackland, the typical soils provide plenty of depth for full root development of any crop. But, in the Grand Prairie, and to a greater extent in the Edwards Plateau, firmly bedded, hard limestone rock is common in many soils at depths of less than 18 inches. This rock restricts roots and severely limits the available water supply that the soil can hold and provide to the crop. Uncertain rainfall, which becomes more of a factor toward the west, intensifies the drouthiness of shallow soils. As a result of these factors some of the land in the Grand Prairie and Edwards Plateau cannot be depended upon to produce consistent yields of most cultivated warm-season crops. Only the deeper soils are directly comparable with soils in the Blackland.

Runoff, erosion and production information on the Blackland station at Temple have been obtained on deep Blackland soils derived primarily from marl. Similar soils in part of the Blackland area are derived from deeply weathered chalk as well as marl. The Austin clay, shallow phase (Figure 2) on the station may be derived partly from chalk. All soil profiles on the station are deeper than 36 inches over any kind of rock that might restrict plant roots. In most places the soil mantle is deeper than 6 feet.

Average annual rainfall at Temple is 34.5 inches. Insofar as the obvious soil and climatic factors are dominant, the data and observations at Temple are likely to apply to the Blackland as a whole. However, variables of cropping, management and inconspicuous soil characteristics in many cases may overshadow the factors of known soil or climatic similarity. It is suggested that specific data at this station be considered as contributing to our understanding of trends, relationships and principles rather than as precise measurements applicable directly to all individual farms, or to a large land area like the Blackland Prairie as a whole.

Soil Erosion

Unpublished data by the Soil Conservation Service[1] indicate that erosion in the Blackland has been serious. The classification by degrees of erosion is: none to slight — 5,250,000 acres; moderate — 2,973,000 acres; moderately severe — 3,440,000 acres; severe — 511,000 acres; very severe — 135,000.

Much progress in soil and water conservation has been made since 1934 by farmers working with the Soil Conservation Service and cooperating agencies, first in demonstration watersheds and more recently in soil conservation districts. However, erosion and other aspects of conservation still are recognized as major problems in the Blackland area. Many practices have been ap-

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[1]Supplied by the State office, Soil Conservation Service. Expanded from direct measurement of field sheets of surveys covering 42 percent of the Blackland Prairie.

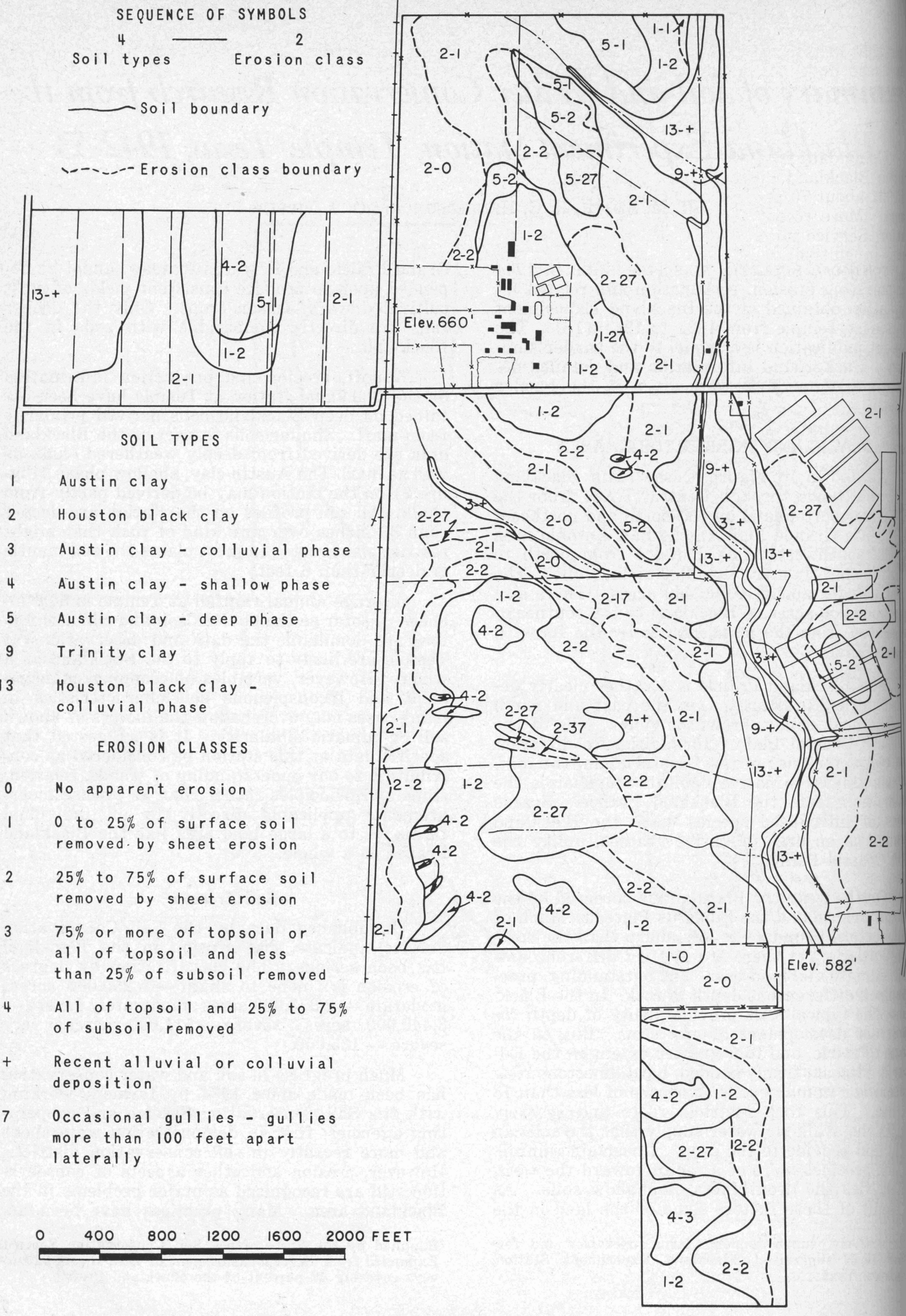


Figure 2. Soil types and the degree of erosion on the Blackland Experiment Station, from original map (18).

plied that help to reduce runoff and erosion losses but these have not solved the basic problem of conservation in row-crop farming.

Land Use Problems

Using data from three counties entirely within the Blackland Prairie, Carter (8) stated that in 1931 about 70 percent of the land was used for crops. More recent figures by the Soil Conservation Service show 8,300,000 acres, or 69 percent, in cultivation, 3,000,000 acres in pasture and 750,000 acres in woodland, or a total of 12,000,000 acres in the Blackland. Cotton is the most abundant crop (almost 3,000,000 acres), followed in acreage by corn, grain sorghum, oats, barley and wheat. Most of the row crops are grown following other row crops. The acreages of soil-improving crops, such as clover and perennial grasses in rotations with row crops, are very limited. Corn normally follows cotton, and cotton follows corn or grain sorghum. Many farms have no fences for handling livestock. Water supplies for livestock often are limited. The cash outlay required for diversified farming with or without livestock is greater than for strictly row-crop farming. These are some of the factors that hinder efforts toward improved conservation.

Land use and management changes are known that can control erosion and reduce runoff, but there is a demand for new information that will make conservation easier and more profitable for farm owners and operators.

Methods of Land Management

The most popular cropping systems and methods in use on many farms give little protection to the soil during seasons of maximum rainfall. This indicates a need for better crop rotations, plus more attention to methods of land preparation, residue handling, stand establishment, fertilization, cultivation and harvesting. The damage to a soil which often is attributed to the crop, may be more a matter of the techniques used in crop production than any bad feature of the crop itself. For example, tractor and tool compaction by plowing or one-way disking of clay soil when it is too wet, may damage soil structure and increase runoff more than growing an extra year of corn or cotton with careful plowing at proper moisture stage. Excessive cultivation or unnecessary working of the ground tends to cause damage to the soil, the crop and the population of beneficial organisms in the soil.

In general, practices that favor heavy crop growth and high yields per acre are good conservation. The fertility needs must be established, not only for the soil and the crop rotation, but also to fit the nature and handling of the residue and other cultural practices. Land use and crop rotation changes are major considerations in permanent production. However, techniques of land management for maximum crop yields and maximum soil improvement are equally important. The Blackland area of heavy clay soils with high productive potentials, appears to be an excellent location for conservation through better techniques of land management. All practices that favor ease of tillage, optimum crop stands, higher water intake, increased water storage, adequate aeration and balanced nutrition are keys to conservation and permanent production.

Land Classifications for Research and Practice

The Soil Conservation Service recognizes land classes relative to slopes for the major deep upland soils, as follows (22): Class I, 0 to 1 percent; Class II, 1 to 3 percent; Class III, 3 to 5 percent; and Class IV, 5 to 8 percent. The upland soil units to which this classification applies include soil unit 2 — deep, fine textured, slowly permeable soils: mostly Houston Black clay, and soil unit 2X — deep, fine textured, permeable soils: mostly Austin clay. Soil unit 4—deep, fine textured, slowly permeable bottomland soil — is rated the same as soil unit 2, except that some areas overflow or suffer from poor drainage and, therefore, are placed in Class V or VI.

Where lime contents are low in Blackland soil and in mixed soils of the Blackland border, soil unit 1 occurs — deep, fine textured, very slowly permeable soil: mostly Wilson and Crockett with clay loam to clay textures. The tightness of soil unit 1 causes eroded areas on slopes of 1 to 3 percent to be placed in Land Class III, instead of Class II as with soil units 2 and 2X. Moreover, Class IV includes soil unit 1 on 3 to 5 percent slopes only, whereas with soil units 2 and 2X, and moderate erosion, slopes from 5 to 8 percent, are included in Class IV.

There are narrow bands of shallow soils over chalk or limestone, and steep, broken land along stream breaks in the Blackland. This land is rated Class VI and Class VII, suitable only for permanent vegetation. The acreage of non-tillable land has been increasing because of severe gully formation on knobby hills and on slopes bordering entrenched streams or along the distinct escarpment that forms part of the western edge of the Blackland.

The following acreages of the different land classes have been determined by the Soil Conservation Service[2]: Class 1—2,265,000, with 1,800,000 acres cultivated; Class II — 5,000,000, with 4,400,000 acres cultivated; Class III — 2,240,000, with 1,110,000 acres cultivated; Class IV — 720,000, with 346,000 cultivated; Class V — 882,000, with 216,000 acres cultivated; Class VI — 254,000, with 165,000 acres cultivated or idle; and Class VII — 740,000 with 229,000 acres cultivated or idle.

[2]Supplied by the State office, Soil Conservation Service. Expanded from direct measurements of field sheets of surveys covering 42 percent of the Blackland Prairie.

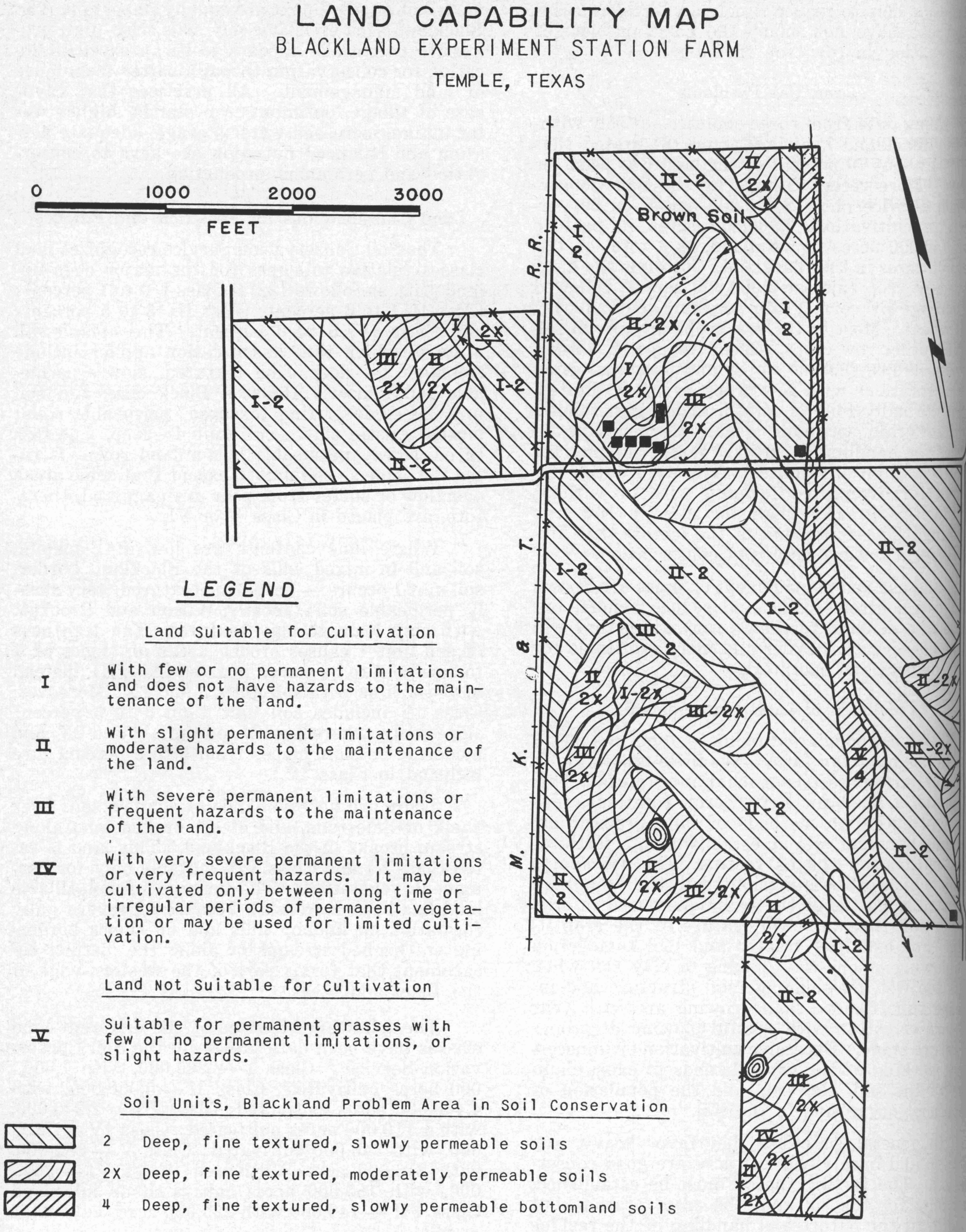


Figure 3. Land capability map, Blackland Experiment Station Farm, Temple, Texas.

Capability units determined by soil, slope and erosion are a primary basis for much research and for conservation planning. The units recognized on the station are shown in Figure 3. This classification is based on relatively permanent features. Temporary physical or fertility conditions may vary widely within capability units and must be considered in specific interpretations or planning. Greater detail of soil types and erosion is given in Figure 2.

THE WEATHER

Figure 4 presents a weather summary on a monthly basis for 40 years of record at Temple. Figure 5 shows total annual rainfall relative to the mean of 34.5 inches. During the period 1947-52, all annual rainfall totals were below the 40-year mean. This may emphasize moisture deficiencies more than is justified over long periods. However, with an average frost-free season of 249 days (March 17 to November 21) and high average summer temperatures, severe drouth periods are inevitable, even in years of normal rainfall. Evaporation (Figure 4) and water use by crops exceed rainfall from mid-June until September. Long dry periods are common. Average

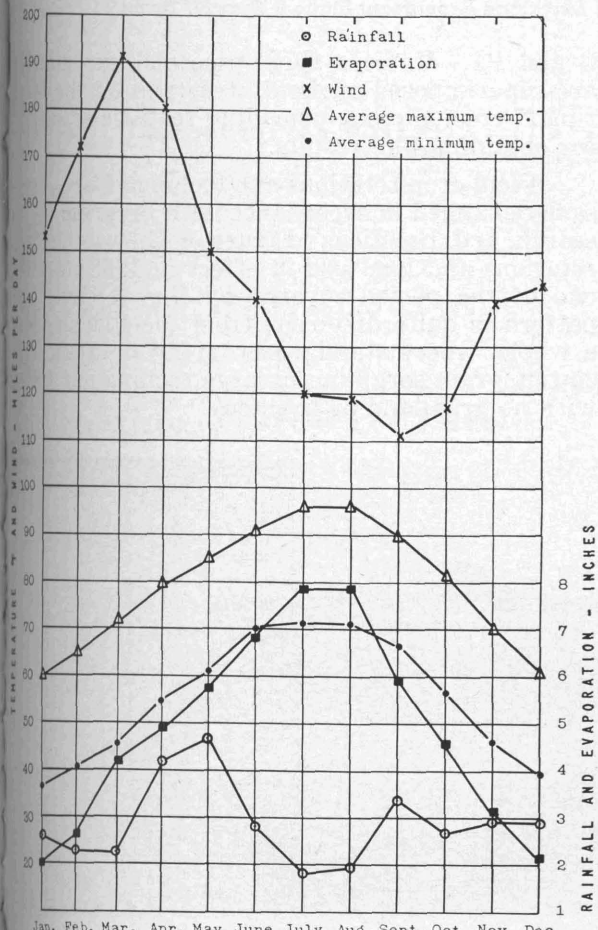


Figure 4. Summary of certain weather factors at Temple on a monthly basis, 1913-52.

open pan evaporation for June is 6.9 inches, July, 7.9 inches and August, 7.9 inches. Rainfall for these 3 months averages 2.9, 1.9 and 1.9 inches, respectively (Figure 4 and appendix tables.)

Wind movement averages about 5 miles per hour during the summer and slightly more in winter and spring. Even though average summer wind movement is lower than spring, strong dry summer winds contribute to drouth damage.

If average evapotranspiration for good crops is estimated as 0.6 times open pan evaporation (24), summer need for water is seen to be greatly in excess of rainfall. On this basis, evapotranspiration for normal crop growth is 13.6 inches for June, July and August, as compared with the average rainfall of 6.7 inches.

Water use by crops calculated by Blaney *et al* (4, 5) indicates that 6.7 inches of summer rainfall is inadequate. For cotton, which is rated as using less water than many crops, the use for June, July and August is 15.2 inches. For grass pasture, a high user, it is 18.4 inches. These calculations are based on average temperature and daylight hours. As shown by Figure 4, open pan evaporation correlates closely with average temperatures. Other factors, such as wind, may be important but they do not alter greatly the average temperature-evaporation relationship.

Another consistent feature of the weather at Temple is a moist or wet period during March, April or May. During this season, the soil normally is permeated with water to at least 3 or 4 feet on all land that has a reasonable intake capacity. One exception was 1950, when the soil probably remained dry below about 24 to 30 inches. Often there is a surplus of water at some time during the spring. This is the time of highest annual runoff and erosion.

Relative humidity commonly goes as low as 30 to 40 percent during hot, dry days in midsummer. In winter and spring, the relative humidity usually approaches 100 percent at night and about 70 percent in midday.

THE STATION

The Blackland Experiment Station is located 2 miles south of Temple. In addition to studies of conservation and land use, the work includes corn breeding and production; cotton root-rot control, production and mechanization; forage crop testing and management; small grain testing and management for grazing and grain; variety testing of all common Blackland crops; beef cattle grazing and management; and supporting laboratory work in soils, microbiology and pathology.

The overall station farm layout is shown in Figures 7 and 8. These two maps indicate how field arrangements have been shifted to provide improved land use in accordance with land capability, and to favor utilization of soil-conserving

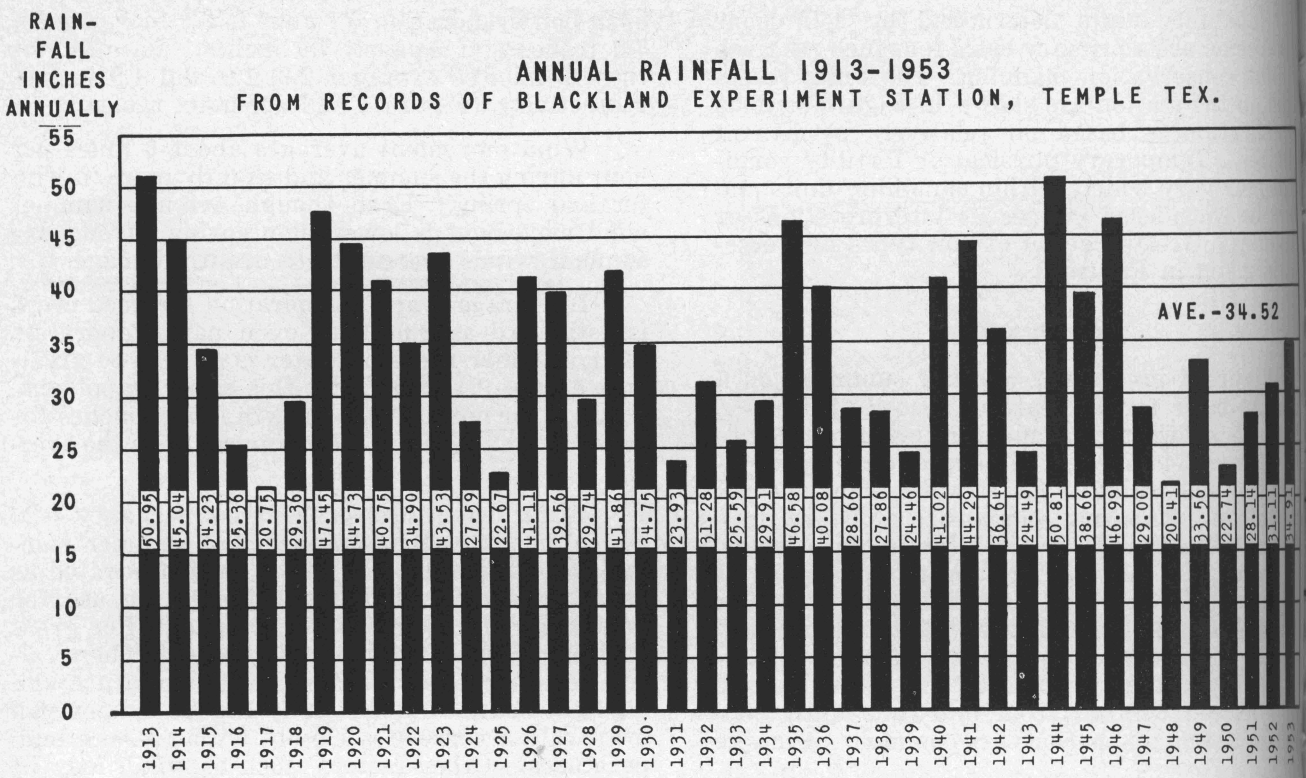


Figure 5. Annual rainfall, 1913-52, from records of Blackland Experiment Station, Temple, Texas.

crops by grazing cattle in a year-round program of beef production. Land character is shown in Figures 2 and 3.

Total area of the farm is 542 acres. Headquarters areas, houses, yards and roads occupy 40 acres. The main permanent pasture along Boggy creek (north and south of road) contains 44 acres, part of which is Class V land that is too wet for practical cultivation. The land in perennial grasses with clover totals 83 acres, or 16 percent of the farm. Long-time plot layouts amount to 30 acres (including large runoff-erosion plots O and P). Various short-time plot experiments are superimposed on field areas and on the large runoff-erosion plots, providing realistic situations for obtaining plot results.

Field-crop rotations and techniques are necessarily changed in accordance with progress by research and practice. Figure 8 shows the crop rotations and land use in effect in 1953 near the end of the period covered by this report. The pattern is quite different from the Blackland as a whole, where standard cropping is often corn, cotton, grain sorghum, in large rectangular fields, with no grassland or livestock.

Figure 6. Permanent grass pasture is good land use and is profitable on bottomland that is too wet for dependable cropping (Class V land). Bermudagrass with cool-season annuals gives a long grazing season and returns of more than 150 pounds of steer gain per acre.

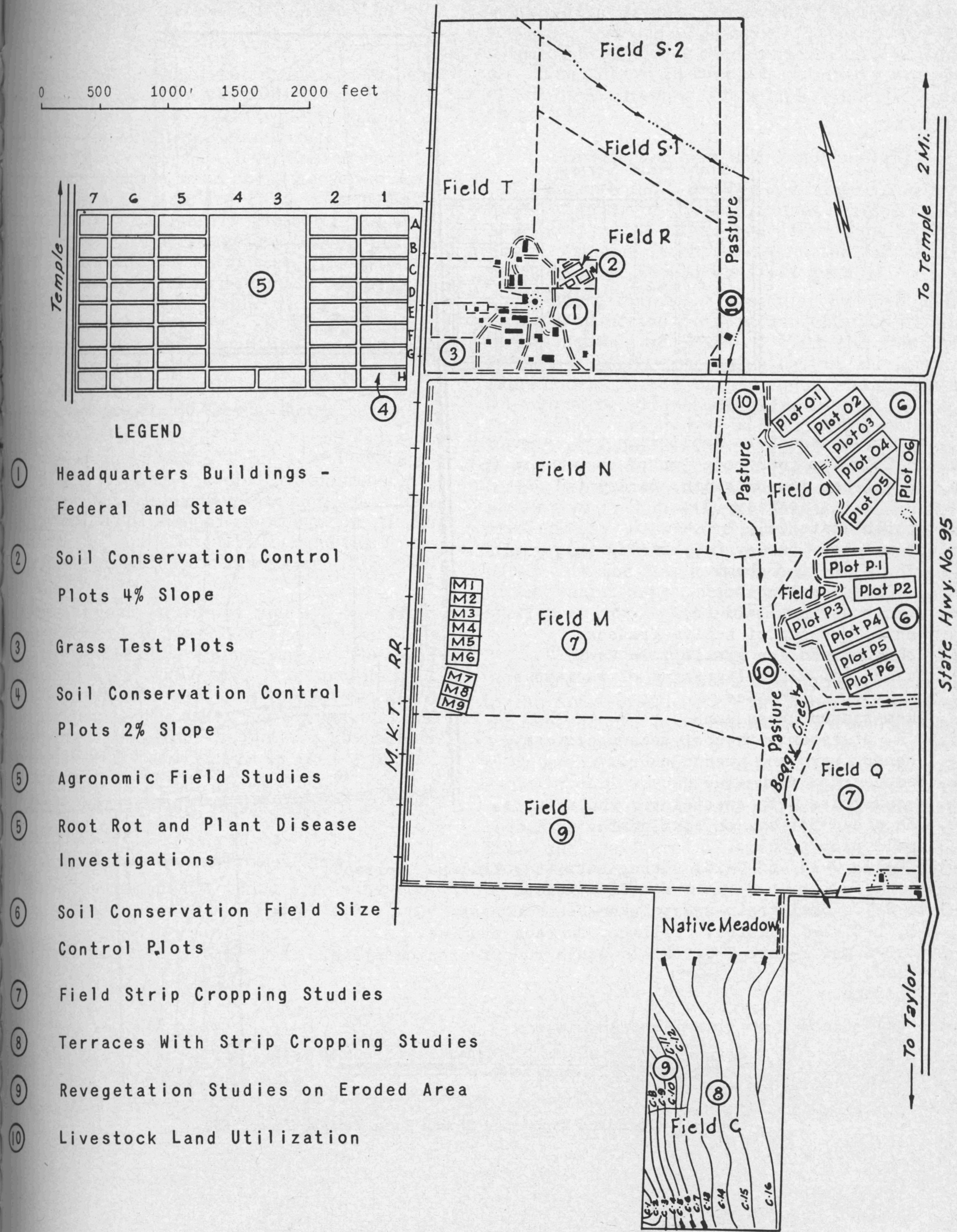
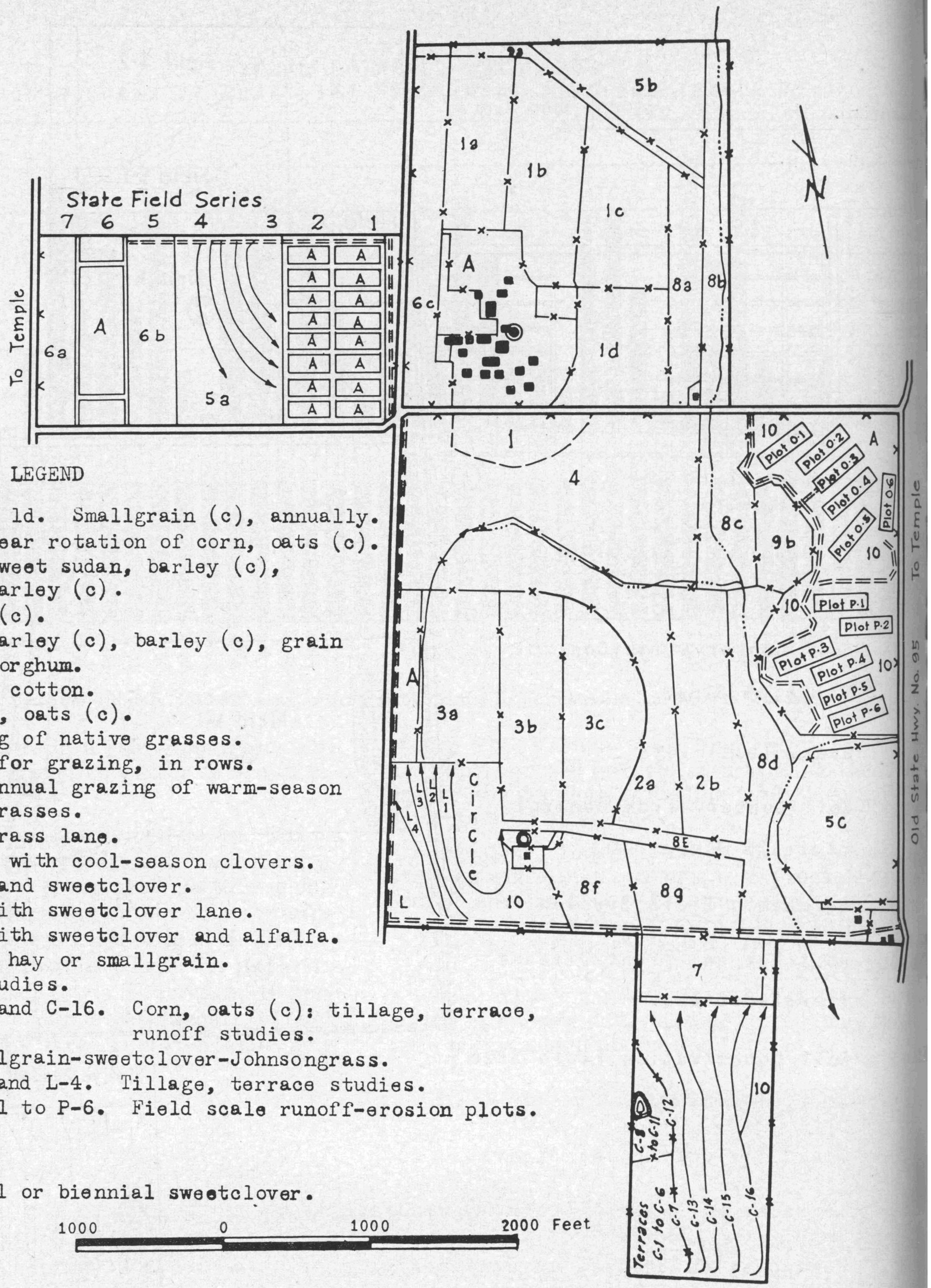


Figure 7. Blackland Experiment Station Farm, Temple, Texas, 1942.



LEGEND

1, 1a, 1b, 1c and 1d. Smallgrain (c), annually.
2a and 2b. Two year rotation of corn, oats (c).
3a, 3b and 3c. Sweet sudan, barley (c), barley (c).
4. Cotton, oats (c).
5a, 5b and 5c. Barley (c), barley (c), grain sorghum.
6a and 6b. Corn, cotton.
6c. Corn breeding, oats (c).
7. Annual grazing of native grasses.
8a. Johnsongrass for grazing, in rows.
8b, 8c and 8d. Annual grazing of warm-season grasses.
8e. Warm-season grass lane.
8f. K.R. bluestem with cool-season clovers.
8g. Johnsongrass and sweetclover.
9a. Fescuegrass with sweetclover lane.
9b. Fescuegrass with sweetclover and alfalfa.
10. Odd areas for hay or smallgrain.
A. Small plot studies.
C-13, C-14, C-15 and C-16. Corn, oats (c): tillage, terrace, runoff studies.
C-1 to C-7. Smallgrain-sweetclover-Johnsongrass.
L, L-1, L-2, L-3 and L-4. Tillage, terrace studies.
O-1 to O-6 and P-1 to P-6. Field scale runoff-erosion plots.

■ - Building.

Note: (c) - Annual or biennial sweetclover.

Figure 8. Blackland Experiment Station Farm, Temple, Texas, 1952.

METHODS OF INVESTIGATION

Weather Records

Amount and intensity of rainfall have been measured with Fergusson recording rain gauges in the immediate area where runoff-erosion records have been obtained. Standard U. S. Weather Bureau gauges also have been used at each location. Temperature, wind and evaporation have been measured by standard U. S. Weather Bureau methods. Barometric pressure has been checked with a Taylor anaeroid barometer and with a Friez recording barometer. Relative humidity measurements have been made with a Friez recording hygro-thermograph, as well as with wet and dry thermometers. Details of rainfall, temperature, wind and evaporation are shown in appendix tables.

Small Runoff-Erosion Plots

The complete list of small runoff-erosion plots is given in appendix Table 17. These consisted of one layout of 16 plots on slopes of 3½ to 4 percent and one layout of six plots on a slope of 2 percent. The steeper slope was on Austin clay soil (SCS Land Class III-2X), and the 2 percent plots were on Houston Black clay (SCS Land Class II-2).

Measurements of runoff and soil loss from small plots No. 1 to No. 11 of 1/200, 1/100 and 1/50 acre were made volumetrically. The total runoff from a plot was caught in a concrete tank at the lower end of the plot. Samples were taken of the sludge after the water was drained off. The quantity of soil lost from the plot was determined from the oven-dry soil content of these samples.

Silt boxes and Geib divisors were used for measuring losses from intermediate-size plots No. 12 to No. 25 (18).

Field-scale Runoff-Erosion Plots

These measurements, which are being continued, consist of 12 plots of 1.5 acres each. Type H measuring flumes, developed by the Soil Conservation Service Hydraulics Laboratory, are used for determining rates and amounts of runoff. The soil loss in runoff is obtained by means of silt boxes, Ramser silt samplers and Geib divisors (18).

Terrace Gauging and Maintenance

Surface runoff has been obtained from terraces by means of Parshall flumes equipped with automatic water-stage recorders (type FW-1, Friez). During recent years, no soil loss measurements have been made from terraces.

Terrace maintenance studies included comparisons of terrace cross-sections obtained by different methods of plowing. With the standard method, a backfurrow was placed on the terrace ridge, a dead furrow in the channel and all of the soil above the channel was plowed uphill. A second method consisted of backfurrowing twice on the terrace ridge, leaving dead furrows in the terrace channel and midway between terraces. In earlier work with the standard method, uphill plowing was not practiced. This left a dead furrow midway between terraces. Subtillage or trash-mulch plowing of terraces recently was compared with the standard method. In studies of terrace maintenance, detailed cross-sections were charted at 1 or 2-year intervals.

Crop Production and Land Capability

Field-scale trials of promising crop rotations or improved practices are an important part of the experimental approach at the Temple station. Yields of corn, cotton, grain sorghum and small grain have thus been determined on different land capability units. Observations also have been made of field runoff and erosion. Conclusions regarding productivity of crop rotations and practices, and the degree of runoff and erosion control, therefore, can be based upon experiences from field-scale operations as well as from small plots.

Figure 9. Runoff-erosion plots on 4 percent slopes. Plot 3, continuous corn, shows a sealed-over surface compared with Plot 2, where Hubam stubble has been spaded. The soil level in Plot 3 is about 3 inches lower because of heavy erosion losses during 20 years.

Beef Production in Conservation Systems

The return from soil-conserving forage crops was evaluated by beef production on various fields for a number of years. Profitable year-round grazing has been the goal of these forage crop management studies. All phases of practical beef cattle grazing and feeding were considered to determine whether beef production can be fitted into Blackland conservation farming. Emphasis was placed upon proper stocking and grazing by crop, soil and season. Conservation and profits were observed and compared with results from cash crop farming on different kinds of land.

Land Management

Techniques of land preparation, including trash-mulch plowing, fertilizer application, stand establishment and harvesting were extensively tested under Blackland conditions, and in conjunction with crop rotations, terracing, contouring and strip cropping. Conclusions on the effectiveness of techniques are based primarily on experience and observations, but are supported by certain small plot data, field crop yields, stand counts, residue measurements and soil determinations.

Soil Measurements

Soil profile samples to a 3-foot depth were collected from all small runoff-erosion plots, from the 12 field-scale runoff-erosion plots (O and P plots) and from various field areas. These samples were used for determinations of organic matter (7), bulk density and pore space, moisture tension relations and available moisture holding capacity, soluble nitrates (25), total nitrogen (Kjeldahl method—selected samples only), aggregate stability (27, 32), calcium carbonate equivalents, and readily-extractable phosphates—CO_2-soluble (14).

RESULTS AND DISCUSSION

Runoff and Erosion

Relation to Rainfall, Season and Soil Moisture

The average monthly runoff and erosion from plot 3, continuous corn, is closely related to total rainfall (Figure 10). This tends to be true for all plots with light vegetative cover. Intensities as well as monthly quantities of rainfall correlate closely with runoff and erosion losses.

It is difficult to separate quantity and intensity features of rainfall in monthly or yearly averages. The quantity of water usually is too small to cause serious losses unless intensities are high for periods of 30 minutes or more. Rains of 1.0 inch or more, and intensities higher than 1.0 inch per hour for 30 minutes, cause most losses (appendix Table 16). When rainfall reached 2 inches or more in 24 hours, usually there was some runoff and erosion on row-crop land at Temple.

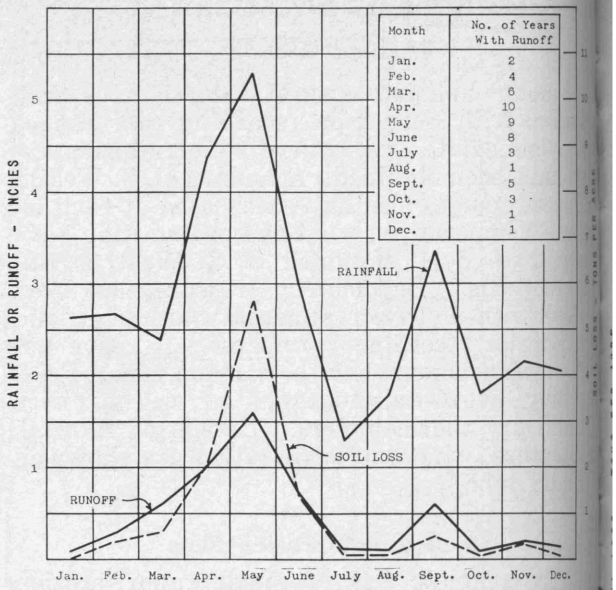


Figure 10. Average runoff and erosion by months on plot 3, Austin clay, 4 percent slope, in continuous corn, shown in relation to rainfall. Results are for the 10-year period 1942-51.

When the soil is dry and in good condition, it takes more than 2 inches in 24 hours to start runoff.

Soil and water losses from row crops, on an annual basis, are closely related to total annual rainfall as shown by Figures 11, 12 and 13. Runoff has been insignificant with ungrazed Bermudagrass on small plots. With small grain in field-scale plots O and P (Figures 11 and 12) there were years when runoff and erosion showed little relation to total rainfall. The explanation was rainfall distribution. Small grain gives excellent protection during April and May. However, during the fall, losses are likely to correlate with rainfall characteristics on small grain as well as on row-crop ground. At that time, the land is plowed and unprotected by vegetation.

Figure 11 shows that normal annual runoff from row-cropped Blackland on 2 to 3 percent

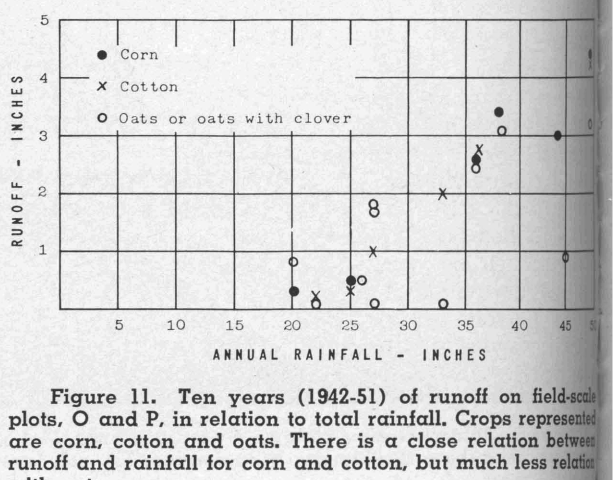


Figure 11. Ten years (1942-51) of runoff on field-scale plots, O and P, in relation to total rainfall. Crops represented are corn, cotton and oats. There is a close relation between runoff and rainfall for corn and cotton, but much less relation with oats.

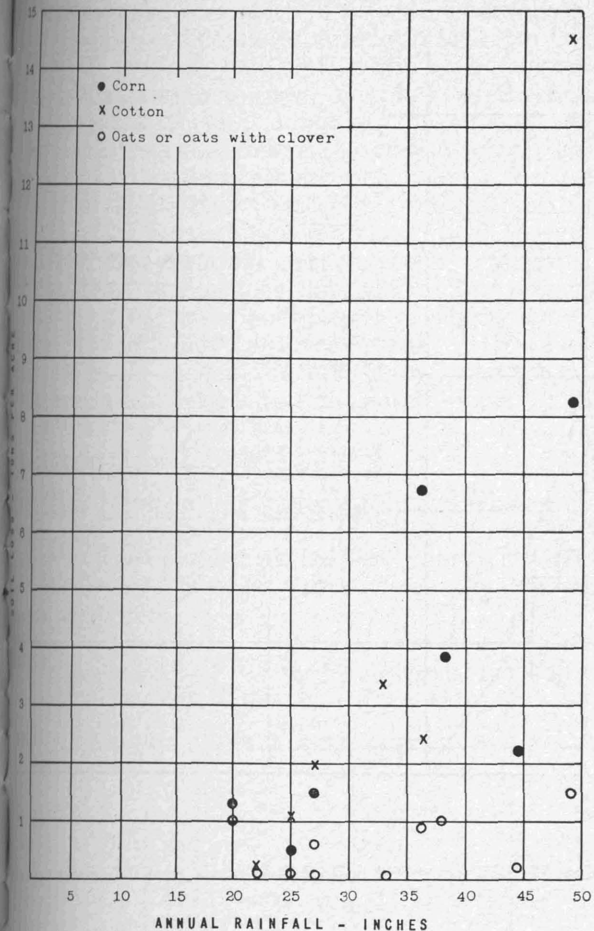


Figure 12. Ten years (1942-51) of soil losses on field-scale plots O and P, in relation to total rainfall, for corn, cotton and oats with clover. There is less relation between erosion and rainfall with oats than with row crops.

slopes is about 2.5 inches for years with an average rainfall of 35 inches. Average soil losses for the same conditions are about 4 tons per acre.

Sample hydrographs (Figures 14, 15, 16 and 17) illustrate the effect of soil moisture on runoff with two types of surface soil conditions on field-scale plots. The 2.0-inch rain on moist soil resulted in runoff of 0.68 inch from corn after cotton (Figure 14) and 0.36 inch from corn following fescuegrass sod (Figure 15). Losses of water were much heavier from the 1.66-inch rain that followed, amounting to 1.08 and 1.15 inches, respectively, for the two plots. This was about two-thirds of the total rainfall. There was a 15-minute peak rainfall intensity for the second rain of 3.3 inches per hour, as compared with a peak of 2.3 inches for the first rain. Even so, the biggest difference in runoff evidently was a result of the wetter soil with a slower infiltration rate during the second rain. Two plots of excellent oats with sweetclover and four plots of fescuegrass with sweetclover showed only a trace of runoff from these same storms. The most important reason was soil dryness. The plots with grass and sweetclover were almost at the wilting point. There was room for intake and storage of 1.7 inches of water per foot, as compared with only 0.3 inch per foot for the moist soil of the corn plots. In addition, on corn plots there may have been significant compaction layers, or "plowpans," limiting the rates of infiltration.

During the first rain, there was a delay in runoff and a reduction of total runoff for the plot with residue of grass sod amounting to about 0.3 inch. This appeared to be caused by the open, immediate surface layer provided by the residue of grass roots and sod fragments or clumps. However, on wet soil where some soil layer below the immediate surface evidently was limiting water intake, the sod residue failed to reduce runoff.

In both cases, there was much less soil loss from the plot with sod residue. Total losses were 6.8 tons for corn after cotton and 2.4 tons for corn after sod. The 6.8-ton loss is one of the heaviest from field-scale plots for a single storm period. Observations indicate that the difference resulted from the binding action of the masses of fine, fibrous fescuegrass roots holding the soil together and preventing its removal.

Relation to Slope Percent

Field-scale plots O and P provide an opportunity to check the effect of slope percent on erosion, within the slope range from 1.39 to 3.01 percent. There is no consistent relation of runoff volume to slope percent (see appendix tables).

Figure 21 shows average soil loss per inch of runoff for each of the 12 field-scale plots in relation to slope during all years the plots were in corn

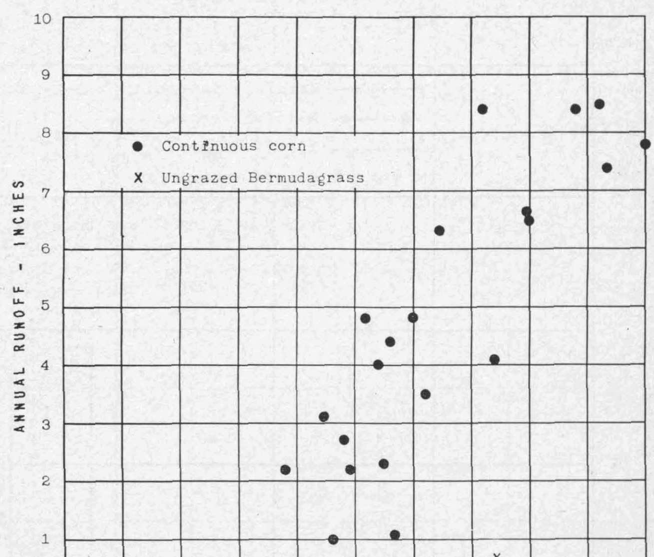


Figure 13. Relation between total rainfall and runoff from plot 3, in continuous corn. Records cover 1931-51. Compare with low or insignificant runoff from continuous, ungrazed Bermudagrass, plot 6.

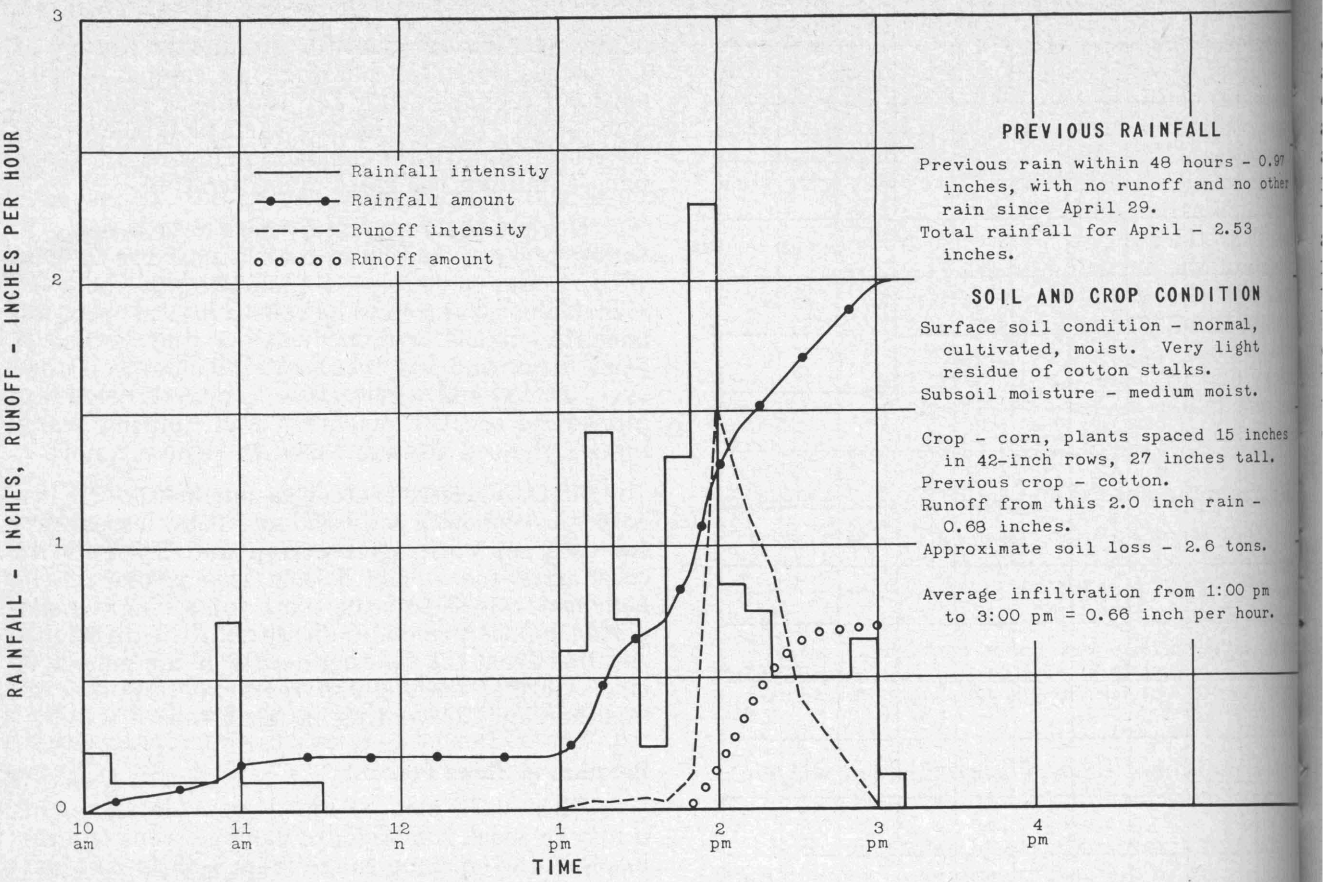


Figure 14. Hydrograph for a storm of 2.0 inches falling on May 12, 1953 on moist soil of field-scale plot 0-1, growing corn following cotton. Plot slope, 2.31 percent.

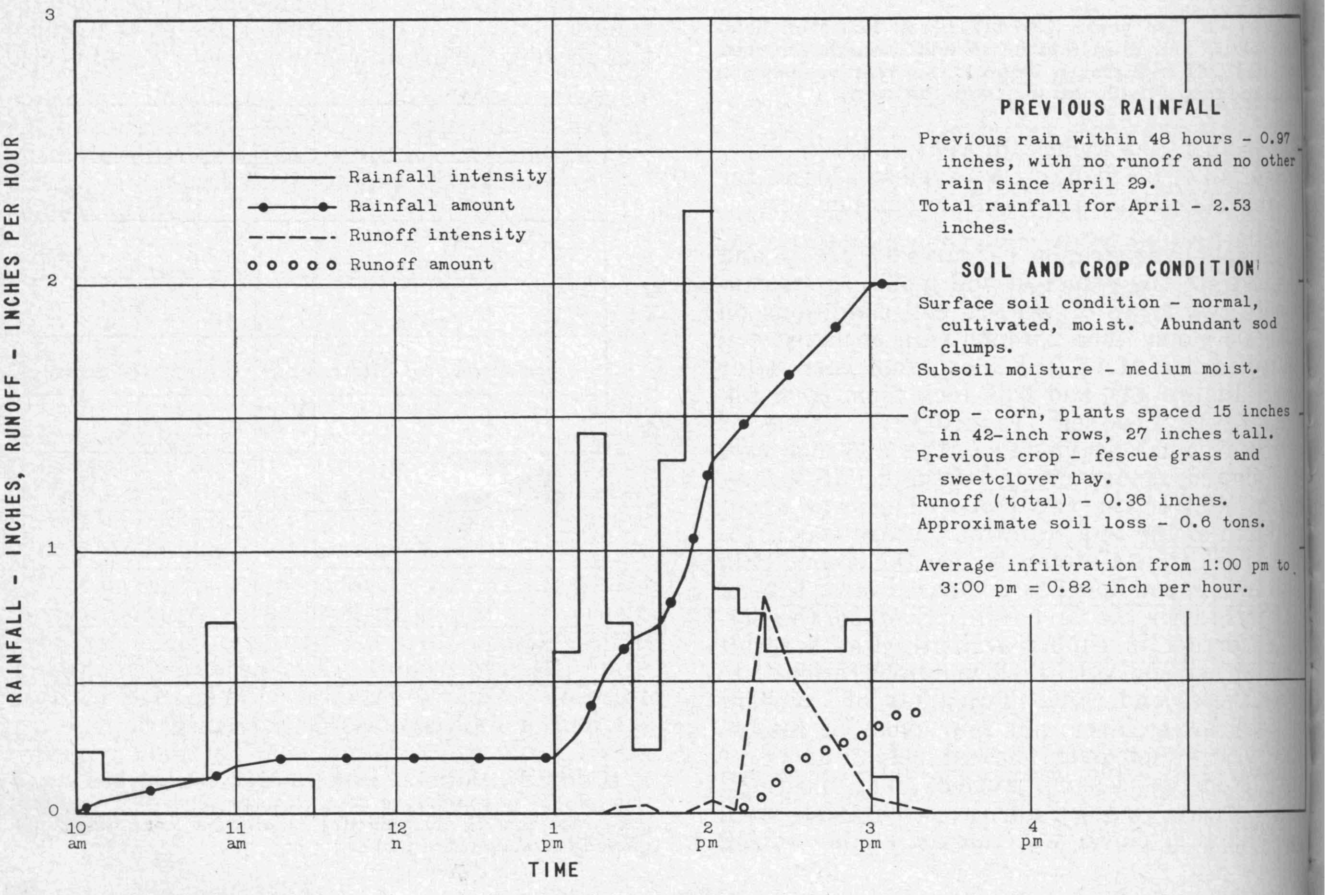


Figure 15. Hydrograph for a storm of 2.0 inches falling on May 12 on moist soil of field-scale plot 0-3, growing corn following grass sod.

or cotton. Soil loss per inch of runoff is chosen as a measure of tendency to erode in order to help eliminate natural soil infiltration differences among plots, and to help equalize differences among years. When studied in this manner, the results show a characteristic increase in soil loss with increasing slope. The data show a reasonable fit to the curve $Y = 0.5X^{1.4}$. The exponential nature of the curve has some theoretical foundation, and the exponent 1.4 has been established by data from various locations (33). The present data would not be conclusive if unsupported by theory and by other empirical results. However, the results are in general agreement with the accepted relation between erosion and slope.

Relation to Slope Length

The result of slope-length comparisons on small plots are summarized in Table 1 and Figure 22. The longest period, 21 years, involves two plots only. For 13 years, three plot lengths were compared.[3]

[3] See appendix page 39 for further evidence and discussion regarding slope length.

Relation to Crop

Tables 2, 3, 4 and 5 and Figures 10, 11, 12 and 13 show crop and crop-rotation effects on runoff and erosion. Greater detail is given in appendix tables. Figures 23 through 34 give annual results for each of the large, field-scale plots.

There is no clear evidence of any difference between row crops, corn and cotton, as they influence runoff and erosion. Neither crop gave much protection during the critical months of March, April, May and September. Losses dur-

Table 1. Summary of results on three continuous corn plots comparing the effect of length of slope on annual runoff and erosion on Austin clay[1]

Plot	Length	Slope percent	Rainfall	Runoff, inches	Soil loss, tons per acre	Soil loss per inch of runoff
			Average for 13-year period, 1931-43			
1	36.3	4	32.4	5.3	20.6	3.9
3	72.6	4	32.4	4.6	19.3	4.2
2	145.2	4	32.4	5.8	18.4	3.2
			Average for 21 years, 1931-51			
1	36.3	4	32.8	5.3	14.5	2.7
3	72.6	4	32.8	4.8	16.0	3.3

[1] There is no clear evidence that slope length is an important factor in influencing runoff or erosion.

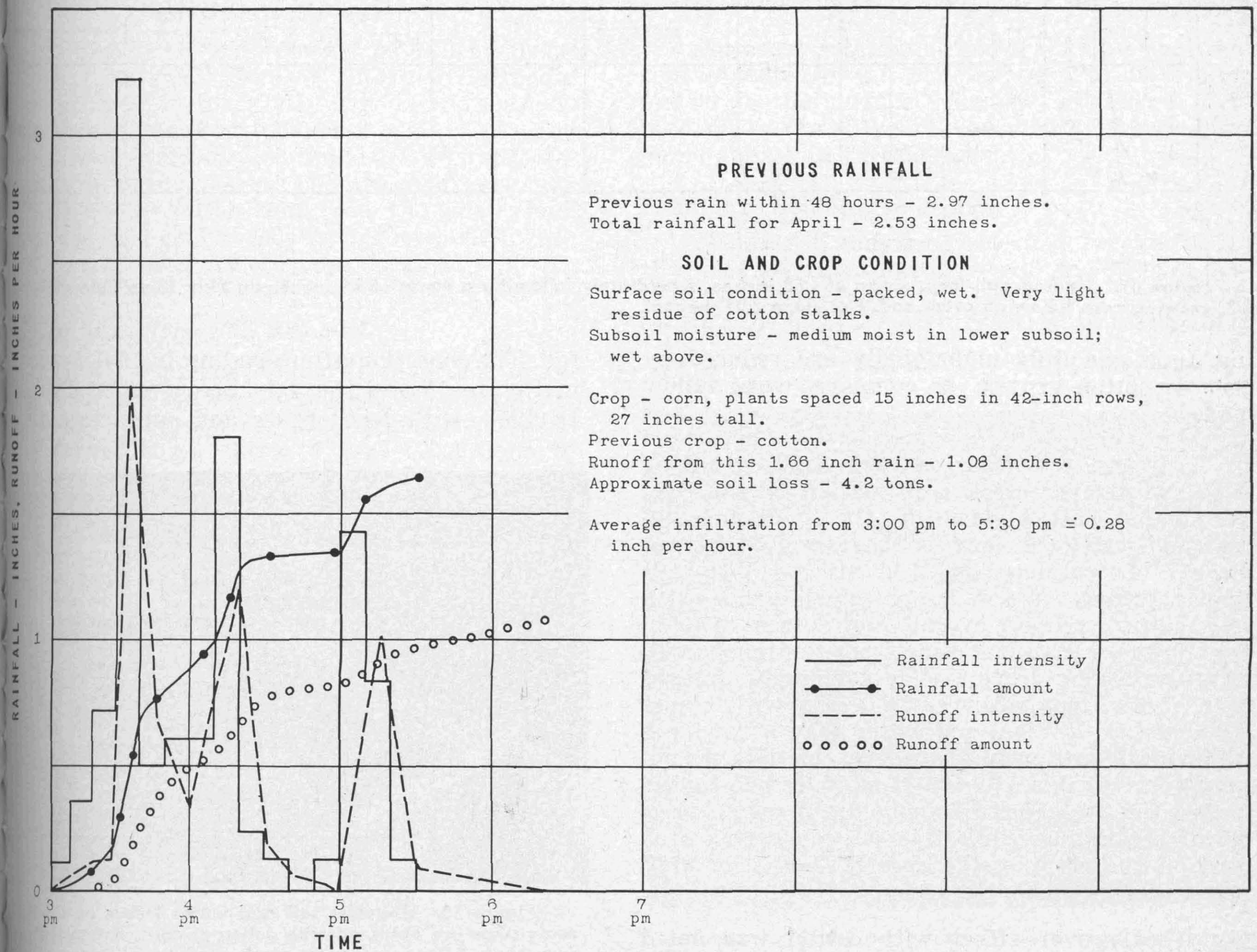


Figure 16. Hydrograph for a storm of 1.66 inches immediately following a storm of 2.0 inches on May 12 on field-scale plot 0-1, growing corn following cotton. Plot slope, 2.31 percent.

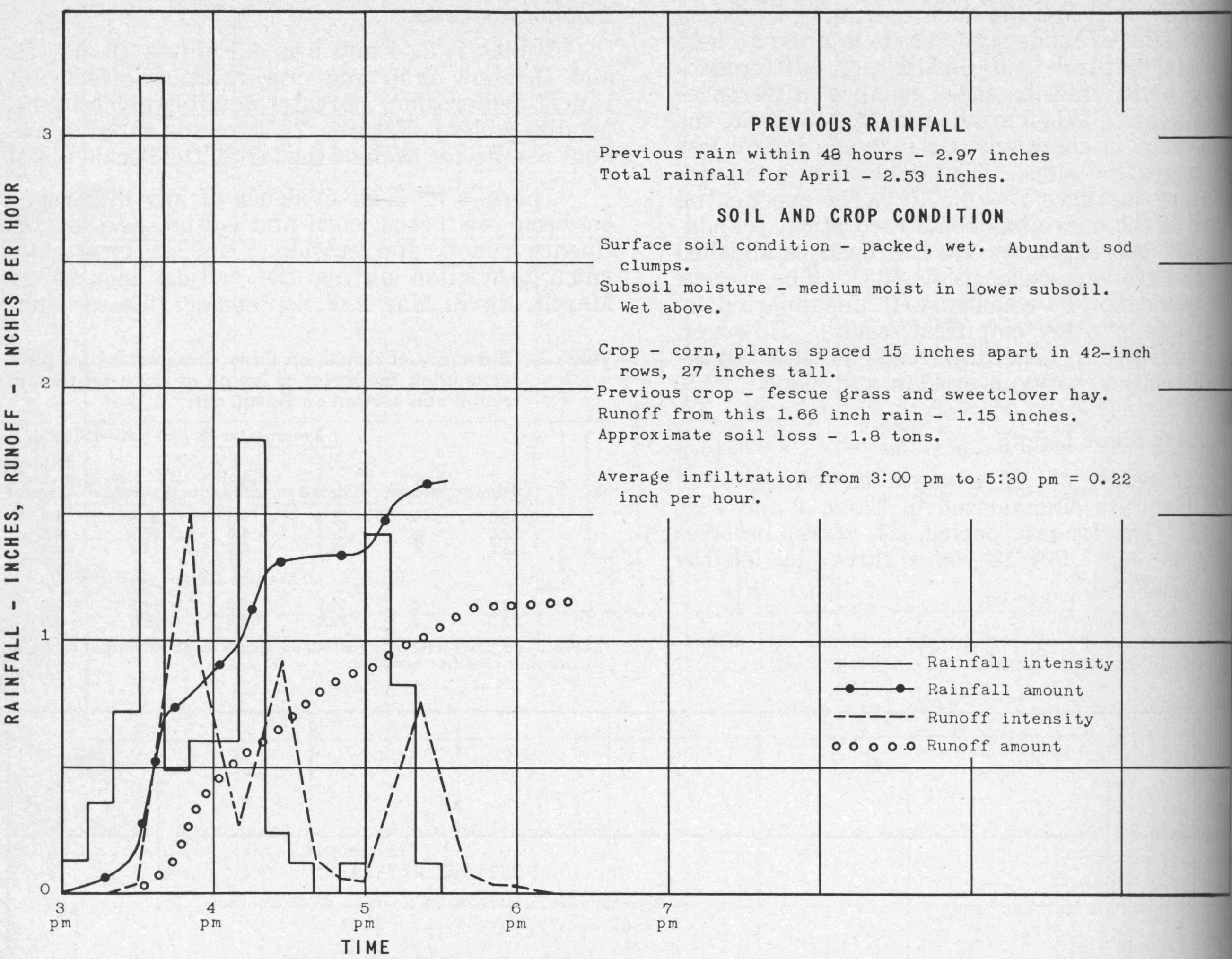


Figure 17. Hydrograph for a storm of 1.66 inches immediately following a storm of 2.0 inches on May 12 on field-scale plot 0-3, growing corn following grass sod. Plot slope 2.08 percent.

ing June and July undoubtedly are reduced by corn or cotton growth, as compared with fallow land.

Soil and water losses with small grain or with sweetclover, or a combination of the two, are small. This is shown by the small plot and the field-scale plots and is substantiated by numerous observations on field areas. Two-year crop rotations of row crops, small grain with sweetclover, reduce overall soil losses to only slightly more than half that from continuous cultivation to row crops. It is commonly thought that a row crop after small grain with clover tends to lose less soil and water than a row crop following a row crop. However, the data do not prove this (Table 5). When residues are turned under, the big effect of small grain with sweetclover is obtained while this soil-conserving crop combination occupies the ground. Hill *et al* (18) noted this in earlier records.

A carryover effect with cotton was noted from 1946 through 1949 when Hubam was grown to maturity and spaded into the ground in the fall. The condition after spading in 1948 is shown in Figure 10 and the data are given in Table 5. In 1953, with fescuegrass and subsurface plow-

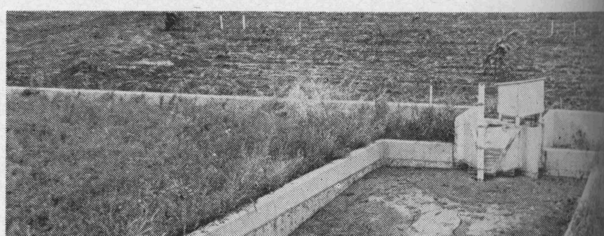


Figure 18. Heaviest soil and water losses on the field-scale plots are obtained with cotton or corn. The mud shown represents 7.9 tons per acre washed off by 7.7 inches of rain during 4 days in May 1953. The plot is planted to cotton following corn. Runoff was 3.3 inches.

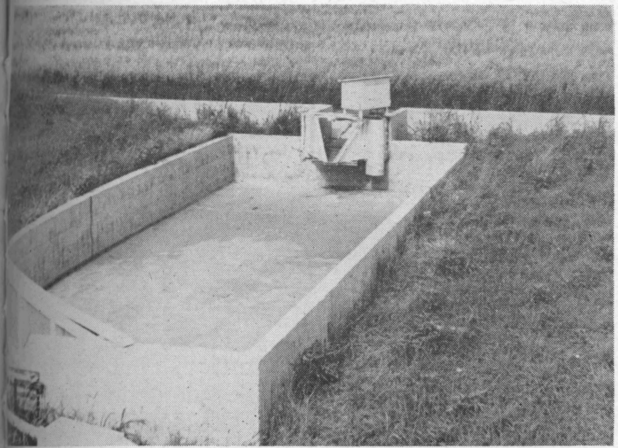


Figure 19. Compare with Figure 18. Oats with sweetclover lost only 0.1 inch of water and a trace of soil from the 7.7 inches of rainfall in May 1953.

ing, there appeared to be a carryover effect of the sod into the corn year (Figures 14, 15, 16 and 17—see "Relation to Rainfall, Season and Soil Moisture"). More records are being obtained to determine the consistent magnitude of the sod influence. Studies at other locations indicate distinct carryover effects in crop rotations (6, 23).

Both soil and water losses have been insignificant from small plots of ungrazed Bermudagrass on Houston Black clay and on Austin clay. Data from grazed Bermudagrass pasture (2) and observations indicate that the losses of water under natural Bermudagrass pasture conditions may be considerably higher than from the small plots, which are loose and porous from roots, earthworn action and the absence of compaction.

Relation to Surface Soil Removal

Plot 11, 4 percent slope, from which 15 inches of surface soil were removed, has continually lost more water and soil than comparable plots with normal soil. Table 4 (see "Relations to Crop") shows that from 1945 through 1949, plot 11 lost an average of 5.1 inches of water and 10.1 tons of soil, annually, as compared with 2.1 inches of water and 4.1 tons of soil by plots 2 and 9. All three plots were in a 2-year rotation of cotton, Hubam sweetclover. During this period, desurfaced plot 11 lost 2.5 times as much water and soil as the normal plots. Soil loss per inch of runoff, or erodibility, was essentially the same for the desurfaced and the normal plots. During previous years, the desurfaced plot lost less soil per inch of runoff than did the normal soil. Heavy soil losses have been caused by greater runoff from the desurfaced soil. And greater runoff, in turn, is at least partly caused by lower water storage capacity in the desurfaced soil. As shown in Table 4, desurfaced plot 11, in the 2-year rotation of cotton, Hubam, lost slightly more water and slightly less soil than plot 3, in continuous corn, or plot 14, in continuous cotton.

On two other plots from which 22 inches of surface soil were removed in 1932, an indication of the rate of soil rebuilding has been obtained. The soil was Austin clay on a 3½ percent slope. One plot was established in mixed native grasses[4] and forbs while the other was maintained in cultivation. During 20 years, the surface 1½ inches gained about 1.3 percent organic matter; the second 1½ inches gained 0.8 percent and the next 3 inches gained 0.3 percent over the adjacent desurfaced plot kept in cultivation. The gain amounts to 6 tons of soil organic matter, or 600 pounds of nitrogen per acre, which is 30 pounds of N per acre per year. The final organic matter and nitrogen percentages by depth, after 20 years, are given in Table 6.

Under grass, there was only a trace of organic matter build-up below 6 inches. The total of 1.3 percent at 6 to 12 inches is only slightly above that in adjacent desurfaced soil under cultivation.

The accumulation of 30 pounds of N per acre per year represents the nitrogen obtained from non-symbiotic fixation in the soil, from rainfall and from symbiotic fixation in root nodules of sparse native legumes associated with the grass.

Adjacent cultivated plots with normal soil contain between 2.0 and 2.4 percent of organic matter in the surface 6 inches. Plot 6, in Bermudagrass for 20 years, contains 3.5 percent organic matter in the same depth.

Relation to Soil Characteristics

Major soil characteristics as recognized in this area are rated in Figures 36 and 37 by a system used elsewhere (28, 15). With "5" representing the ideal for each practical property, like-

[4]The predominant grass species was little bluestem, Andropogon scoparius.

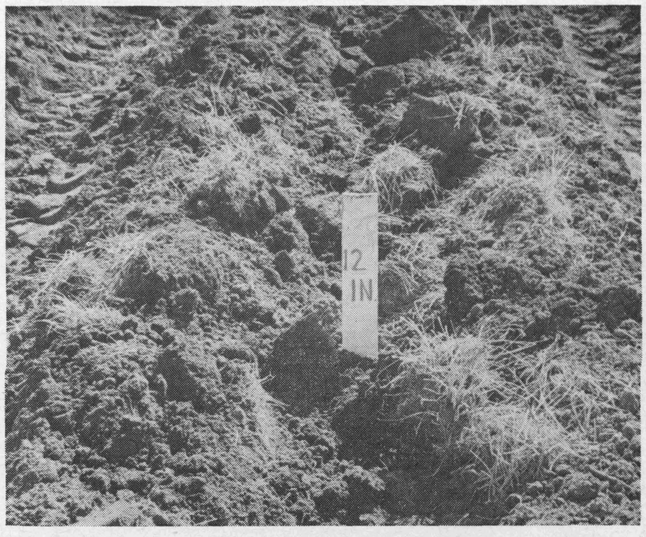


Figure 20. Many sod clumps remain when fescuegrass sod is plowed and bedded. Some farmers do not like this soil condition for planting, but it contributes to water intake and reduces erosion.

ly ranges from the ideal are shown for each soil. For example, "workability" for soil unit 2 may vary from "6" to "9," depending on the physical condition of the soil. A "6" rating means good but not ideal, or slightly too tight, but it is the best to be expected with soil unit 2. A "9" means very bad workability, the worst that is ever recognized for this soil, or very much too heavy. The extreme rating of "10" is reserved for soils such as black alkali that cannot be worked satisfactorily.

These ratings show that natural erodibility is believed to be high for both 2 and 2X soils, but reaches the extreme only with 2X. Water and air properties are highly variable, depending on physical soil condition. Soil unit 2 includes more variability than 2X. Extremes of tightness and of air deficiency are seldom, if ever, found with 2X. Also, soil unit 2 at its best holds more available water than soil 2X. Available nutrient problems involve phosphorus and nitrogen. With phosphorus, the problem is strictly one of availability rather than total. In the case of nitrogen both total and available are highly variable with history and management.

In comparing erodibility of soil unit 2 and 2X on small runoff-erosion plots, no difference can be shown clearly between the two sites. In Table 4, higher soil loss per inch of runoff is indicated for Austin clay (soil unit 2X) than for Houston Black clay (soil unit 2), but when the influence of slope percent is taken into account, as shown by Figure 22, the two soils appear similar in tendency to erode. At least, it is obvious that minor crop differences overshadow differences between the soils.

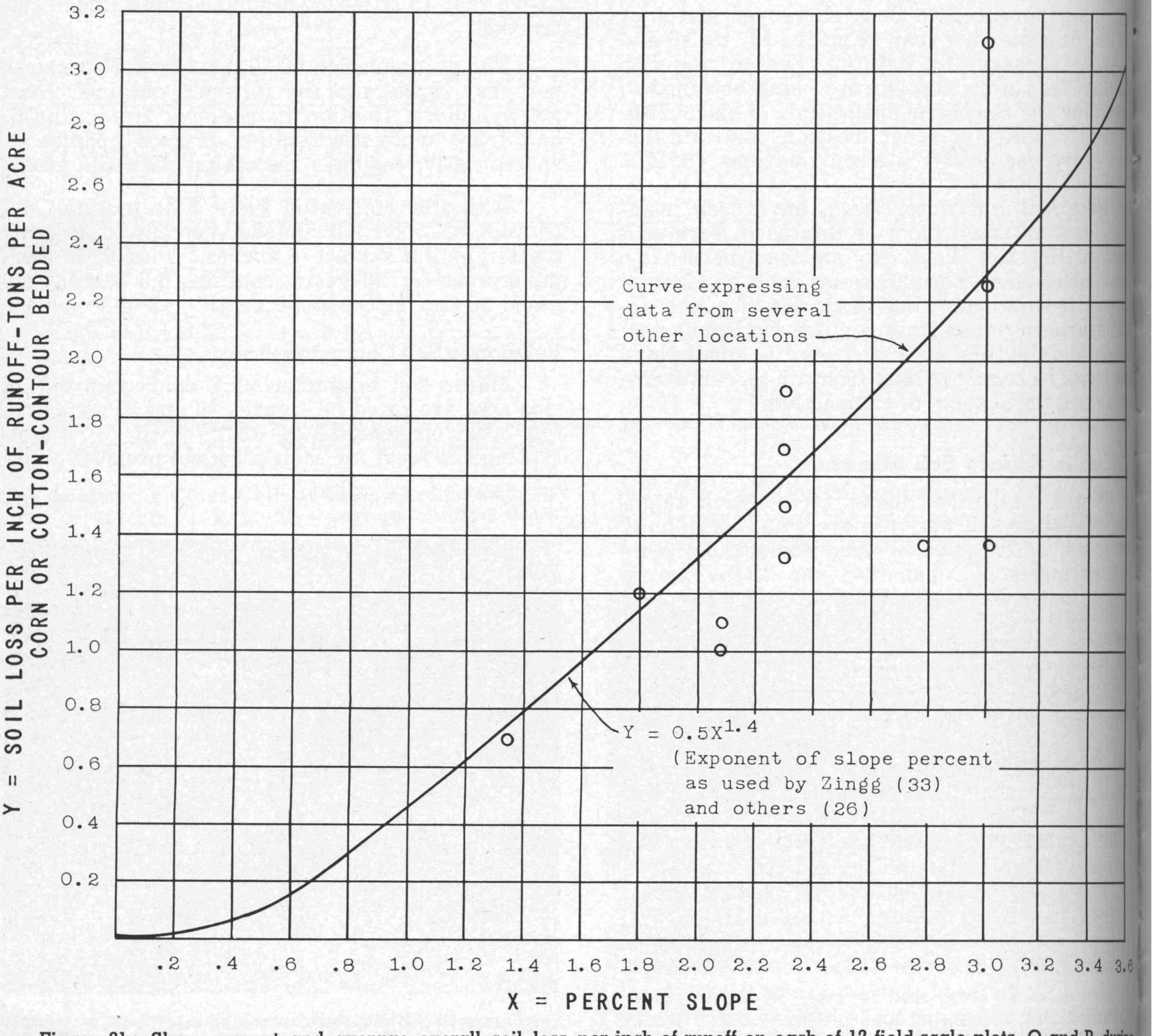


Figure 21. Slope percent and average overall soil loss per inch of runoff on each of 12 field-scale plots, O and P, during all years that the plots were in row crops, corn or cotton, are shown in relation to empirical curve with exponent of slope percent derived from data at several other locations (31, 24).

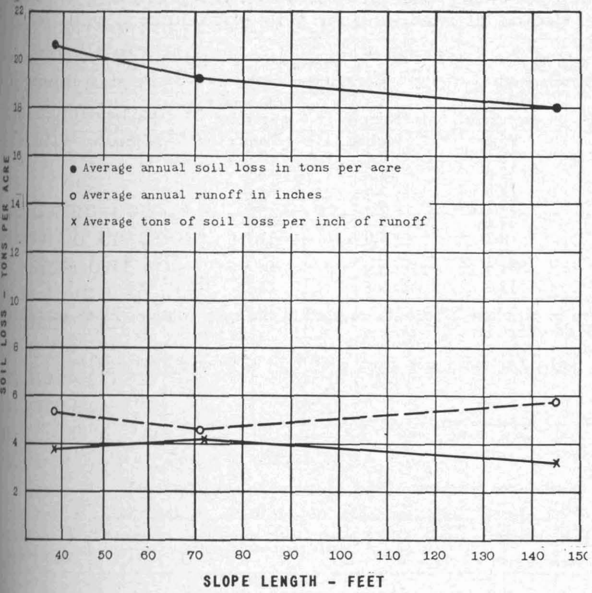


Figure 22. Thirteen-year average (1931-43) runoff, soil loss and soil loss per inch of runoff, shown in relation to slope length on three plots of Austin clay, 4 percent slope, in continuous corn.

Table 3. Average runoff, soil loss and oat yields from plot 19, on Houston Black clay, 2 percent slopes, 1945-49, while the plot was in continuous oats, compared with losses from adjacent plot 22, in continuous corn for the entire period, 1933-51[1]

			1945-49 Five-year average annual results			
Plot	Preceding cropping history	Slope	Crop	Runoff	Soil loss per acre	Oat or corn yield per acre
	1933-44	%		Inches	Tons	Bushels
19	3-year rotation	2	Oats	1.1	0.5	34.6 (oats)
22	Continuous corn	2	Corn	4.0	7.7	21.3 (corn)

[1] Average annual rainfall, 32.5 inches. The crops were not fertilized.

Soil samples for laboratory study were taken in 1952 from all small plots and all field-scale runoff-erosion plots. The following depths were sampled: plow layer (0 to 6 or 8 inches); plow depth to 12 inches; 12 to 24 inches; and 24 to 36 inches. Measurements made on these soil samples included total organic matter and total nitrogen; moisture retention at pF-2.5 and pF-4.2 and at the moisture equivalent; bulk density (paraffin coating) and pore space (naphtha saturation) of dry soil lumps; phosphorus extracted with CO_2 (20-minute bubbling of CO_2 through soil in water); water stability of 1 gram aggregates against air slaking and water drops; dispersion ratio on dry soil that was first put through a ½-inch mesh screen; and water-stable aggregate on 2 and on 0.2 mm mesh screens, by the Yoder method (32).

These various soil measurements indicate differences that help to explain runoff and erosion results. Physically, the soil in all small runoff-erosion plots is looser and easier to work than in field areas. This is thought to be caused primarily by the fact that the plots have been worked by hand for more than 20 years. The soil has not been compacted by tractors or other heavy tools. Earthworms are more active than in most cultivated field soil. The absence of compaction evidently has favored earthworm populations and the earthworms have favored soil looseness and large pore spaces.

Samples from the surface of the small plots show an average of 1.49 grams per cc for the bulk density of dry lumps. Field samples from the

Table 4. Summary of runoff and erosion from small plots in several different crop sequences at Temple, 1945-49[1]

Crop or rotation	Length of rotation	Plot numbers	Rain-fall	Run-off	Soil loss per acre	Soil loss per acre per inch of runoff
		3½ to 4% slope, Austin clay soil				
	Years		Inches	Inches	Tons	Tons
			Average for the rotation			
Continuous corn	Continuous	3	32.3	5.0	10.6	2.1
Cotton, Hubam	2	2 and 9	32.3	2.1	4.1	1.9
Cotton, oats	2	5 and 7	32.3	2.5	8.4	3.4
Cotton, oats with Hubam	2	4 and 8	32.3	1.9	6.5	3.4
Bermudagrass (ungrazed)	Continuous	6	32.3	0.2	trace	trace
Cotton, oats, alfalfa	3	12, 15 and 16	32.3	1.4	3.0	2.2
Continuous cotton, rows on contour	Continuous	13	32.3	2.8	9.5	3.4
Continuous cotton, rows down slope	Continuous	14	32.3	4.3	11.8	2.7
Cotton, Hubam	2	11	32.3	5.1	10.1	2.7
		2% slope, Houston Black clay soil				
Continuous corn		22	32.7	4.1	7.68	1.9
Continuous corn (Hubam green manure)		20	32.7	2.3	2.50	1.1
Continuous cotton (Hubam green manure)		21	32.7	3.6	6.39	1.4
Continuous oats		19	32.7	1.1	0.48	0.5
Continuous oats (Hubam)		17	32.7	1.2	0.37	0.3
Continuous Bermudagrass (ungrazed)		18	32.7	0.5	0.09	0.2

[1] Average annual rainfall was 32.5 inches, or 2 inches below the 39-year average.

Table 2. Summary of runoff and erosion on field-scale plots O and P, comparing losses with cotton and corn to those with Hubam clover, and oats with Hubam

Year	Number of plots each crop[1]	Annual rainfall[2]	Runoff Corn	Runoff Cotton	Runoff Oats[3]	Runoff Hubam	Soil loss Corn	Soil loss Cotton	Soil loss Oats[3]	Soil loss Hubam
		Inches					Tons per acre			
1942	2	36.4	2.6	2.8	2.5	—	6.7	2.4	0.9	—
1943	2	25.1	0.5	0.4	0.5	—	0.5	1.1	0.1	—
1944	2	49.4	4.4	4.3	3.2	—	8.2	14.5	1.5	—
1945	4	38.1	3.4	—	3.1	4.1	3.8	—	1.0	2.8
1946	4	44.5	3.0	—	0.9	3.0	2.2	—	0.2	1.5
1947	4	27.4	1.5	—	1.8	1.0	1.5	—	0.6	0.6
1948	4	19.6	0.3	—	0.8	0.4	1.3	—	1.0	0.4
1949	6	32.7	—	2.0	0.1	—	—	3.4	trace	—
1950	6	22.0	—	0.2	0.1	—	—	0.2	0.1	—
1951	6	27.1	—	1.0	0.1	—	—	2.0	—	trace
Average[4]		32.2	2.2	1.8	1.3	2.1	3.5	3.9	0.5	1.3

[1] These plots range in slope from 1.4 percent to 3.0 percent. The average is 2.37 percent. See figures 17 to 28 or appendix table F for details.
[2] Average rainfall for the 10 years was 2.2 inches below normal.
[3] Hubam was seeded with the oats 1947-51.
[4] Averages for corn and cotton are not for the same years. A direct comparison between these crops is provided by the years 1942, 1943 and 1944.

Table 5. Average runoff and soil loss for small plots growing cotton following oats in a rotation, compared with runoff and soil loss for plots in cotton following Hubam sweetclover grown for seed, and for plots of continuous cotton or corn[1]

Year	No. of plots[4]	Rainfall	Average of cotton following oats[2]		Plot 14 Continuous cotton		Plot 3 Continuous corn		Plots 2 and 9 Cotton following mature Hubam[3]	
			Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre
		Inches	Inches	Tons	Inches	Tons	Inches	Tons	Inches	Tons
1942	4	36.1	3.5	7.5	2.7	6.3	8.4	30.0		
1943	1	24.6	1.8	3.3	1.8	3.0	2.2	4.5		
1944	1	32.7	10.3	35.9	9.8	26.8	7.8	24.8		
1945	2	37.2	3.2	5.6	5.1	13.1	4.1	7.5		
1946	2	45.8	5.5	26.6	7.1	19.4	8.5	20.4	5.6	21.7
1947	2	27.2	3.3	16.3	3.2	8.1	4.0	11.7	2.3	3.3
1948	2	19.0	2.5	8.3	2.3	10.7	2.2	3.0	1.2	2.8
1949	2	32.3	3.5	15.3	3.6	7.7	6.3	10.4	2.9	2.3
Average		31.8	4.2	14.8	4.5	12.0	5.4	14.1	3.0	7.5

[1] All plots are 72.6 feet long, with a 4 percent slope, on Austin clay soil. There is no clear difference related to the crop rotation where oat residues were spaded under, but with mature Hubam there is evidence of a carryover effect for 1947-49.
[2] Hubam was seeded with the oats in 1947, 1948 and 1949.
[3] Hubam was grown to maturity on plots 2 and 9 and was spaded into the soil. The data are from plot 2 in 1947 and 1949 and from plot 9 in 1946 and 1948. See Figure 11.
[4] Plots of cotton following oats.

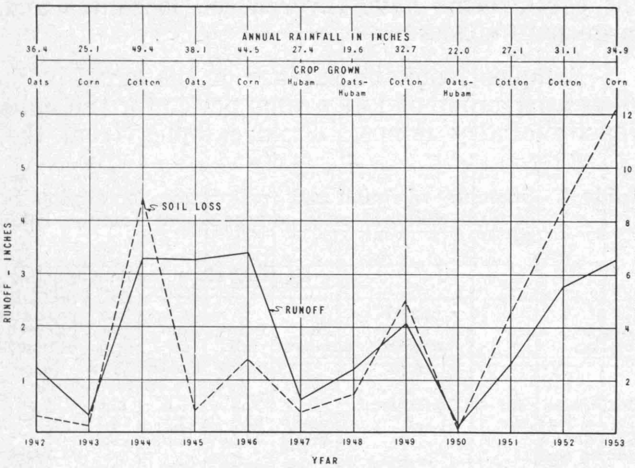


Figure 23. Ten years of runoff and erosion on field-scale plot 0-1, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 2.3 percent. SCS Capability Unit, II-2.

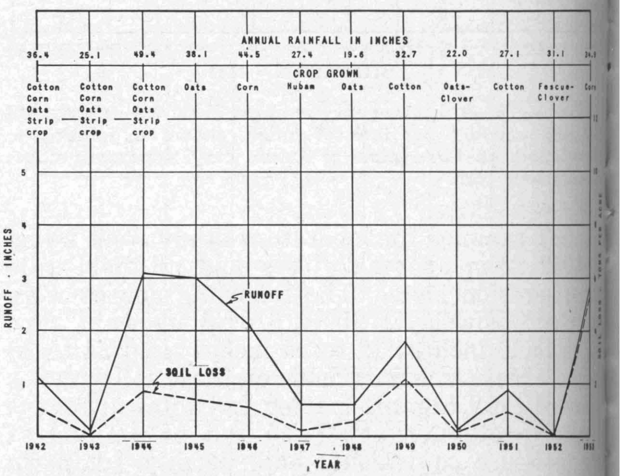


Figure 25. Ten years of runoff and erosion on field-scale plot 0-3, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 2.1 percent. SCS Capability Unit, 11-2.

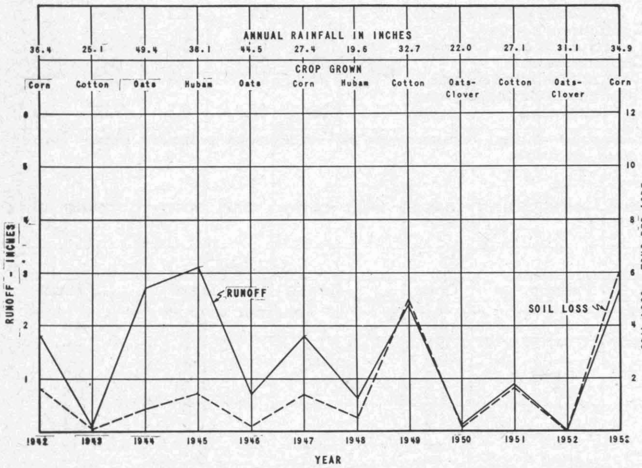


Figure 24. Ten years of runoff and erosion on field-scale plot 0-2, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 1.8 percent. SCS Capability Unit, 11-2.

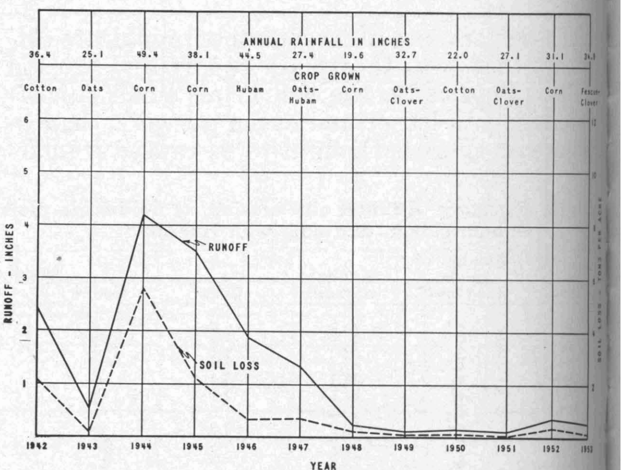


Figure 26. Ten years of runoff and erosion on field-scale plot 0-4, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 2.1 percent. SCS Capability Unit, 11-2.

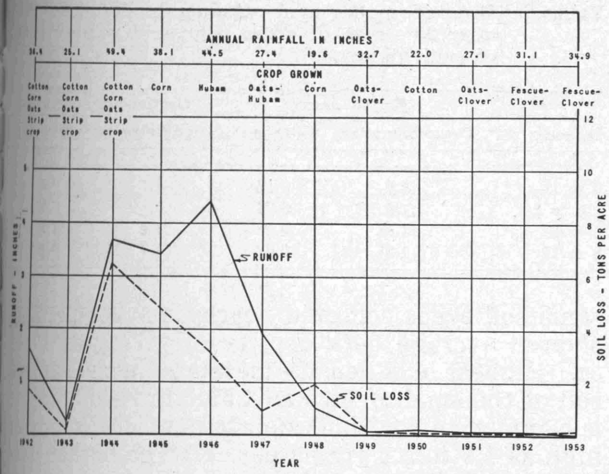


Figure 27. Ten years of runoff and erosion on field-scale plot 0-5, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 2.3 percent. SCS Capability Unit, 11-2.

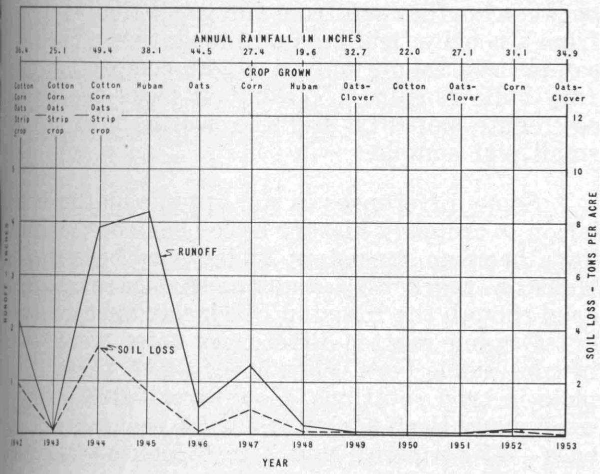


Figure 28. Ten years of runoff and erosion on field-scale plot 0-6, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 1.4 percent. SCS Capability Unit, 11-2.

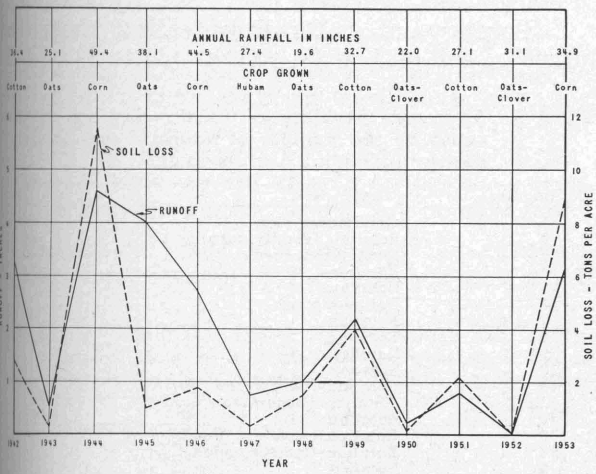


Figure 29. Ten years of runoff and erosion on field-scale plot P-1, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 2.3 percent. SCS Capability Unit, 11-2.

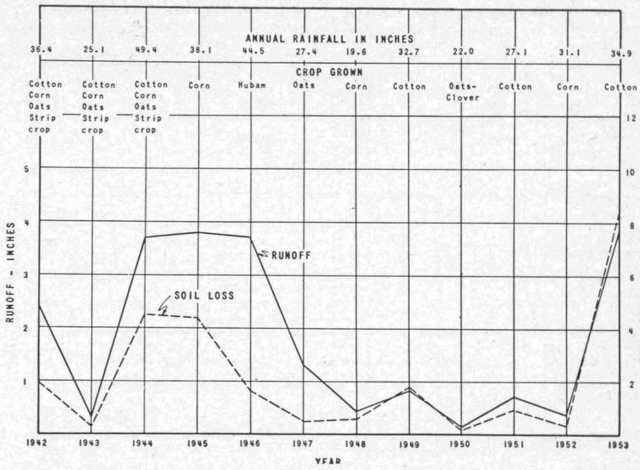


Figure 30. Ten years of runoff and erosion on field-scale plot P-2, shown in relation to rainfall and crop. Soil, Houston Black clay. Slope, 2.3 percent, SCS Capability Unit, 11-2.

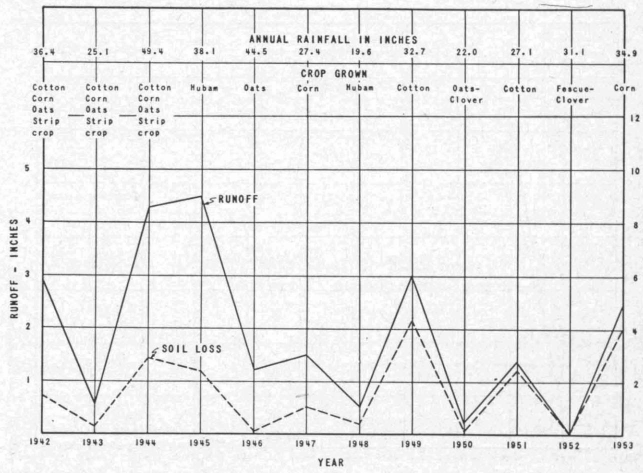


Figure 31. Ten years of runoff and erosion on field-scale plot, P-3, shown in relation to rainfall and crop. Soil, Houston Black clay, 75 percent; and Austin clay, 25 percent. Slope, 2.8 percent. SCS Capability Units, 11-2 and 2X.

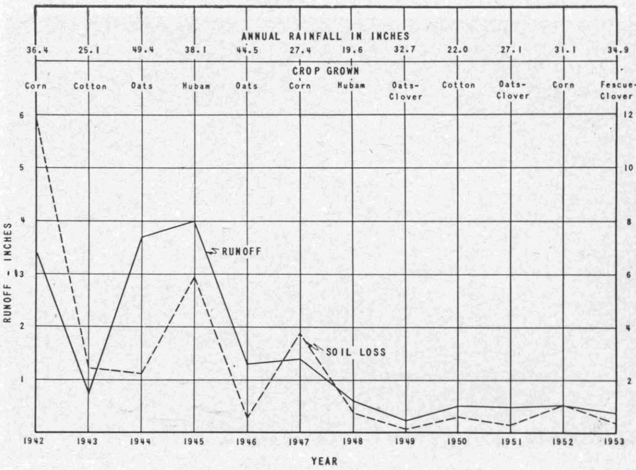


Figure 32. Ten years of runoff and erosion on field-scale plot, P-4, shown in relation to rainfall and crop. Soil, Houston Black clay, 40 percent; Austin clay, 60 percent. Slope, 3.0 percent. SCS Capability Unit, 111-2X and 2.

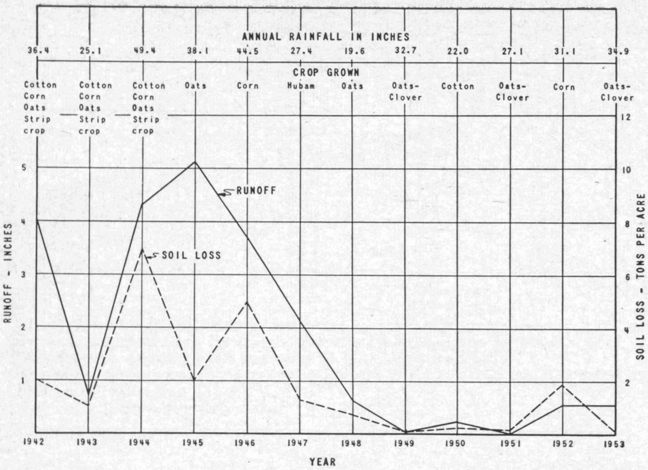


Figure 33. Ten years of runoff and erosion on field-scale plot, P-5, shown in relation to rainfall and crop. Soil, Houston Black clay, 60 percent; Austin clay, 40 percent. Slope, 3.0 percent, SCS Capability Unit, 111-2 and 2X.

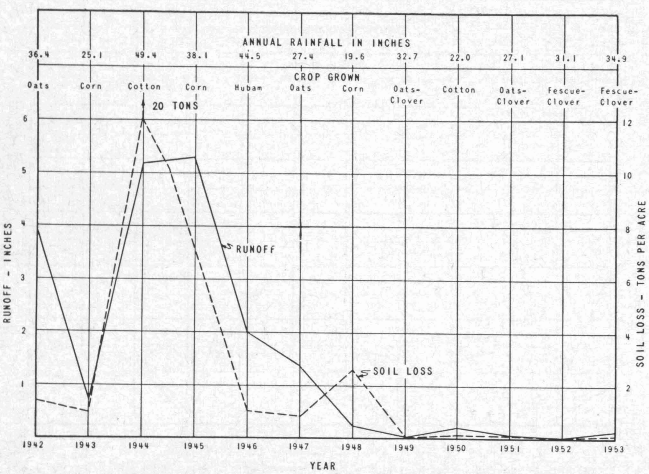


Figure 34. Ten years of runoff and erosion on field-scale plot, P-6, shown in relation to rainfall and crop. Soil, Houston Black clay, 90 percent; Austin clay, 10 percent. Slope, 3.0 percent. SCS Capability Unit, 111-2 and 2X.

Figure 35. Earthworms have a great influence on physical properties of Blackland soils. Their effect is most evident in permanent grass or where the soil is mulched. Excessive cropping and heavy machinery on wet soil reduce earthworms to a minimum and cause dense soil.

Table 6. Organic matter and nitrogen in desurfaced soil after 20 years of grass compared with 20 years of cultivation

Inches	Native grass: Organic matter	Native grass: Nitrogen	Continuous cultivation: Organic matter	Continuous cultivation: Nitrogen
	Percent			
0 to $1\frac{1}{2}$	2.4	0.13	1.1	0.06
$1\frac{1}{2}$ to 3	1.9	0.08	1.1	0.06
3 to 6	1.4	0.07	1.1	0.06
6 to 12	1.3	0.07	1.2	0.06

same soil types collected nearby, for comparison, showed average bulk density of 1.77 grams per cc. Highest bulk density measured in the surface soil of the small plots was 1.59. In field areas, it is common to find bulk densities of dry lumps as high as 1.9 to 2.1 grams per cc. The higher densities are indications of the condition known as a "plowpan," which is considered serious in Blackland soils (13). No dense soil or distinct layering, as with plowpans, has been observed in the small plots. Figure 38 shows a typical contrast between surface soil from the small plots and that from a nearby field area on the station. The field sample represents only a slight compaction pan, (dry-bulk density, 1.77) but it lacks the coarse aggregate porosity and the worm holes of the small plot sample.

Some differences in soil organic matter in relation to cropping history have been noted. There have been no consistent differences between the Houston Black clay and the Austin clay plots, even though the Houston Black clay appears darker. Organic matter differences noted were: plots in continuous corn, plow layer—2.05 percent; all plots in crop rotations, plow layer—2.28 percent; continuous Bermudagrass for 20 years, 0 to 3 inches—3.94 percent, and 3 to 6 inches—3.24 percent. These differences in organic matter may have had some effect on runoff and erosion. However, the cropping differences associated with major organic matter variables prevent any proof of the effect of the organic matter, as such.

Slaking and water-drop testing show that lumps of soil of 1 gram weight (¼ to ½ inch di-

Table 7. Aggregate stability of Austin clay soil as indicated by the number of falling drops required to destroy individual 1-gram lumps

Plot number	Land use	Drops[1]
1	Continuous corn	5
2	Rotation (mostly corn)	3
3	Continuous corn	3
4	Rotations	8
5	Rotations	6
6	Bermudagrass	73
7	Rotation	6
8	Rotation	7
9	Rotation	9
10	Rotation	6
11	Rotation (desurfaced plot)	24
11a	Rotation (desurfaced plot)	12
12	Rotation	4
13	Rotation (mostly cotton)	1
14	Rotation (mostly cotton)	5
15	Rotation	7
16	Rotation	11
	Desurfaced, rotation	11
	Desurfaced, native grass for 20 years	93

[1] Each value is an average of 5 or more replications. The drop fall was 60 cm.

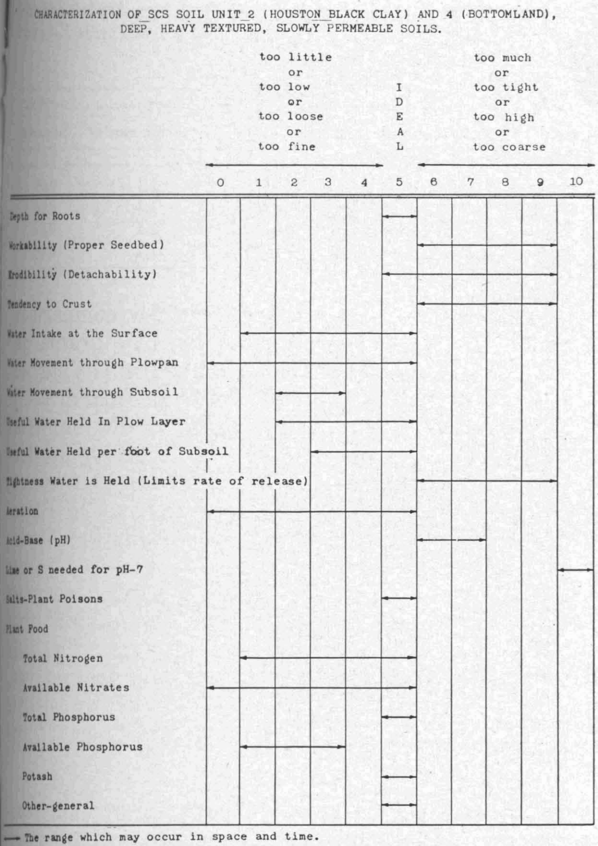


Figure 36. Characterization of SCS Soil Unit 2 (Houston Black clay) and 4 (bottomland), deep, heavy textured, slowly permeable soils.

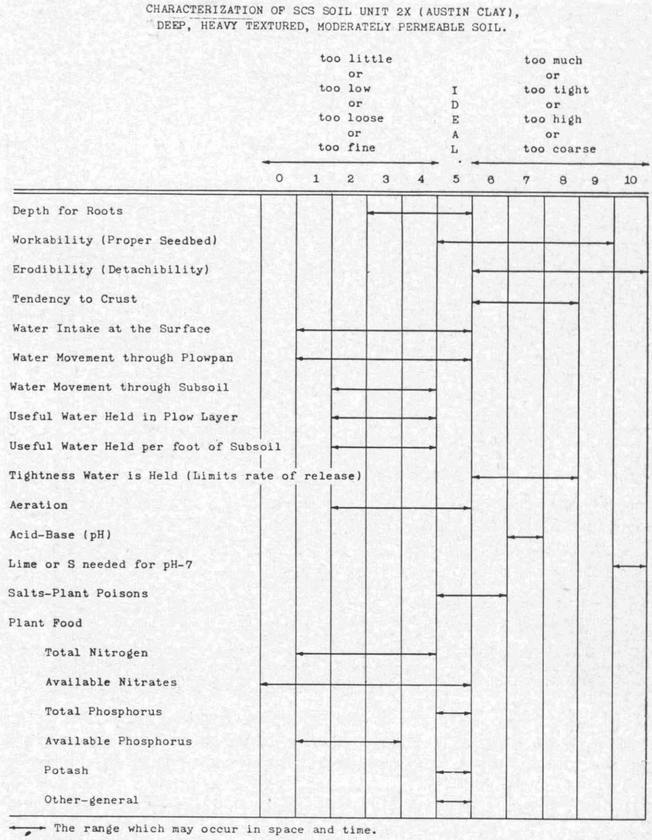


Figure 37. Characterization of SCS Soil Unit 2X (Austin clay), deep, heavy textured, moderately permeable soil.

ameter) are more stable in grass plots than under cultivation (Table 7).

Desurfaced plots show slightly more aggregate stability than most normal soil plots. This is consistent with the fact that in the past desurfaced plot 11 lost less soil per inch of runoff than plots with normal soil. Its aggregation helps to resist erosion.

The grass effect on Houston Black clay is evident but is smaller than for the Austin.

Some rotation plots show a little more aggregate stability than plots in continuous cropping but the difference is small. Of course, most of the rotations had a row crop more than 50 percent of the time, so big effects on physical properties or organic matter would not be expected.

Dispersion ratios and wet-sieving aggregate analyses show smaller differences between grass plots and cultivated plots than the slaking and water-drop test. However, results with all tests tend to point in the same direction. Long periods of grass definitely favor water-stable soil units or aggregates. The effect of short rotations on soil aggregates has been very small, as gauged by the methods of measurements used.

If the difference between pF-2.5 and 4.2 in the laboratory (air-pressure extraction) is taken as an index of available moisture, some small differences among plots are shown on the two small plot layouts (Table 9).

These data show a 2 to 3 percent difference of available water capacity in favor of Houston Black clay. (Other data on the station show as much as 5 percent available moisture capacity in favor of Houston Black clay.) On Austin clay,

Table 8. Aggregate stability of Houston Black clay soil in runoff plots as indicated by the number of falling drops required to destroy individual 1-gram lumps

Plot number	Land use	Drops[1]
17	Rotation	3
18	Bermudagrass	17
19	Rotation	6
20	Rotation	5
21	Rotation	3
22	Continuous corn	3

[1]Each value is an average of 5 or more replications. The drop fall was 60 cm.

Table 9. Total available water-holding capacity from pF 2.5 to 4.2, determined in the laboratory for runoff-erosion plots of Houston Black clay and Austin clay

	Plow layer Available moisture percent (Laboratory methods)		
	Continuous row crops	Rotation plots	Grass plots
Austin clay	11.1 (2 plots)	12.1 (13 plots) 9.5 (3 desurfaced plots)	12.3 (1 plot) 11.5 (1 desurfaced plot, 20 yrs. grass)
Houston Black clay	14.1	14.1	12.5

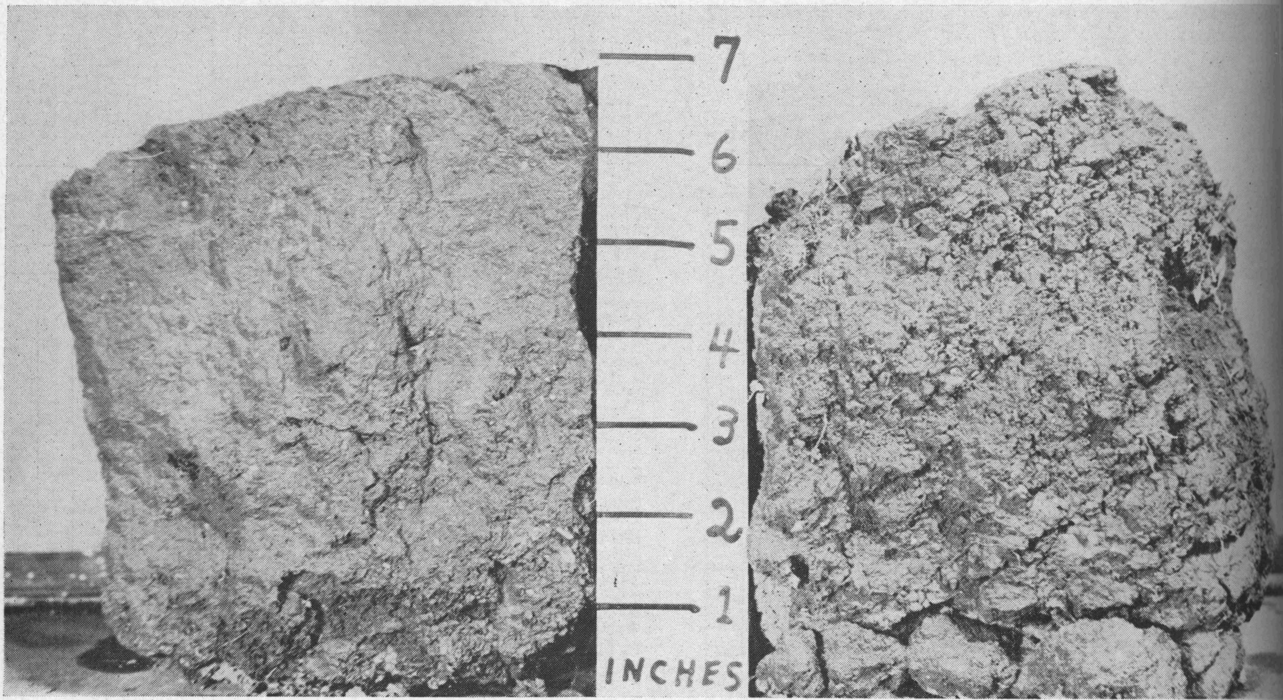


Figure 38. Typical, loose, porous Austin clay soil in small plots where no heavy machinery has been used (right) compared with normally dense Austin clay in a field area (left). Vigorous earthworm activity has helped keep the soil porous in the small plots. Heavy machinery compacts the field soil.

the surface layer of desurfaced plots shows slightly less available moisture capacity than normal soil. There is a small difference favoring rotation plots and grass plots on Austin clay but not on Houston Black clay. This is consistent with the known tendency of Austin clay to respond to physical improvement better than Houston Black clay. The main reason probably is the heavier texture of Houston Black clay, which is likely to predominate over other factors.

Fertilization with phosphorus has been practiced during recent years for the growth of soil-improving sweetclovers. There is a suggestion of an increase in phosphorus extracted with carbon dioxide. All rotation plots, which were fertilized, gave an average of 5.8 ppm of P_2O_5 as compared with 3.4 for continuous corn plots with no fertilizer. The Bermudagrass plot on Austin clay (plot 6) showed 20.7 ppm of P_2O_5, and the grass plot on Houston Black clay, 6.9 ppm. Phosphorus tests are interpreted as indicating a need for repeated applications of moderate amounts of phosphorus fertilizer if serious nutrient limita-

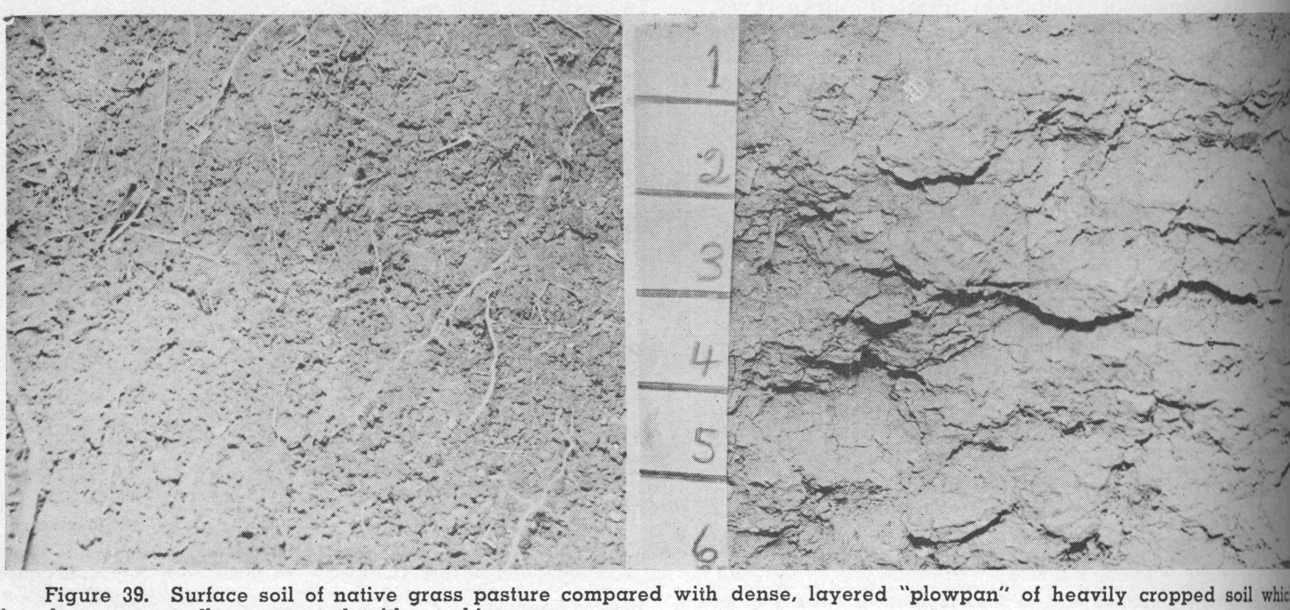


Figure 39. Surface soil of native grass pasture compared with dense, layered "plowpan" of heavily cropped soil which has been repeatedly compacted with machinery.

Figure 40. Deep dark porous grass-root filled soil profile of Austin clay in native prairie grass pasture on the Blackland station. This soil has never been plowed. The surface contains 5.5 percent organic matter.

Figure 41. Austin clay soil under cultivation for 60 years, with serious erosion, on a 3 percent slope. The surface soil contains 1.9 percent organic matter. This site would be like Figure 40, which is 30 feet away, except for cropping and erosion.

tions are to be avoided. This also is the general conclusion from fertilizer experiments.[5]

Relation to Mechanical Factors

Contour bedding always has showed a saving of water and soil in small plots over flat planting. The amount of the saving depends on the size of the beds, or ridges, and the type of rainfall. Past records (18) show reductions of 50 percent or more in the losses of both soil and water. It is recognized that field bedding often cannot be as perfectly contoured as in the small plots, and that the field control is, therefore, less.

From 1945 through 1949, contour-planted cotton (plot 13) was compared with cotton planted up and down the slope (plot 14). No beds were formed after 1946. All working was by hand. In this case, contouring apparently reduced water loss from 4.3 inches (plot 14) to 2.8 inches and reduced soil loss from 11.8 to 9.5 tons (Table 4). The saving is enough to be important. Also, the contoured cotton gave a yield of 253 pounds of lint per acre as compared with 207 pounds for rows down the slope.

On field-scale plots O and P, as shown in Table 10, contour bedding resulted in lower water and soil losses than flat handling of the soil, even though the crop residue was removed from four of the bedded plots. The saving evident from bedding was 0.4 inch of water and 1.1 tons of soil per acre per year during 1949-51. These were

[5]Unpublished data of the Blackland station, by J. W. Collier, E. D. Cook and R. P. Bates.

Table 10. Summary of results on field-scale plots O and P, with three methods of tillage and artificial residue management, in a 2-year rotation of cotton, oats with clover, 1949-51

Method	Management	Plots	Rain-fall	Run-off	Soil loss per acre
			Inches	Inches	Tons
1[1]	Residue on top. Flat. No bedding.	4	27.20	1.3	2.8
2	Residue turned under. Bedded. Standard practice.	4	27.20	1.0	1.6
3[2]	Residue (oats-clover) removed. Bedded.	4	27.20	0.9	1.7

[1] In 1949, the residue was removed for plowing and was then returned to the surface. In 1950 and 1951, the land was prepared by subtillage with a Graham-Hoeme plow.
[2] In method 3, the oats with clover was baled and removed. Otherwise the method was the same as method 2.

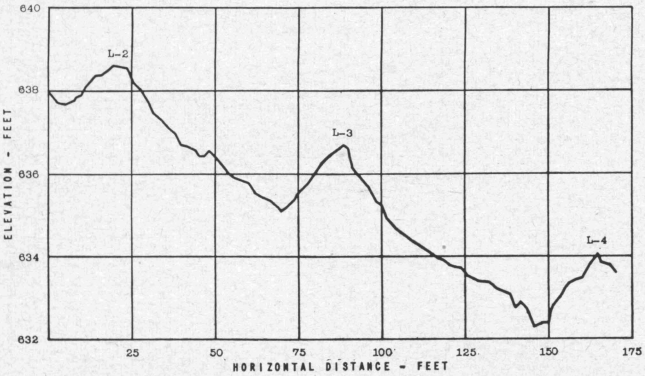


Figure 42. Cross section of terraces L-2, L-3 and L-4, 1951, after 6 years of maintenance by plowing. The depression midway between L-2 and L-3 is the dead furrow left by ordinary plowing. The interval between L-3 and L-4 shows no such depression because all of the furrow slices from the channel of L-4 to the ridge of L-3 have been turned uphill. Terrace ridge L-2 is somewhat low (10 inches), whereas L-3 and L-4 are a good 16 inches high. An extra backfurrow on L-2 with dead furrow in the channel would increase the height to a safe 15 to 18 inches. This practice has been followed on L-3.

low rainfall years. Residue handling was artificial in 1949 and probably not as effective as with good subsurface plowing.

Studies continued since 1945 showed that good terrace maintenance on standard Nichols (drainage) type terraces (16) is obtained by the following practices: plowing so a backfurrow falls on the terrace ridge; leaving a dead furrow in the terrace channel; and turning all furrow slices uphill in the interval between terraces.

Terrace maintenance without plowing the land uphill between terraces has tended to leave an undesirable low place midway between terraces. This may be avoided in part by shifting the position of the dead furrows in the channel and between terraces year after year. Some care and skill by the operator are required to obtain a desirable cross section by this method. Uphill plowing is simpler and better, but reversible disk plows are not now available for uphill plowing. When a low area is developed between terraces, a part of the land slope is increased. This causes increased soil movement and exposure of subsoil, as well as inconvenience in land preparation and management.

Even with a desirable terrace cross section, Figure 43, there is an increase in slope percent from the top of one terrace ridge to the bottom of the channel of the terrace below. In this figure, the original land slope was 3.8 percent. With well-maintained terraces it now averages 7.0 percent from ridgetop to channel bottom of the next lower terrace. Uphill plowing counteracts any tendency for this increased percent of slope to cause greater erosion.

Re-plowing a second backfurrow on the terrace ridge with dead furrow in the channel, after the first plowing, was tested as a means of maintaining adequate terrace height. This was satisfactory but generally not necessary. Settled terrace heights of 15 to 18 inches have been maintained in most cases by a single backfurrow on the ridge.

Three years of stripcropping results were reported previously on the field-scale plots O and P (18). It is now possible to add 3 more years, making a total of 6 years of records, summarized in Table 11. Details by plots and slopes are given in Figures 23 through 34. Stripcropping shows considerable reduction of soil loss, especially on the 3 percent slope. Water loss differences also

Table 11. Average annual soil and water losses from a contoured rotation and a similar rotation stripcropped, 6 plots each, 1939-44

Plots	Average slope	Cropping	Treatment	Average annual rainfall	Runoff	Soil loss per acre
	Percent			Inches	Inches	Tons
O	2	3-year rotation, cotton, oats, corn	Contoured	36.14	1.76	1.62
O	2	"	Stripcropped	36.14	1.67	1.17
P	3	"	Contoured	36.14	3.14	5.62
P	3	"	Stripcropped	36.14	2.55	1.97

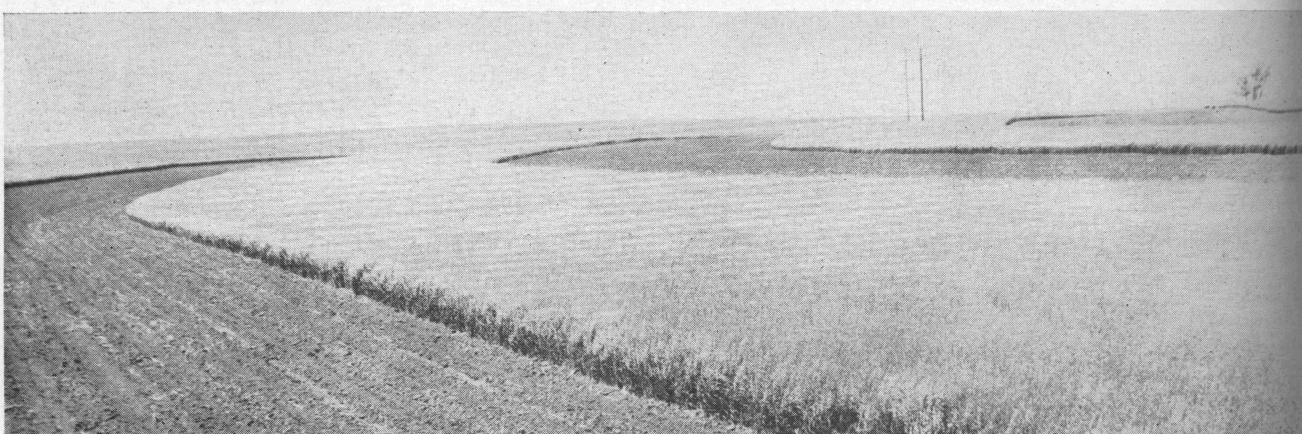


Figure 43. Newly planted cotton in strips alternating with Mustang oats and Hubam. Erosion control and production are good on 1 to 3 percent slopes (Class II land). But on slopes of 3 to 4 percent (Class III, Austin clay), rills and small gullies have formed.

favor the stripcropped plots. The difference is small on the 2 percent slope.

As discussed in previous publications (18, 19), rill and gully erosion were not stopped by stripcropping on the 3 percent slope. A big advantage of well-maintained terraces over stripcropping is the prevention and control of gullies. However, when terraces are not supported by proper maintenance and by good cropping practices they often break during critical periods of heavy rainfall and intensify gully formation. From this standpoint, stripcropping introduces less hazards.

Stripcropping is being used successfully on a field area on the station, with a 2-year rotation of cotton, oats with Hubam. During the past few years of comparatively low rainfall, some rill erosion and small gullies have formed where the slopes are between 3 and 4 percent. On slopes of 2 to 3 percent, erosion does not appear serious. The strips are approximately 90 feet wide. Uneven width is taken up by the strip of oats with clover. The topography is comparatively uniform, which is necessary for satisfactory stripcropping.

Land Preparation and Management

Subsoiling was tested at several locations and results were discussed in a previous publication (18). The only effect noted on water intake was temporary and was not considered worthwhile. More recently, chiseling to about 10 or 12 inches has been practiced with chisels mounted on a Dempster-type of trash-mulch tool carrier. The main purpose of this work has been to break up the soil in dry weather so it can be plowed with subsurface sweeps. The chisels can be pulled in

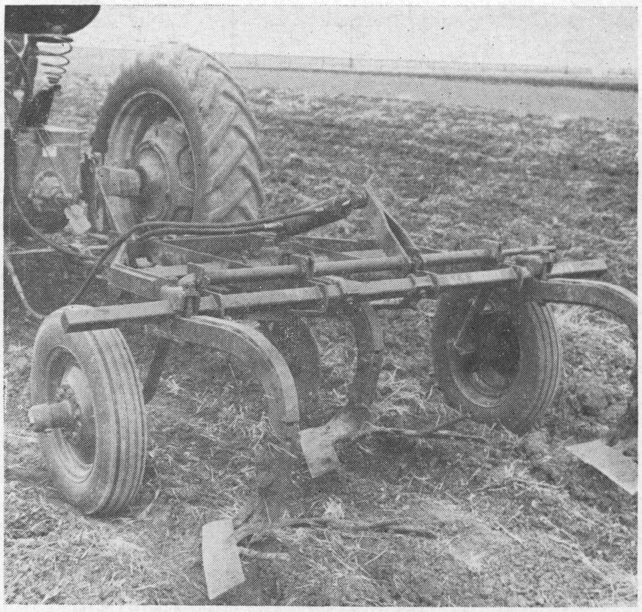


Figure 45. Subsurface plows (used to the north and west) are readily adapted to Blackland conditions. When the ground is very dry, it is necessary to break the soil with chisels before plowing. Deep-furrow or hard-ground drilling of small grain and fertilizer is another promising trash-mulch practice. This same carrier can be used with the deep-furrow drill.

soil that is essentially air dry and is difficult to plow. Subsurface (or "plowpan") shattering when the soil is quite dry is more likely to be beneficial than when the soil is moist. Even so, the only effects observed from chiseling have been temporary. This soil slakes thoroughly in water, either in the laboratory or in the field, and there seems to be good reason to conclude that most of

Figure 44. Subsurface or trash-mulch plowing is a promising new practice for economy, efficiency and conservation in the Blackland.

Figure 46. Deep-furrow, hard-ground drill that is doing a good job of putting small grain and fertilizer 3 to 4 inches deep into hard, dry ground. This drill, with shoe-type openers and spring shanks, is useful for drilling into biennial clover, established grass, lanes or heavy residues of any kind.

the influence of chiseling is lost with the first soaking rains.

The properties of shrinkage and swelling are developed to a high degree in the Blackland clay soils (21). Volume changes of more than 25 percent have been measured with standard 3-inch cores in drying from saturation to complete dryness. It seems inevitable that such volume changes will repeatedly break dense soil layers of the upper profile into blocks, in much the same manner as a chisel. In the laboratory, the soil volume begins to reduce almost immediately as water is lost from a saturated core or lump, and in the field visible shrinkage cracks appear when the soil is still well above the wilting range of moisture content.

Subsurface plowing, or trash-mulch tillage, has not given conclusive evidence regarding its value in the Blackland. However, considerable experience has been obtained with tools and methods similar to those used in the Amarillo area (20) and elsewhere. These tools can be used in the Blackland Prairie. Residues left at the surface appear to give significant soil protection and maximum opportunity for infiltration (6, 12, 18). The soil layer that is lifted and shattered by subsurface sweeps is loose and in an excellent condition to receive water. In addition to possible soil and water conservation benefits, there may be practical advantages that favor certain trash-mulch methods, strictly from the standpoint of economical production. Subsurface plowing has been satisfactory after all of the major crops, i.e., cotton, corn, small grain, sorghum grain, sorghum hay (redtop cane), sweetclover and fescuegrass sod. *Deep-furrow drilling* of small grain and fertilizer into hard ground with shoe-type openers on spring shanks also has been successful. The drill can be mounted on the same carrier used for subsurface plowing, chiseling or field cultivating.

Trash-mulch is now being compared with plowing on gauged terraces, to determine its effects on runoff. And on large, field-scale plots O and P, trash-mulch plowing is used on all plots, in connection with studies of the amount, distribution and influences of different types of residues in three cropping systems. On these large plots, and on other plots studied, the subsurface plow has extra advantages. It represents a convenient method for avoiding high and low areas within plots. With other plowing, the dead furrows and backfurrows create these difficulties.

Major uncertainties about trash-mulch farming involve questions of Johnsongrass control and the economy of bedding before planting row crops. It appears that Johnsongrass can be controlled satisfactorily, especially when land is summer-plowed early before severe summer dry periods. The necessity of bedding for row crops remains uncertain. If necessary, land that has been subsurface plowed can be bedded as well as any other plowed ground, but this is more expensive than bedding without plowing. Preliminary tests of planting without bedding have been satisfactory. Trash-mulch plowing without bedding is the only method being studied that may prove to be both cheaper and better for conservation and production than the farm practice of bedding and rebedding for row crop production.

Crop Production

Cotton Yields and Root Rot

Highest yields of cotton on the station are being obtained in rotations where cotton follows small grain or fescuegrass with Hubam or vetch. These rotations are partly an outgrowth of early runoff-erosion studies which showed the effectiveness of small grain and grass for conservation of water and soil. Recent plot rotation data show average yield increases of 100 to 150 pounds of

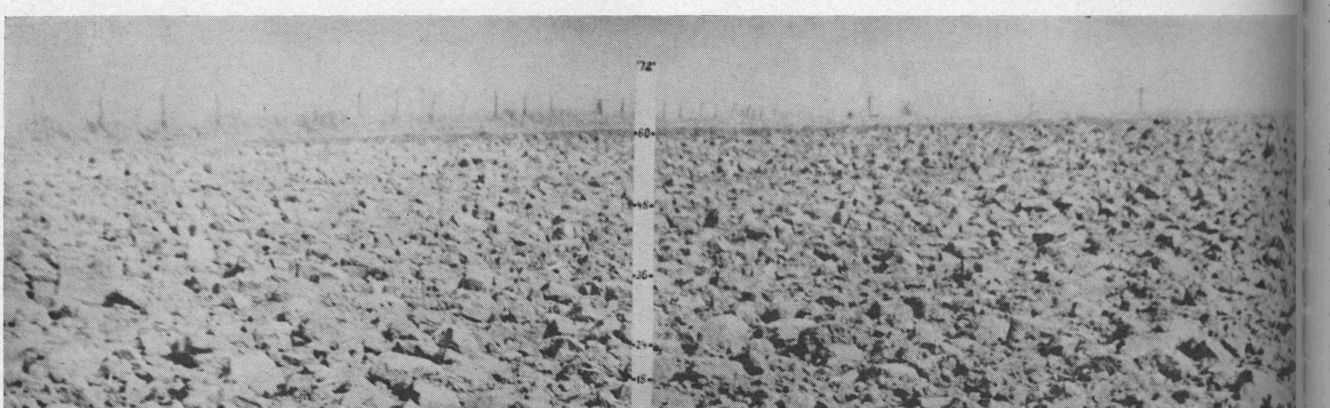


Figure 47. Blackland clay soil breaks into large clods like this when turned with a disk plow while the soil is very dry. The clods are too coarse for dry planting of small grain. They slake readily when rains come and tend to form a surface crust that is only slowly permeable to water. Subsurface plowing shatters the soil into smaller lumps and leaves residues in the surface.

Figure 48. Crop rotation plots with cotton following various close-growing or soil-improving crops. One of the best rotations for yield, root-rot reduction, and conservation is cotton following Mustang oats with Hubam sweetclover. Minimum root rot has been obtained where cotton follows fescuegrass alone or with annual legumes.

seed cotton per acre for the rotations over continuous cotton (17). There has been some tendency for a reduction in cotton root rot where the cotton follows 1 year of small grain with Hubam or vetch, or 2 years of fescuegrass, alone or with Hubam or vetch.

Cotton yield apparently has been increased by the soil-conserving practice of contouring. Consistent yield increases of as much as 200 pounds of seed cotton per acre have resulted from spacing cotton plants at 2 to 4 inches in 40-inch rows over spacings of 8 to 12 inches. Yield, conservation and mechanical harvesting are favored by this simple, inexpensive practice.

Direct fertilization of cotton on the station has shown little or no effect in standard rotations where 40 pounds of P_2O_5 per acre are used with the small grain and clover preceding the cotton. In off-station work, on land that has been cropped continuously without fertilizer, a response has been obtained to combined treatments of nitrogen and phosphorus (11).

Corn Yields

In small runoff-erosion plots, comparatively stable yield levels of 23 bushels per acre were obtained during 20 years of continuous cropping to corn with no fertilizer. The organic matter content of the surface and subsurface soil at the end of the 20-year period was 2.0 percent. Results were about the same on one plot of Houston Black clay and one plot of Austin clay. In field plots, an average corn yield of 29 bushels per acre was obtained on Houston Black clay during a different 20-year period. Final soil organic matter percentages were 2.5 in the surface and 2.3 in the subsurface. No distinct yield trends with time were evident in any of these tests of continuous corn (29).

Higher corn yields are obtained by improved hybrids, closer plant spacing, crop rotation with corn following phosphated sweetclover (either alone or with small grain or grass), limiting corn production to well-adapted land and phosphate and nitrogen fertilizer, if needed.

During the past 6 years of subnormal rainfall, average corn yields on the station have been near 45 bushels per acre. On level Houston Black clay, the yields have been near 55 bushels. Comparisons indicate that Houston Black clay yields about 5 to 8 bushels per acre more than Austin clay with similar management (9). Moisture studies show that Houston Black clay on the station holds from 2 to 5 percent more available water than Austin clay. An average difference (3.5 percent) means that Houston Black clay can store about 0.5 inch of water per foot more than Austin clay.

Grain Sorghum Yields

The production pattern with grain sorghum is similar to that for corn. If anything, the grain sorghum yield has been less responsive to increase than corn. This is probably because grain sorghum is grown more often on sloping or depleted land than is corn. Crops following grain sorghum may tend to need nitrogen fertilizer more than after corn, and certainly more than after cotton. Close stands, vigorous growth and heavy residues, characteristics that go with high yields per acre, also are the characteristics for the best prevention of runoff, erosion and soil depletion.

Small Grain with Sweetclover

Fall-seeded oats, barley and wheat, with phosphate fertilizer and sweetclover, have become the backbone of station conservation and production. The largest acreage is oats, with barley next and wheat grown only to a limited extent. These are multiple-purpose crops. In cool weather small grain constitutes the main grazing. By early March, it is necessary to remove cattle from areas where maximum grain production or a heavy hay yield is expected. Some fields are grazed out completely to provide an abundance of pasture during March, April and May.

Small grain yields have been increased consistently by improved varieties, phosphate fertilization and deep drilling. Oats, in particular, seems to profit from deep drilling which prevents germination from early fall showers before the ground has enough deep moisture to permit continuous growth. Nitrogen fertilizer helps to give quicker ground cover and more winter grazing. On the station, nitrogen is used sparingly because of dependence on sweetclover, and the fact that heavy winter growth by small grain tends to damage sweetclover stands and growth.

In dry periods, small grain profits from level, moist soil, i.e., Class I land, Houston Black clay or bottomland. But on the average, small grain yields are less sensitive to soil and slope than row crops. Average yields of leading varieties in variety trials during the past 4 years (10) have been: Mustang oats, 62 bushels; Quanah wheat, 21 bushels; and Cordova barley, 38 bushels. These trials have been on Class I or Class II land, Houston Black clay. Field yields have averaged about 20 percent less than the variety trials. A part of the difference is loss during harvest, which at present seems unavoidable, either with direct combining or by windrowing followed by pickup with a combine.

Grazing returns from small grain and sweetclover reached highs of 342 pounds of steer gain per acre in 1946-47 and 339 pounds in 1952. The average for oats in 1952 was 275 pounds. The lowest, on Austin clay, Classes III and IV, was 198 pounds. Complete grazing of barley and clover in 1952 gave 260 pounds of steer gain per acre, or essentially the same as oats. Wheat is never grazed completely because of the small acreage. Winter grazing on small grain reached a high of 178 pounds of steer gain per acre on oats with clover before March 1, 1946. The average for several years, without nitrogen fertilizer, is about 60 pounds per acre. Steer gain per acre from all fields of biennial sweetclover on oat or barley stubble ranged from 20 to 65 pounds in 1952, and from 31 to 60 pounds in 1953.

These returns per acre give a good indication of the value of crops that provide excellent soil protection and water conservation during the critical spring period of highest rainfall. At normal prices for beef and other animal products, the return per acre appears generally competitive with the net return from cash crops. On Class III and Class IV land, Austin clay, Houston Black clay and Houston clay (not represented on the station), the soil-conserving combinations of small grain with sweetclover are in an especially favorable economic position in comparison with row crops.

Other Grazing Crops and Beef Production

Proper land use as now practiced has led to the use of a strip of bottomland along Boggy creek for permanent pasture. Overflow and local wet spots prevent the successful use of this land for cultivated crops. It is mostly Class V (wet land). The main perennial grasses are Bermudagrass on the lowest parts and buffalograss on higher, dry areas. Cool season grasses, Texas wintergrass

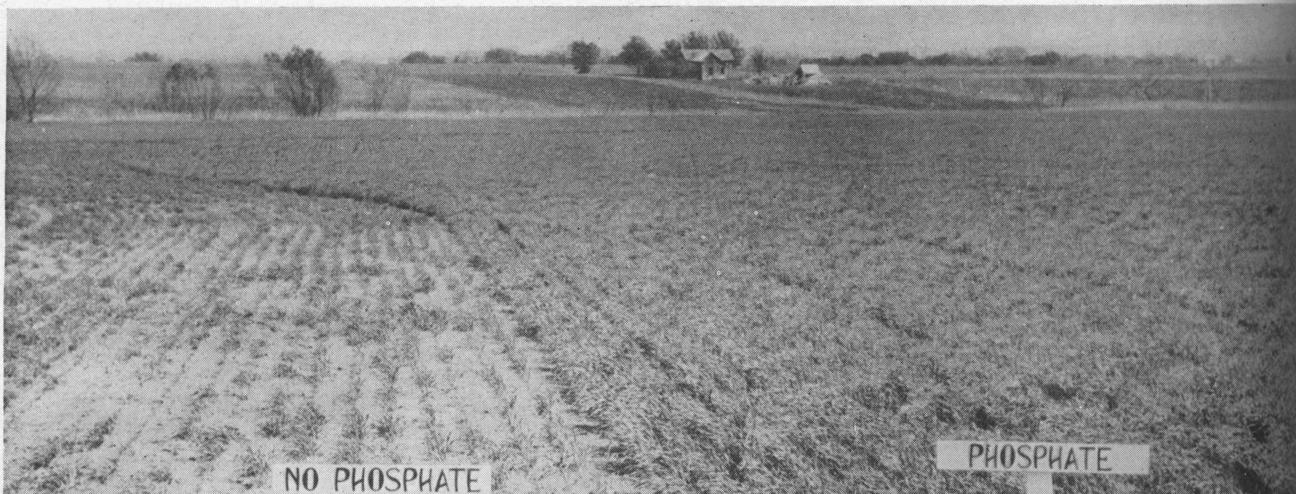


Figure 49. In extreme cases, phosphate fertilizer makes the difference between conservation and production, or failure. Winter-killing of oats was severe on this depleted Austin clay soil where no phosphate was used. Sweetclover and most other crops tend to need moderate fertilization with phosphate on lime-rich Blackland soils.

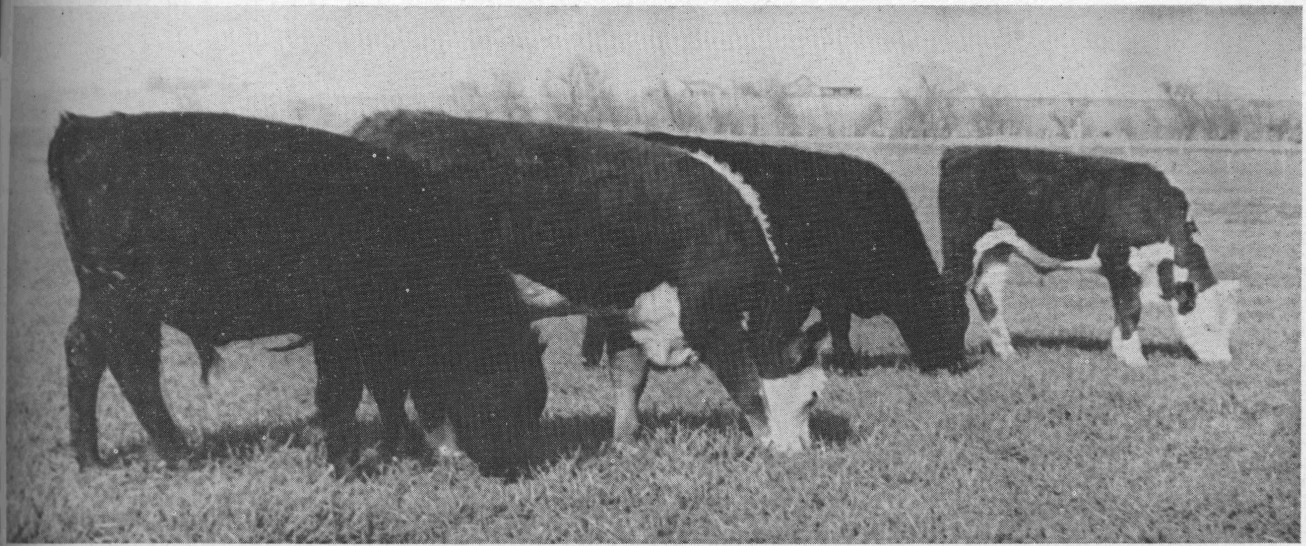


Figure 50. Dense soil cover of fall-drilled oats with sweetclover being grazed with choice steer calves in conservation farming system on Class III land. Oats and clover are the backbone of year-round grazing and conservation in the Blackland.

(*Stipa leucotricha*), rescuegrass (*Bromus catharticus*) and little wild barley (*Hordeum pussillum*), also contribute to the total growth and the length of the grazing season. During 6 years of record (31), this pasture has given profitable returns of 153 pounds of steer gain per acre at an average rate of gain of 1.0 pound per head per day. Rapid rates of gain are obtained from early growth in March and April. During midsummer, when gains are lower than 1.0 pound per head per day, it is usually better to depend on supplemental grazing.

As shown by small plots, soil erosion is insignificant with good grass cover. Water intake depends greatly on grazing intensity, especially during wet periods. With good grazing management, shrinkage, earthworms and roots keep the pasture soil open and receptive to water. On the average, there is more runoff from grazed grass pasture than from small runoff plots. Careful grazing management is the key to high water intake and to high returns per acre, year after year. Where grazed conservatively, permanent grasses have survived and produced well during recent extremely dry years.

The station maintains one 8-acre native grass pasture, consisting of little bluestem (*Andropogon scoparius*), big bluestem (*A. furcatus*), Indiangrass (*Sorghastrum nutans*), side-oats grama (*Bouteloua curtipendula*), Texas wintergrass (*Stipa leucotricha*), wild alfalfa (*Psoralea tenuiflora*), catclaw sensitive brier (*Mimosa biuncifera*), yellow neptuni (*Neptunia lutea*) and many other minor species. The 5-year average return per acre, 1947-51, was 90 pounds of steer gain at the rate of 1.6 pounds per head per day. Recently, this pasture has been grazed in accordance with its growth by species, as recommended by Allred (1) rather than on an arbitrary schedule. Two years by this method gave 142 pounds of steer gain per acre in 1952 at 2.3 pounds per head per day, and 152 pounds in 1953 at 2.5 pounds per head per day.

Johnsongrass with sweetclover or Johnsongrass with small grain and sweetclover is a valuable conservation grazing crop. Its full potentialities have not been realized because of the damage by Johnsongrass as a weed in row-crop farming. Also, Johnsongrass often dies under normal grazing. Two years of results on eroded, sloping land (Classes II and III, Austin clay) gave an average return of 160 pounds of steer gain per acre at a rate of 1.4 pounds per head per day from oats and Hubam drilled into Johnsongrass.

Use of Johnsongrass with sweetclover, or with other species, probably is more attractive on land that is too sloping for much cotton or corn (Classes III and IV). In rotations with grain sorghum for farm use as feed, there appears to be little need to control Johnsongrass completely if the land can be used for grazing combinations during 1 or more years before each crop of grain sorghum. A rotation of this type used successfully on the station on Class II and Class III land, Houston Black clay and Austin clay, consists of 1 year of grain sorghum followed by 2 years of barley and sweetclover with the Johnsongrass. This is a cheap and profitable rotation when grazing and grain are balanced with the livestock load on the farm.

Sudangrass, sweet or common, is one of our best summer grazing crops for year-round grazing systems. The 6-year average acre return has been 309 pounds of steer gain at an average rate of 1.9 pounds per head per day. This grazing is especially valuable because it comes in hot, dry weather when other grazing is scarce.

No runoff and erosion measurements are available for Sudangrass planted in 40-inch rows.

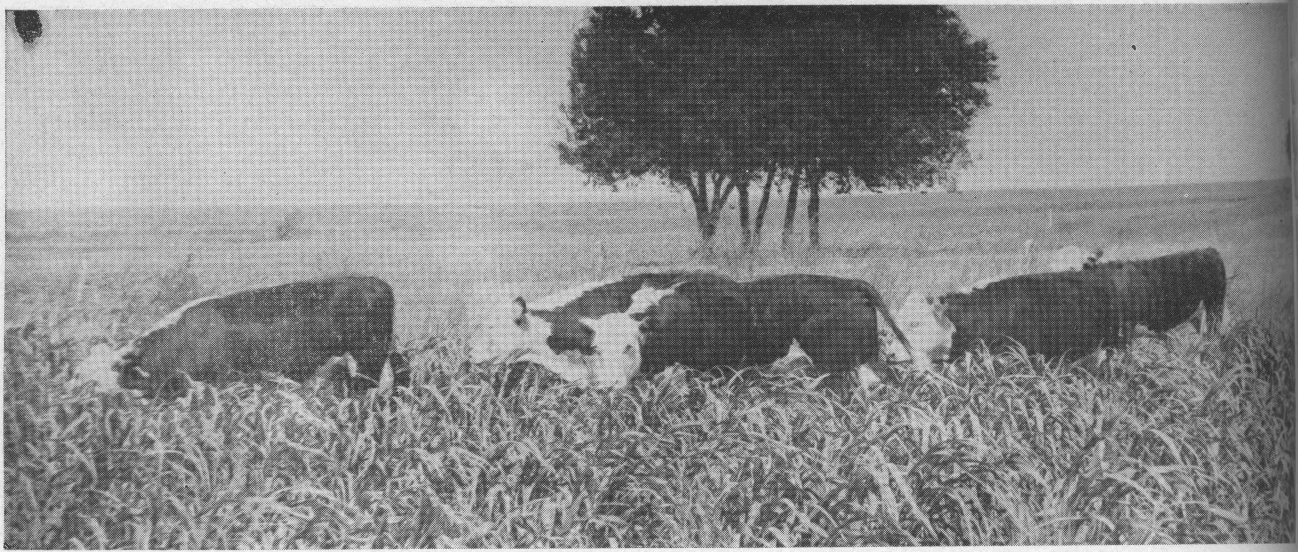


Figure 51. Sudangrass for summer supplementary grazing is an important part of year-round grazing in conservation farming systems. Sudangrass is grown in rotation with small grain and sweetclover on Class II and Class III land, with returns of more than 200 pounds of steer gain per acre.

Where contour planted and not overgrazed, it gives better control than corn or cotton. Trash-mulch methods, minimum land preparation and minimum cultivation may give better conservation with Sudangrass. However, at present this crop is grown like other row crops, in 2 or 3-year rotations following 1 or 2 years of soil-conserving small grain with clover.

Other grasses for conservation and production have been studied and tested, both in small plots and in field areas. Fescuegrass (Ky. 31 or Alta) is being used to some extent for cool-season grazing or hay. It can be established consistently from fall or winter drilling. Yields are low but, in combinations with sweetclovers or alfalfa, the total legume and grass yield may be satisfactory. The root growth of fescuegrass has a strong conditioning effect on the soil. It may find a wider use with legumes, especially on moist sites.

KR bluestem (*Andropogon ischaemum* var.) is a warm-season grass that can be established successfully by drilling in rows in the spring. It persists and thickens under varied conditions and management. Highest grazing returns have been obtained when cool-season clovers are grown with KR bluestem for early grazing. Its use is recommended in combination with clovers on shallow, severely-eroded or steeply-sloping soils.

Buffelgrass (*Pennisetum ciliare*), Caucasian bluestem (*Andropogon caucasicus*) and blue panicum (*Panicum antidotale*) are three of the most promising introduced grasses now being tested. However, the only good stands obtained have been

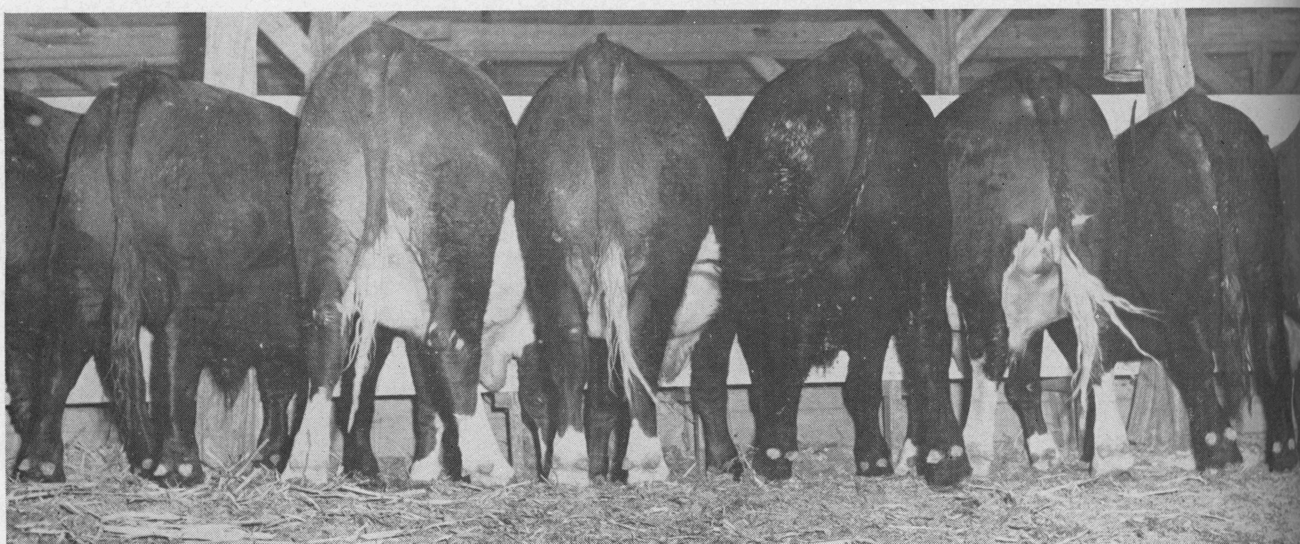


Figure 52. Feedlot finishing for maximum profit is an essential part of a well-balanced conservation beef-production plan. Plenty of hay and grain for cattle finishing and wintering can be produced on typical Blackland.

in small plots, and hay yields have not been equal to Johnsongrass. There is no assurance that these or other introduced grasses, except Bermudagrass, will soon find a prominent place in Blackland agriculture. Consistent and quick establishment, and ability to compete with Johnsongrass are characteristics needed but still are not entirely satisfied by any of the numerous warm-season grasses that have been tested at this station.

The various intermediate or tall native grasses of this area are too slow in establishment for use in short-time crop rotations. For permanent grass pasture or grass hay (other than low-lying sites suitable for Bermudagrass), Johnsongrass and the native grasses probably are the best species known. It takes several years to get well-established stands of the tall native grasses. Then it is necessary to follow proper tall grass grazing management (1). The most satisfactory native grasses to establish include: Indiangrass (*Sorghastrum nataus*), little blustem (*Andropogon scoparius*), big bluestem (*A. furcatus*), side-oats grama (*Bouteloua curtipenduia*) and switchgrass (*Panicum virgatum*).

For close grazing on dry sites, the best native grass that can be seeded successfully is buffalograss (*Buchloe dactyloides*).

There is hope of finding other grasses that will improve conservation and production in the Blackland, but more attention is being given to improved management and treatment of the grasses that we now have and whose good and bad characters are known. Johnsongrass, Bermudagrass and tall native grasses are the most promising for grassland improvement through improved management.

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Appendix

Relation to Slope Length

Field-scale plots, O and P, were established in 1939. These plots are 432 feet long and 151 feet wide. Individual plots range from 1.39 to 3.01 percent slope. Thus, data from these plots are not comparable directly with small plot data. Moreover, cotton and corn on the field-scale plots have been bedded on the approximate contour instead of being planted essentially flat, as on the small plots. Other data and interpretations from this station (18) indicate that contour bedding may reduce soil losses 50 percent or more in small plots, especially on slopes of 4 percent or less and for storms of short duration and low intensity. This is about the maximum control from contouring reported by others (26). On field areas, where contouring is necessarily imperfect, the erosion control value of contouring appears to be smaller than indicated by small plot data.

As an approximate check on likely slope length effects, it may be of value to compare the losses from the field scale and the small plots, with the best available corrections for contouring and for slope percent (or degree of slope). Considering the 10-year period, 1942-51, the 12 large runoff plots (432 feet long) showed an average annual runoff of 2.0 inches and an annual soil loss of 3.7 tons per acre, on an average slope of 2.37 percent, while in corn or cotton. During the same period, all of the small plots in corn and cotton on a 4 percent slope of Austin clay, slope length 72.6 feet, gave average annual runoff of 4.1 inches and average soil loss of 11.7 tons per acre. Crop rotations were essentially the same on the small and on the large plots. None of the corn or cotton was grown after grass sod. On the 72.6-foot plots with 4 percent slope, the soil loss per inch of runoff was 2.9 tons per acre; on the 432-foot plots with 2.37 percent it was 1.9 tons per inch of runoff. When corrected to a 4 percent slope by the formula of Zingg (33) and confirmed by others (26)—that soil loss is proportional to slope percent to the 1.4 power—the predicted soil loss for the 432-foot plots, if on a 4 percent slope, would be 7.8 tons per acre, or 3.9 tons per inch of runoff, as compared with a measured total soil loss of 11.7 tons per acre, or 2.9 tons per inch of runoff on the 72.6-foot plots. If a contour cultivation is credited with approximately a 50 percent reduction in soil loss, the predicted loss for the 432-foot plots, if planted flat to corn or cotton, becomes 15.6 tons per acre. This credit to contour bedding and planting may be somewhat high because the contouring is not perfect and the furrows break in low spots, as is common for field areas. These corrections for slope percentage and for contouring place the soil losses on 432-foot plots in the same order of magnitude as losses on 72.6-foot plots. Erosion might be considerably higher if runoff from the long plots was equal to that on the short plots, for erosion per inch of runoff (with comparable slope) seems higher on the long than on the short plots. However, it is evident that the time factor favors infiltration on long slopes. There is more time for water to soak in as it flows over a long slope. This is generally recognized (3, 6, 18, 26, 33).

Considering absolute erosion per acre, a slope length ratio of 432:72.6, or 6, seems associated with a soil loss ratio of not more than 15.6:11.7, or 1.33. On this basis, doubling the length of a slope might be expected to increase soil loss per acre by about 5 percent, an amount which is small compared to the error in most erosion measurements. Actually this amount is probably well within the error of our corrections for slope percentage and for contouring.

In the central Blackland area, on slopes of less than about 5 percent, it often is observed that soil erosion is severe on the upper portion of slopes but is not evident in mid or lower-slope positions. It appears that colluvial deposits are common on long slopes on the uplands much farther up the heads of drainageways and further up on long slopes than is common in many humid areas farther east. Rills or small washes often occur close to the break from ridges to slopes even though there is no appreciable watershed above the wash to supply accumulated water.[6] Blackland soil, when bare cultivated or fallow, is picked up quickly and easily by raindrop splash and by running water. The same tendency has been confirmed by detailed water drop studies (30). The same thing is suggested by the tendency toward formation of long, colluvial slope deposits. If runoff water gets its load quickly on upper slopes, no additional soil detachment is likely down the slope unless slope degree increases. Moreover, as time permits extra infiltration on long slopes and reduces runoff volume, the tendency would be for upper slope solids to be dropped on lower slopes even though no decrease in slope percentage occurs.

These general observations and measurements as well as the data presented, are not considered precise or inclusive enough to justify an absolute statement that sheet erosion is greater or less on long or on short slopes in this area. There is, perhaps, some evidence in favor of a slight increase in soil loss per acre with increasing slope length, as found at other locations. However, the exponent of 1.6 for C (slope length) in the formula by Zingg (33) is higher than indicated by average longtime small-plot data at this location. The longest record (21 years) with slope lengths indicates an exponent of 1.1. Shorter time periods indicate variable exponents from 0.9 to 2.4. Calculated comparisons from field-scale plots suggest an exponent of 1.1. Considering the several lines of evidence mentioned, it is apparent that factors sometimes considered of minor importance, such as approximate contouring or slightly increased infiltration, can easily overshadow effects of slope length on sheet erosion on gentle slopes in the Blackland. In collecting basins, on the other hand, or where water becomes confined and forms gullies, the length of run may be much more important because of greatly increased volumes of water on the eroding area.

Conclusions About Slope Length

Small-plot studies over a 20-year period at Temple indicate that on the Blackland soils represented, on a 4 percent slope, soil erosion losses are influenced only to a very limited extent by length of slope. This small plot result is supported by data from large, field-scale plots and from observations on field areas.

Factors thought to account for the small or insignificant influence of slope length at Temple are:

Increased time for infiltration on the lower parts of long slopes which tends to decrease runoff on long slopes as compared with short slopes.

Soil profiles with meduim or high water intake capacities during most rains. This is strongly influenced by shrinkage whenever the soil is below saturation as well as by soil structure and cropping practices.

Surface soil which is easy to disperse and detach (30), thus permitting sheet water to pick up a full load in a short distance.

[6] These observations are supported by the observations and experience of W. R. Elder, soil scientist, SCS Operations, who has for several years studied this aspect of soil conservation in the Texas Blacklands.

Table 12. Rainfall summary by months and years, 1942-53, compared with the average from 1931-41, and the 41-year average from 1913-53

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	0.37	1.48	0.87	6.38	6.63	3.14	0.16	3.46	6.85	3.33	1.97	2.00	36.64
1943	0.92	0.02	3.26	1.53	3.52	1.08	5.36	0.36	3.53	1.19	1.75	1.97	24.49
1944	5.80	4.74	4.11	1.90	12.91	3.84	0.35	2.17	3.22	0.26	6.80	4.71	50.81
1945	2.98	5.26	2.85	7.74	2.42	4.39	0.23	4.18	1.74	3.33	0.61	2.93	38.66
1946	4.06	3.43	3.17	4.77	7.85	3.00	0.98	2.74	6.64	1.16	6.26	2.93	46.99
1947	4.52	0.62	3.48	4.43	5.25	0.50	0.95	3.94	0.45	0.23	2.01	2.62	29.00
1948	1.84	1.99	1.35	2.91	3.06	3.51	1.44	0.59	0.67	0.93	0.68	1.44	20.41
1949	3.29	2.11	3.01	6.53	0.50	5.30	2.37	0.59	1.36	4.92	0.10	3.48	33.56
1950	1.04	4.37	0.27	5.05	3.24	2.77	0.95	0.31	2.99	1.32	0.38	0.05	22.74
1951	1.59	2.64	1.69	2.72	7.39	2.54	0.10	0.04	6.27	1.66	1.09	0.41	28.14
1952	0.46	3.51	2.75	5.64	5.39	1.49	0.76	T	0.55	0.00	5.18	5.38	31.11
1953	0.97	1.23	1.66	2.61	7.72	1.03	2.48	2.57	2.18	8.44	1.40	2.62	34.91
1942-53—12-year average	2.32	2.62	2.37	4.35	5.49	2.72	1.34	1.75	3.04	2.23	2.35	2.55	33.12
1931-41—11-year average	2.93	2.27	2.09	3.10	4.13	3.46	3.01	1.09	2.71	2.00	2.93	3.33	33.05
1913-53—41-year average	2.53	2.34	2.26	4.16	4.77	2.78	1.85	1.92	3.36	2.83	2.84	2.90	34.52

Table 13. Average monthly temperatures[1] at Temple, Texas

Month	Monthly averages of daily temperatures				
			1913 to 1951		
	10-year average, 1942-51	11-year average, 1931-41	39-year average maximum	39-year average minimum	39-year average of the maximum & minimum
Jan.	48.4	49.8	59.9	36.7	48.3
Feb.	53.5	52.7	64.6	40.5	52.6
Mar.	59.6	59.9	71.8	46.4	59.1
Apr.	67.7	67.2	79.3	54.7	67.0
May	74.2	74.0	84.9	62.6	73.8
June	81.0	80.6	91.9	69.8	80.8
July	84.0	83.4	95.5	72.0	83.8
Aug.	84.6	84.1	96.3	71.8	84.1
Sept.	78.2	79.5	90.2	66.6	78.4
Oct.	70.5	71.5	82.2	56.9	69.5
Nov.	59.7	57.7	70.4	45.9	58.2
Dec.	52.1	52.2	62.3	39.4	50.8
Annual average	67.8	67.7	79.1	55.3	67.2

[1] Temperatures shown in degrees Fahrenheit.

Table 14. Evaporation from a free water surface[1] at Temple, Texas

Month	10-year average, 1942-51	11-year average, 1931-41	37-year average, 1915-51	Extremes of absolute daily evaporation during 37 years					
				Maximum			Minimum		
				Year	Day	Amount	Year	Day	Amount
Jan.	1.924	1.957	2.062	1938	31	0.310	1943	13	0.001
Feb.	2.250	2.403	2.537	1927	21	.523	1948	23	.001
Mar.	4.020	4.348	4.184	1950	27	.440	1947	5	.001
Apr.	4.490	5.219	4.888	1948	1	.662	1949	21	.006
May	5.122	5.939	5.664	1929	2	.526	1942	18	.006
June	6.409	6.825	6.899	1926	16	.479	1950	3	.022
July	7.520	7.568	7.895	1926	1	.588	1926	14	.010
Aug.	7.915	7.635	7.871	1929	5	.525	1939	2	.039
Sept.	5.650	6.094	5.890	1924	1	.457	1930	30	.002
Oct.	4.323	4.681	4.567	1927	25	.516	1942	29	.002
Nov.	3.329	3.012	3.061	1950	24	.347	1936	1	.003
Dec.	2.262	2.201	2.220	1940	17	.553	1946	27	.000
Annual average	55.314	57.882	57.738						

[1] Standard 6-foot diameter U.S. Weather Bureau pan.

Table 15. Miles of wind movement at Temple, Texas

Month	10-year average, 1942-51	11-year average, 1931-41	38-year average, 1914-51	Extremes—38-year period						Prevailing direction
				Maximum			Minimum			
				Year	Day	Movement	Year	Day	Movement	
Jan.	5256	5036	4732	1929	5	566	1928	10	8	North
Feb.	5011	5586	4834	1929	9	535	1923	11	15	North
Mar.	6204	6950	5985	1932	5	640	1925	24	13	South
Apr.	5929	6233	5437	1936	6	563	1927	10	17	South
May	5260	5166	4618	1929	2	562	1915	17	17	South
June	5156	4458	4219	1928	18	436	1918	20	14	South
July	4316	4035	3697	1939	3	390	1926	29	8	South
Aug.	4479	3925	3603	1915	17	482	1926	1	11	South
Sept.	3913	3990	3372	1939	29	450	1927	27	9	South
Oct.	4084	4320	3627	1926	13	563	1924	22	5	South
Nov.	4766	4931	4161	1929	13	530	1926	10	4	North
Dec.	4890	4941	4450	1940	27	492	1927	24	16	North
Annual average	59264	59571	52735							
Extremes				March 5, 1932—640						Nov. 4, 1929—4

Table 16. Record of amount and intensities of all individual storms of 1.0 inch or more, 1942-53, at the Blackland station, Temple, Texas. These storms which amount to about 50 percent of the total rainfall, caused more than 75 percent of the total water and soil losses

Date	Amount	Maximum intensities 5-minute period	15-minute period	30-minute period	2-hour period
	Inches	— — — — Inches per hr.	— — — —		
1942					
Apr. 7-8	2.55	2.40	1.68	1.14	0.65
Apr. 23-25	2.23	2.76	1.52	0.96	0.55
May 7-8	1.67	1.80	1.60	1.42	0.48
May 11	1.19	4.32	1.84	0.96	0.27
May 18-19	3.16	3.24	2.64	2.24	1.22
June 6	1.21	3.12	2.00	1.90	1.60
June 10-11	1.07	1.08	0.88	0.82	0.36
Aug. 16	1.57	6.00	4.28	2.70	0.78
Sept. 7-8-9	6.17	3.60	2.68	2.18	0.88
Dec. 19-20	1.39	2.16	1.44	1.32	0.46
1943					
Mar. 24	2.38	3.84	2.68	2.32	0.91
Apr. 8	1.51	2.40	1.36	1.08	0.36
May 29-30	1.62	1.92	0.96	0.70	0.31
July 10-11-12	3.29	3.60	2.88	1.80	0.75
July 29	1.65	1.08	0.88	0.86	0.41
Sept. 25-26-27-28-29	3.00	1.68	1.64	0.90	0.35
Oct. 12-13	1.15	1.32	1.24	1.22	0.44
Nov. 26	1.08	0.60	0.48	0.38	0.21
1944					
Jan. 1	2.00	0.84	0.52	0.42	0.26
Jan. 13-14	1.24	0.36	0.24	0.20	0.09
Jan. 29	1.04	0.96	0.60	0.42	0.32
Feb. 8	1.43	2.76	2.12	1.48	0.48
Feb. 25	1.08	2.40	1.56	0.96	0.33
Mar. 16	1.42	3.60	2.12	1.30	0.62
Mar. 22	1.12	1.80	1.68	1.08	0.47
Apr. 29	1.50	1.68	1.48	1.12	0.40
Apr. 30	2.22	3.00	2.08	1.40	0.79
May 1	3.52	6.00	3.60	3.10	1.06
May 9	1.07	3.24	2.32	1.60	0.43
May 22	1.04	1.68	1.20	1.20	0.44
May 25	1.02	2.04	0.92	0.66	0.24
May 27	1.02	5.28	3.04	1.72	0.51
June 5	2.10	2.80	2.80	2.30	0.81
Sept. 6	1.45	2.40	1.64	1.08	0.73
Sept. 26	1.11	2.88	1.52	0.92	0.41
Nov. 16	1.78	0.96	0.56	0.48	0.26
Nov. 18	1.22	0.48	0.24	0.16	0.11
Nov. 24	3.00	3.60	2.08	1.48	0.63
Dec. 4	1.92	1.92	1.84	1.30	0.63
1945					
Jan. 18	1.68	1.08	0.76	0.54	0.33
Feb. 12	2.05	1.44	1.08	0.72	0.70
Apr. 1	1.22	1.44	0.92	0.92	0.41
Apr. 21	5.19	4.32	2.92	2.78	1.36
June 12	1.65	1.56	1.40	1.24	0.58
Sept. 28	1.15	3.96	2.32	1.44	0.45
Oct. 9	1.03	0.36	0.28	0.20	0.13
Dec. 2	2.51	2.16	1.12	0.70	0.51
1946					
Jan. 4	1.06	5.04	2.80	1.56	0.53
Feb. 18	1.10	3.12	2.00	1.20	0.47
Mar. 13	1.25	0.84	0.60	0.44	0.25
Apr. 22	1.83	2.88	2.00	1.46	0.88
Apr. 23	1.10	0.48	0.32	0.32	0.21
Apr. 29	1.06	2.64	1.60	1.20	0.48
May 15	2.79	7.44	6.08	3.40	0.99
May 29	1.04	3.60	1.80	1.22	0.52
May 31	1.36	3.60	3.16	1.92	0.62
Aug. 28	1.33	2.40	1.76	1.08	0.42
Sept. 1	2.32	1.92	1.72	1.64	0.78
Sept. 12	1.65	3.00	2.16	1.64	0.83
Nov. 3	1.48	3.36	2.56	1.88	0.65
Nov. 15	2.41	4.32	3.60	2.90	1.20
Dec. 10	1.06	1.32	0.92	0.72	0.26
Dec. 11	1.44	2.28	1.08	0.74	0.57
1947					
Jan. 17	1.24	0.48	0.40	0.34	0.13
Mar. 18	1.40	0.96	0.64	0.52	0.36
Apr. 12	1.58	3.60	2.56	1.48	0.57
Apr. 19	1.68	7.20	4.40	3.24	0.84
May 9	1.00	1.20	0.76	0.44	0.27
May 18	1.45	6.00	4.08	2.46	0.72
May 20	1.35	4.80	4.00	2.66	0.68
Aug. 18	1.13	4.20	2.80	1.98	0.56
Aug. 26	1.65	1.20	0.72	0.52	0.28
1948					
Apr. 13	1.23	2.04	1.20	1.20	0.44
Apr. 25	1.01	1.20	0.92	0.64	0.25
May 18	1.33	2.40	2.00	1.60	0.67
June 28	3.20	3.60	2.56	2.48	1.48
1949					
Feb. 26	1.13	0.60	0.40	0.28	0.27
Mar. 21	1.97	3.24	2.84	2.10	0.95
Apr. 24	2.42	4.56	3.24	2.12	0.72
Apr. 28	1.39	4.08	2.76	1.44	0.57
June 14	2.53	3.60	3.24	2.50	0.66
June 22	1.62	3.96	3.04	2.52	0.81
July 31	1.23	3.00	1.76	1.26	0.61
Oct. 21	1.17	2.28	1.44	0.92	0.58
Oct. 24	2.53	3.12	2.00	2.00	0.95
1950					
Feb. 9	1.19	1.68	0.60	0.36	0.24
Feb. 12	1.40	4.44	3.32	2.06	0.65
Apr. 13	1.16	1.08	0.76	0.58	0.35
Apr. 16	2.03	4.56	2.40	1.66	0.57
May 13	1.14	4.80	3.84	2.08	0.57
June 5	1.33	1.20	0.72	0.68	0.28
Sept. 10	1.56	6.00	4.00	2.44	0.61
Oct. 19	1.24	0.60	0.48	0.36	0.24
1951					
Jan. 13	1.27	4.80	2.56	1.50	0.39
Feb. 18	1.35	2.40	1.00	0.66	0.42
Apr. 29	1.72	2.40	1.76	1.44	0.76
May 15	1.89	2.88	1.92	1.50	0.72
June 3	1.08	0.48	0.40	0.32	0.21
Sept. 13	3.06	4.20	3.60	3.30	1.48
Sept. 25	1.33	4.56	2.80	1.98	0.67
Oct. 23	1.27	1.44	1.28	0.92	0.49
1952					
Feb. 24-25	1.41	0.72	0.48	0.40	0.22
Mar. 9-10	1.26	2.88	2.28	1.28	0.40
Apr. 11	1.17	1.44	0.72	0.48	0.32
Apr. 19-20	1.26	1.68	0.88	0.64	0.21
Apr. 21-22	1.87	1.08	0.88	0.64	0.38
May 17-18	2.10	4.08	2.24	1.32	0.40
May 24-25	2.01	3.36	2.08	1.52	0.86
May 27-28	1.12	0.48	0.40	0.36	0.14
Oct. 22-23-24	3.76	2.40	1.36	1.36	0.37
Oct. 28-29	1.20	0.24	0.16	0.16	0.12
Dec. 18-19	2.44	3.84	1.60	1.08	0.42
Dec. 29-30	2.16	1.68	0.64	0.26	0.20
1953					
Mar. 8-9-10-11	1.01	0.60	0.40	0.40	0.18
Apr. 23-24	1.80	2.16	1.44	1.28	0.48
May 11	3.66	4.80	2.16	1.44	0.90
May 14-15	2.00	2.64	2.16	1.28	0.62
June 12	1.03	2.40	1.92	1.48	0.51
July 12	1.25	3.60	3.36	2.44	0.62
Aug. 19-20	2.42	1.92	1.36	0.96	0.65
Sept. 3	1.27	4.08	3.20	1.84	0.50
Oct. 22-23	3.50	3.12	1.44	1.12	0.60
Oct. 25-26	4.50	4.08	2.72	2.68	0.92
Nov. 3	1.20	0.60	0.56	0.40	0.16
Dec. 1	1.68	0.96	0.64	0.64	0.32

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested[1]	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	Inches	Inches	Tons	Tons
1	Area 1/200 acre, 6 by 36.3 feet. Land slope, 4 percent. Soil, Austin clay. Cropping practice, continuous corn with furrows and rows down slope. Planted flat without bedding, 1947-52. In July 1951 a 4-ton mulch of straw was applied. There was no runoff after mulching.	1931		Corn	32 bu.	23.4	0.7	4.9	6.7
		1932		do	27	31.3	4.1	19.8	4.8
		1933		do	24	25.7	5.5	19.9	3.6
		1934		do	11	29.7	5.4	33.8	6.3
		1935		do	29	46.7	9.2	44.7	4.8
		1936		do	32	39.9	7.4	39.3	5.3
		1937		do	36	28.6	1.3	4.4	3.4
		1938		do	28	27.6	2.6	7.5	3.0
		1939		do	29	23.8	2.9	11.1	3.8
		1940		do	13	39.9	7.4	9.4	1.3
		1941		do	4	43.8	10.1	33.9	3.3
		1942		do	8	36.1	9.4	12.5	1.3
		1943		do	26	24.6	2.3	3.7	1.7
		1944		do	14	50.1	8.8	14.3	1.6
		1945		do	25	37.2	5.1	5.3	1.0
		1946		do	29	45.8	8.5	14.1	1.6
		1947		do	23	27.2	4.4	8.3	1.9
		1948		do	19	19.0	2.2	1.8	0.8
		1949		do	27	32.3	6.5	4.0	0.6
		1950		do		22.4	2.4	1.6	0.7
		1951		do	20	18.6	2.9	2.7	0.9
		20½—year average				32.9	5.3	14.5	2.7
2	Area 1/50 acre, 6 by 145.2 feet. Land slope, 4 percent. Soil, Austin clay. Cropping practice, continuous corn, with furrows and rows down slope, 1931-44.	1931		Corn	32 bu.	23.4	0.7	1.6	2.2
		1932		do	26	31.3	3.3	20.6	6.2
		1933		do	26	25.7	3.6	11.8	3.3
		1934		do	11	29.7	4.6	27.3	6.1
		1935		do	33	46.7	7.0	31.4	4.5
		1936		do	29	39.9	7.5	37.6	5.1
		1937		do	33	28.6	0.7	3.1	4.2
		1938		do	26	27.6	1.9	9.4	4.9
		1939		do	29	23.8	1.6	6.3	4.0
		1940		do	12	39.9	6.9	14.6	2.1
		1941		do	22	43.8	8.3	43.6	5.2
		1942		do	5	36.1	7.2	22.3	3.1
		1943		Corn	31 bu.	24.6	1.8	4.1	2.3
		1944 ½ year		do		32.7	8.1	27.7	3.4
		13½-year average				33.6	4.7	19.4	4.1
	Since 1944, rotation, cotton, Hubam, with rows down slope or flat. Since 1946, all crops were planted flat without furrows.	1945		Cotton	263 lbs.	37.2	4.3	7.7	1.8
		1946		Hubam	1296	45.8	0.5	0.3	0.6
		1947		Cotton	208	27.2	2.3	3.3	1.4
		1948		Hubam	210	19.0	0.2	0.0	0.2
		1949		Cotton	461	32.3	2.9	2.3	0.8
		5-year average				32.3	2.0	2.7	1.3
	Since 1949, rotation, corn, oats, planted flat.	1950		Oats		22.4	0.4	0.2	0.6
		1951		Corn	60 bu.	27.7	2.9	1.9	0.6
		2-year average				25.1	1.6	1.0	0.6
3	Area 1/100 acre, 6 by 72.6 feet. Land slope, 4 percent. Soil, Austin clay. Cropping practice, continuous corn, with furrows and rows down slope.	1931		Corn	38 bu.	23.4	1.0	2.5	2.5
		1932		do	28	31.3	3.5	19.0	5.5
		1933		do	29	25.7	4.8	14.7	3.1
		1934		do	14	29.7	4.8	39.2	8.3
		1935		do	33	46.7	7.4	29.1	3.9
		1936		do	36	39.9	6.5	38.6	5.9
		1937		do	30	28.6	1.1	4.2	3.7
		1938		do	32	27.6	2.3	12.6	5.5
		1939		do	39	23.8	2.7	14.2	5.3
		1940		do	12	39.9	6.6	13.7	2.1
		1941		do	26	43.8	8.4	38.8	4.6
		1942		do	7	36.1	8.4	22.0	2.6
		1943		do	32	24.6	2.2	4.5	2.1
		1944		do	19	50.1	7.9	24.8	3.1
	Since 1946, planted flat with no furrows.	1945		do	27	37.2	4.1	7.5	1.8
		1946		do	28	45.8	8.5	20.4	2.4
		1947		Corn	29 bu.	27.2	4.0	11.7	2.9
		1948		do	11	19.0	2.2	3.0	1.4
		1949		do	30	32.3	6.3	10.4	1.6
		5-year average (1945-1949)				32.3	5.0	10.6	2.1
		1950		do		22.4	3.1	2.4	0.8
		1951		do	26	27.7	4.4	4.2	0.9
		2-year average				25.1	3.8	3.3	0.9
		21-year average (1931-1951)				32.5	4.8	16.1	3.4
4	Area 1/100 acre, 6 by 72.6 feet. Land slope, 4 percent. Soil, Austin clay. Cropping practice, rotation cotton, corn, oats. Rows down slope.	1931		Corn	36	23.4	0.5	0.8	1.5
		1932	Oats	Oats	75	31.3	0.0	0.0	1.6
		1933		Cotton	335 lbs.	25.7	2.4	5.2	2.1
		1934		Corn	18 bu.	29.7	3.9	22.6	5.9
		1935	Oats	Oats	46 bu.	46.7	0.1	0.4	3.8
		1936	Vetch	Cotton	240 lbs.	39.9	7.9	54.9	6.9
		1937	Vetch	Corn	38 bu.	28.6	1.9	5.5	2.8
		1938	Oats	Oats	67	27.6	0.1	0.1	1.0
		1939		Cotton	237 lbs.	23.8	2.0	7.3	3.8
		1940		Corn	14 bu.	39.9	6.2	13.7	2.2
		1941	Oats	Oats	72	43.8	0.6	0.3	0.6
		1942		Cotton	273 lbs.	36.1	4.8	11.9	2.5
		1943		Corn	43 bu.	24.6	1.4	2.6	1.9
		1944	Oats	Oats		32.7	0.1	0.1	0.6
		13½-year average				33.6	2.4	9.3	3.9
	Since 1944, rotation cotton, oats (H), rows down slope or flat.	1945		Cotton	320 lbs.	37.2	2.4	3.8	1.5
		1946		Oats (H)	35 bu.	45.8	0.1	0.2	2.1
		1947		Cotton	300 lbs.	27.2	3.3	16.5	5.1
		1948		Oats (H)	26 bu.	18.9	0.6	0.6	1.0
		1949		Cotton	342 lbs.	32.3	3.6	17.1	4.7
		5-year average				32.3	2.0	7.6	3.8

[1] (H) Hubam; (E) Evergreen; (C) Sweetclover.

Table 17. **Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)**

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches — —		— — — Tons — — —	
	Since 1949, rotation oats (H), corn planted flat.	1950		Oats (H)		22.4	0.3	1.1	3.1
		1951		Corn	56 bu.	27.7	2.0	2.5	1.2
		2-year average				25.1	1.2	1.8	1.5
		1931		Corn	34	23.4	0.2	0.7	2.9
		1932	Oats	Oats	57	31.3	0.2	0.5	2.3
		1933		Cotton	361 lbs.	25.7	0.9	3.3	3.7
		1934		Corn	15 bu.	29.7	3.5	13.7	0.4
	Area 1/100 acre, 6 by 72.6 feet.	1935	Oats	Oats	40	46.7	0.9	0.8	0.9
	Land slope, 4 percent.	1936		Cotton	320 lbs.	39.9	4.5	15.7	0.4
5	Soil, Austin clay.	1937		Corn	29 bu.	28.6	0.9	2.2	2.6
	Cropping practice, rotation cotton, corn, oats.	1938	Oats	Oats	50	27.6	0.1	0.1	1.1
	1931 rows down slope.	1939		Cotton	212 lbs.	23.8	0.2	0.6	3.6
	Rows on contour, 1932-44.	1940		Corn	13 bu.	39.9	4.6	5.3	1.2
		1941	Oats	Oats	61 bu.	43.8	1.1	0.4	0.4
		1942		Cotton	251 lbs.	36.1	1.8	2.3	1.3
		1943		Corn	38 bu.	24.6	1.1	2.6	2.3
		1944	Oats	Oats		32.7	0.5	0.2	0.4
		13½-year average				33.6	1.6	3.6	2.4
		1945		Cotton	301 lbs.	37.2	4.0	7.5	1.9
		1946		Oats	31 bu.	45.8	0.5	0.5	1.1
	Since 1944, crop rotation cotton, oats	1947		Cotton	252 lbs.	27.2	3.3	16.2	0.5
	rows down slope or flat.	1948		Oats	28 bu.	18.9	0.7	0.5	0.7
		1949		Cotton	352 lbs.	32.3	3.4	13.5	0.4
		5-year average				32.3	2.4	7.6	3.2
	Since 1949, crop rotation corn, oats (E)	1950		Oats (E)		22.4	0.5	0.9	1.6
	planted flat.	1951		Corn	51 bu.	27.7	2.5	3.0	1.2
		2-year average				25.1	1.5	2.0	1.3
		1931	Grass	None	None	23.4	(1)	(2)	
		1932	do	do	do	31.3	(1)	(2)	
		1933	do	do	do	25.7	(1)	(2)	
		1934	do	do	do	29.7	(1)	(2)	
	Area 1/100 acre, 6 by 72.6 feet.	1935	do	do	do	46.7	0.1	0.2	2.4
	Land slope, 4 percent.	1936	do	do	do	39.9	0.0	0.0	1.4
6	Soil, Austin clay.	1937	do	do	do	28.6	(1)	(2)	
	Cropping practice, continuous Bermudagrass,	1938	do	do	do	27.6	0.0	0.1	2.8
	clipped.	1939	do	do	do	23.8	0.0	0.0	5.0
		1940	do	do	do	39.9	(1)	(2)	
		1941	do	do	do	43.8	0.1	0.0	0.2
		1942	do	do	do	36.1	0.1	0.1	0.1
		1943	do	do	do	24.6	0.0	T	
		1944	do	do	do	50.1	0.6	0.1	0.1
		1945	do	do	do	37.2	0.7	0.0	0.1
		1946	do	do	do	45.8	0.2	0.0	0.2
		1947	do	do	do	27.2	0.0	T	
		1948	do	do	do	19.0	0.0	T	
		1949	do	do	do	32.3	0.0	T	
		5-year average				32.3	0.2	0.0	0.1
		1950	do	do	do	22.4	0.0	T	
		1951	do	do	do	27.7	(1)	(2)	
		2-year average				25.1	0.0	T	
		21-year average				32.5	0.1	0.0	0.2
		1931		Cotton	No rec.	23.4	0.4	0.9	2.2
		1932		Corn	32 bu.	31.3	3.4	19.9	0.6
		1933	Oats	Oats	20	25.7	0.3	0.9	1.0
		1934		Cotton	250 lbs.	29.7	4.6	19.3	0.4
		1935	Vetch	Corn	36 bu.	46.7	7.5	37.5	0.5
	Area 1/100 acre, 6 by 72.6 feet.	1936	Oats	Oats	38	39.9	1.3	3.7	2.8
	Land slope, 4 percent.	1937	Vetch	Cotton	344 lbs.	28.6	1.0	5.1	5.1
7	Soil, Austin clay.	1938		Corn	34 bu.	27.6	2.4	14.3	0.6
	Croopping practice, rotation cotton, corn,	1939	Oats	Oats	58	23.8	0.1	0.2	1.7
	oats. Rows down slope.	1940		Cotton	302 lbs.	39.9	5.3	13.2	0.2
		1941		Corn	34 bu.	43.8	7.5	26.0	0.3
		1942	Oats	Oats	10	36.1	0.2	0.1	0.4
		1943		Cotton	463 lbs.	24.6	1.8	3.3	1.8
		1944		Corn		32.7	8.3	35.6	0.4
		13½-year average				33.6	3.3	13.3	0.4
		1945		Oats	39 bu.	37.2	2.0	0.4	0.2
	Since 1944, crop rotation cotton, oats,	1946		Cotton	92 lbs.	45.8	6.2	34.4	0.6
	rows down slope or flat.	1947		Oats	17 bu.	27.2	1.5	1.0	0.7
		1948		Cotton	216 lbs.	19.0	2.5	9.6	3.8
		1949		Oats	70 bu.	32.3	0.9	0.5	0.5
		5-year average				32.3	2.6	9.2	3.5
	Since 1949, crop rotation corn, oats (E)	1950		Corn		22.4	0.5	0.8	1.7
	planted flat.	1951		Oats		27.7	0.3	0.2	0.8
		2-year average				25.1	0.4	0.5	1.3
		1931		Corn	34 bu.	23.4	0.4	0.7	1.6
		1932	Oats	Oats	71	31.3	0.1	0.4	4.4
		1933		Cotton	300 lbs.	25.7	2.3	7.9	3.4
		1934		Corn	16 bu.	29.7	3.6	15.7	0.4
	Area 1/100 acre, 6 by 72.6 feet.	1935	Oats	Oats	49	46.7	0.8	0.8	1.0
	Land slope, 4 percent.	1936		Cotton	270 lbs.	39.9	7.8	53.3	0.7
8	Soil, Austin clay.	1937		Corn	32 bu.	28.6	2.0	6.3	3.1
	Cropping practice, rotation cotton, corn, oats.	1938	Oats	Oats	48 bu.	27.6	0.2	0.1	0.7
	1931 rows on contour.	1939		Cotton	263 lbs.	23.8	1.9	8.1	4.2
	1932-41 rows down slope.	1940		Corn	15 bu.	39.9	7.4	18.1	0.2
		1941	Oats	Oats	66	43.8	1.1	0.4	3.7
		1942		Cotton	257 lbs.	36.1	4.7	11.1	0.2
		1943		Corn	41 bu.	24.6	1.4	2.8	2.1
		1944	Oats	Oats		32.7	0.3	0.2	0.5
		13½-year average				33.6	2.5	9.3	3.7

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches	— —	— — — Tons	— — —
		1945		Oats	30 bu.	37.2	0.9	0.1	0.1
		1946		Cotton	107 lbs.	45.8	4.8	18.8	0.4
	Since 1944, crop rotation cotton, oats (H),	1947		Oats	21 bu.	27.2	0.8	0.9	1.1
	rows down slope or flat.	1948		Cotton	250 lbs.	19.0	2.5	6.9	2.7
		1949		Oats	78 bu.	32.3	0.5	0.3	0.7
		5-year average				32.3	1.9	5.4	2.9
	Since 1949, crop rotation corn, oats (H)	1950		Corn		22.4	0.4	0.4	1.0
	planted flat.	1951		Oats (H)		27.7	0.0	0.0	0.2
		2-year average				25.1	0.2	0.2	0.9
		1931	Oats	Oats	No rec.	23.4	0.1	0.2	2.8
		1932		Cotton	do	31.3	2.2	9.2	4.1
		1933		Corn	26 bu.	25.7	3.7	11.5	0.3
		1934	Oats	Oats	13	29.7	0.5	1.0	2.1
		1935	Vetch	Cotton	360 lbs.	46.7	6.5	27.3	4.2
	Area 1/100 acre, 6 by 72.6 feet.	1936		Corn	45 bu.	39.9	8.6	52.5	6.1
	Land slope, 4 percent.	1937	Oats	Oats	36	28.6	1.7	2.9	1.8
9	Soil, Austin clay.	1938		Cotton	340 lbs.	27.6	3.9	16.0	4.1
	Cropping practice, rotation cotton, corn, oats.	1939		Corn	45 bu.	23.8	2.5	11.8	4.7
	Rows down slope.	1940	Oats	Oats	22	39.9	7.3	13.5	1.9
		1941		Cotton	540 lbs.	43.8	7.6	30.4	4.0
		1942		Corn	7 bu.	36.1	7.8	20.7	2.6
		1943	Oats	Oats	32 bu.	24.6	0.0	0.0	0.5
		1944	(1/2 year)	Cotton		32.7	10.2	35.9	3.5
		13 1/2-year average				33.6	4.6	17.3	3.7
		1945		Hubam	965 lbs.	37.2	2.7	1.2	0.4
		1946		Cotton	90	45.8	5.6	21.7	3.9
	Since 1944, crop rotation cotton, Hubam	1947		Hubam	410	27.2	1.2	0.8	0.6
	rows down slope or flat.	1948		Cotton	241	19.0	1.2	2.8	2.4
		1949		Hubam	240	32.3	0.6	0.7	1.2
		5-year average				32.3	2.2	5.4	2.4
	Since 1949, crop rotation corn, oats,	1950		Corn		22.4	0.2	0.4	1.9
	planted flat.	1951		Oats		27.7	0.0	0.0	0.8
		2-year average				25.1	0.1	0.2	1.8
		1931		Corn	30 bu.	23.4	0.3	0.4	1.6
		1932		Oats	64	31.3	0.0	0.0	1.6
		1933	Oats						
			Vetch						
			A. W. peas						
			Vetch	Cotton	311 lbs.	25.7	0.7	0.8	1.2
		1934		Corn	16 bu.	29.7	2.9	6.7	2.3
	Area 1/100 acre, 6 by 72.6 feet.	1935	Oats	Oats	57	46.7	0.0	0.1	6.3
	Land slope, 4 percent.	1936	Vetch	Cotton	345 lbs.	39.9	4.6	11.1	2.4
10	Soil, Austin clay.	1937		Corn	27 bu.	28.6	1.3	2.0	1.5
	Cropping practice rotation cotton, corn, oats.	1938	Oats	Oats	63	27.6	0.1	0.0	0.4
	Rows on contour from 1931-44.	1939		Cotton	333 lbs.	23.8	0.2	0.6	2.7
		1940		Corn	13 bu.	39.9	5.8	7.4	1.3
		1941	Oats	Oats	27	43.8	1.7	0.3	0.2
		1942		Cotton	252 lbs.	36.1	2.7	4.6	1.7
		1943		Corn	44 bu.	24.6	1.1	2.3	2.1
		1944	(1/2 year)	Oats		32.7	0.2	0.1	0.6
		13 1/2-year average				33.6	1.6	2.7	1.7
		1945		Corn	29 bu.	37.2	2.7	4.2	1.6
		1946		Cotton	69 lbs.	45.8	5.1	24.9	0.5
	Since 1944, crop rotation cotton, corn,	1947		Corn	17 bu.	27.2	2.7	12.2	4.6
	rows down slope or flat.	1948		Cotton	150 lbs.	19.0	2.2	7.6	3.4
		1949		Cotton	256	32.3	2.9	13.6	4.7
		5-year average				32.3	3.1	12.5	4.0
	Crop rotation continuous oats (E).	1950		Oats (E)		22.4	0.5	0.7	1.5
		1951		Oats (E)		27.7	0.0	0.0	1.3
		2-year average				25.1	0.3	0.4	1.5
		1931		Corn	8 bu.	23.4	0.3	0.4	1.1
		1932	Oats	Oats	23	31.3	0.7	1.2	1.9
		1933		Cotton	93 lbs.	25.7	5.5	30.4	5.6
		1934		Corn	00	29.7	3.9	11.7	3.0
	Area 1/100 acre, 6 by 72.6 feet.	1935	Oats	Oats	22 bu.	46.7	9.5	7.1	0.7
	Land slope, 4 percent.	1936		Cotton	110 lbs.	39.9	9.6	60.1	6.2
11	Soil, Austin clay; top 15 inches removed.	1937		Corn	12 bu.	28.6	3.0	10.3	3.4
	Cropping practice rotation, cotton, corn, oats.	1938	Oats	Oats	30	27.6	5.4	4.5	0.8
	Rows down slope or flat.	1939		Cotton	122 lbs.	23.8	3.0	15.4	5.2
		1940		Corn	6 bu.	39.9	10.7	19.0	1.8
		1941	Oats	Oats	22	43.8	11.5	7.2	0.6
		1942		Cotton	55 lbs.	36.1	7.9	20.5	2.6
		1943		Corn	12 bu.	24.6	2.9	4.3	1.5
		1944	Oats	Oats		32.7	3.5	0.6	0.2
		13 1/2-year average				33.6	5.7	14.3	2.5
		1945		Hubam	340 lbs.	37.3	3.2	2.3	0.7
		1946		Cotton	22	45.8	9.6	29.0	3.0
	Crop rotation cotton, Hubam.	1947		Hubam	180	27.2	3.7	3.4	0.9
		1948		Cotton	8	19.0	2.7	6.9	2.5
		1949		Hubam	90	32.3	6.6	8.7	1.3
		5-year average				32.3	5.1	10.1	1.9
	Crop rotation continuous oats (E).	1950		Oats (E)		22.4	1.1	0.5	0.5
		1951		Oats (E)		27.7	0.1	0.1	0.4
		2-year average				25.1	0.6	0.3	0.5
		1931							
		1932		Cotton	(3)				
				Cane	(3)	20.5	(1)	(1)	
		1933		Cotton	(3)				
				Sudan	(3)	25.7	(1)	(2)	

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches	— —	— — — Tons	— — —
		1934		Cotton	(3)				
			Oats	Oats	(3)	29.7	(1)	(2)	
	Area 0.0463 acre, 12 by 168 feet.	1935		Cotton	317 lbs.				
	Land slope, 3½ percent.		Oats	Oats	42 bu.	46.6	0.2	0.1	0.3
12	Soil, Austin clay.	1936		Cotton	217 lbs.				
	Cropping practice, strip-cropped, beginning at			Cane	(3)	39.9	1.3	3.3	2.5
	bottom of plot.	1937		Cotton	212 lbs.				
	24-foot resistant crop, 60-foot cotton.			Sudan	3 tons	28.6	0.1	0.3	2.1
	24-foot resistant crop, 60-foot cotton.	1938		Cotton	241 lbs.				
	Rows on contour, 1931-44.		Oats	Oats	65 bu.	27.6	0.2	0.2	1.1
		1939		Cotton	203 lbs.				
				Cane	5 tons	23.8	0.2	0.7	4.5
		1940		Cotton	252 lbs.				
				Sudan	3 tons	39.9	0.5	0.7	1.3
		1941		Cotton	324 lbs.				
			Oats	Oats	61 bu.	43.8	0.3	0.2	0.8
		1942		Cotton	211 lbs.				
				Cane	5 tons	36.1	1.4	2.1	1.5
		1943		Cotton	408 lbs.				
				Sudan	2 tons	24.6	0.1	0.1	1.7
		1944 (½ year)		Cotton					
				Oats		32.7	2.5	2.1	0.9
		12½-year average				34.5	0.6	0.8	1.4
		1945		Alfalfa	1 ton	37.2	3.2	3.0	0.9
		1946		Cotton	122 lbs.	45.8	3.8	19.4	5.0
	Since 1944, crop rotation cotton, oats, alfalfa.	1947		Oats	36 bu.	27.2	0.3	0.2	0.8
	Rows down slope or flat.	1948		Alfalfa	1 ton	19.0	0.4	0.8	2.0
		1949		Cotton	451 lbs.	32.3	1.5	4.5	3.1
		5-year average				32.3	1.8	5.6	3.1
	Crop rotation corn, oats (E).	1950		Corn		22.4	1.4	4.2	2.9
		1951		Oats (E)	44 bu.	27.7	0.1	0.1	1.2
		2-year average				25.1	0.8	2.2	2.8
		1931							
		1932		Cotton	(3)	20.5	1.6	3.7	2.3
		1933		do	(3)	25.7	1.7	1.8	1.1
		1934		do	(3)	29.8	0.0	0.2	6.3
		1935		do	282 lbs.	46.7	3.8	14.6	3.8
	Area 0.0847 acre, 22 x 168 feet.	1936		do	222	39.9	3.9	18.7	4.7
	Land slope, 3½ percent.	1937		do	218	28.6	0.0	0.1	2.9
[illegible]	Soil, Austin clay.	1938		do	250	27.6	1.6	8.8	5.4
	Cropping practice, continuous cotton.	1939		do	210	23.8	0.7	2.4	3.5
	Rows on contour, 1931-44.	1940		do	213	39.9	0.2	0.6	2.9
		1941		do	320	43.8	1.5	6.1	4.0
		1942		do	244	36.1	2.4	3.9	1.6
		1943		do	506	24.6	0.0	T	
		1944		do	170	50.1	6.9	22.8	3.3
		1945		do	222	37.2	2.7	11.0	4.1
		1946		do	111	45.8	3.6	13.3	3.8
	Since 1944, rows down slope or flat.	1947		do	229	27.2	3.4	10.5	3.1
		1948		do	220	19.0	2.2	5.0	2.3
		1949		do	328	32.3	2.3	8.1	3.5
		5-year average				32.3	2.8	9.6	3.4
		17½-year average				33.9	2.2	7.5	3.4
		1950		Oats (E)		22.4	0.7	0.7	0.9
	Crop rotation corn, oats (E), oats (E).	1951		Oats (E)		27.7	0.0	0.0	0.2
		2-year average				25.1	0.4	0.3	0.9
		1931							
		1932		Cotton	(3)	20.5	0.8	13.7	16.7
		1933		do	(3)	25.7	4.1	6.4	1.6
		1934		do	(3)	29.7	5.2	13.4	2.5
		1935		do	226 lbs.	46.7	7.5	23.9	3.2
	Area 0.0309 acre, 8 x 168 feet.	1936		do	230	39.9	7.7	31.7	4.1
	Land slope, 3½ percent.	1937		do	302	28.6	0.3	0.4	1.4
	Soil, Austin clay.	1938		do	227	27.6	3.1	12.0	3.8
	Cropping practice continuous cotton.	1939		do	187	23.8	2.3	7.3	3.2
	Rows down slope or flat.	1940		do	207	39.9	6.1	14.0	2.3
		1941		do	288	43.8	7.3	29.2	4.0
		1942		do	218	36.1	2.7	6.3	2.3
		1943		do	412	24.6	1.8	3.0	1.7
		1944		do	140	50.1	9.8	26.8	2.7
		1945		do	164	37.2	5.1	13.1	2.6
		1946		do	49	45.8	7.1	19.4	2.7
		1947		do	202	27.2	3.2	8.1	2.5
		1948		do	189	19.0	2.3	10.7	4.6
		1949		do	281	32.3	3.6	7.7	2.2
		5-year average				32.3	4.3	11.8	2.8
		17½-year average				33.9	4.5	14.0	3.1
	Since 1949, crop rotation corn, oats	1950		Oats (E)		22.4	0.6	0.6	0.9
	with Evergreen clover.	1951		Corn	44 bu.	27.7	0.1	0.1	0.5
		2-year average				25.1	0.4	0.3	0.8
		1931							
		1932		Cotton	(3)				
	Area 0.0847 acre, 22 by 168 feet.			Cane	(3)	20.5	(1)	(2)	
	Land slope, 3½ percent.	1933		Cotton	(3)				
	Soil, Austin clay.		Oats	Oats	(3)	25.7	(1)	(2)	
	Cropping practice, strip-cropped	1934		Cotton	(3)				
	beginning at bottom of plot.			Guar	(3)	29.7	0.0	0.3	13.0
	24 feet resistant crop, 60 feet cotton, 24 feet	1935		Cotton	240 lbs.				
	resistant crop, 60 feet cotton.			Sudan	(3)	46.7	2.0	1.9	0.9
	Rows on contour, 1931-44.	1936		Cotton	225				
			Oats	Oats	46 bu.	39.9	1.4	1.3	0.9

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	Inches	Inches	Tons	Tons
		1937		Cotton	262 lbs.				
				Sudan	3 tons	28.6	0.3	0.7	2.2
		1938		Cotton	221 lbs.				
				Cane	6 tons	27.6	1.2	2.7	2.2
		1939		Cotton	186 lbs.				
			Oats	Oats	25 bu.	23.8	0.0	0.0	0.0
		1940		Cotton	207 lbs.				
				Cane	6 tons	39.9	0.2	0.2	1.1
		1941		Cotton	286 lbs.				
				Sudan	3 tons	43.8	0.8	1.8	2.1
		1942		Cotton	234 lbs.				
			Oats	Oats	No yld.	36.1	1.0	0.7	0.7
		1943		Cotton	446 lbs.				
				Cane	3 tons	24.6	0.1	0.1	1.6
		1944		Cotton					
				Sudan		32.7	5.7	0.0	1.6
		12½-year average				31.1	1.1	1.5	1.5
		1945		Oats	40 bu.	37.2	0.9	0.1	0.1
		1946		Alfalfa	2 tons	45.8	2.2	0.9	0.4
	Since 1944, crop rotation cotton, oats, alfalfa. Rows down slope or flat.	1947		Cotton	225 lbs.	27.2	2.7	5.3	2.0
		1948		Oats	47 bu.	19.0	0.3	0.2	0.7
		1949		Alfalfa	1 ton	32.3	0.3	2.1	8.1
		5-year average				32.3	1.3	1.7	1.4
	Crop rotation corn, oats (E), oats (E).	1950		Corn		22.4	0.8	1.1	1.4
		1951		Oats (E)		27.7	0.1	0.0	0.5
		2-year average				25.1	0.4	0.6	1.4
		1932		Cotton	(3)				
				Sudan	(3)	20.5	(1)	(2)	
		1933		Cotton	(3)				
			Oats	Oats	(3)	25.7	(1)	(2)	
		1934		Cotton	(3)				
				Sudan	(3)	29.7	0.1	0.2	2.1
		1935		Cotton	220 lbs.				
				Cane	(3)	46.7	1.1	0.9	0.8
		1936		Cotton	221 lbs.				
				Sudan	(3)	39.9	1.1	0.6	0.5
		1937		Cotton	438 lbs.				
			Oats	Oats	22 bu.	28.6	0.1	0.1	0.7
16	Area 0.0503 acre, 13 by 168 feet. Land slope, 3½ percent. Soil, Austin clay. Cropping practice, strip-cropped beginning at bottom of plot. 24 feet resistant crop, 60 feet cotton, 24 feet resistant crop, 60 feet cotton. Rows on contour, 1931-44.	1938		Cotton	217 lbs.				
				Sudan	5 tons	27.6	0.8	1.4	1.9
		1939		Cotton	189 lbs.				
				Sudan	3 tons	23.8	0.1	0.2	2.2
		1940		Cotton	245 lbs.				
			Oats	Oats	14 bu.	39.9	0.5	0.6	1.4
		1941		Cotton	310 lbs.				
				Cane	6 tons	43.8	0.7	1.6	2.1
		1942		Cotton	220 lbs.				
				Sudan	3 tons	36.1	1.1	0.7	0.8
		1943		Cotton	431 lbs.				
			Oats	Oats	7 bu.	24.6	0.1	0.1	0.8
		1944		Cotton					
				Cane		32.7	5.7	6.4	1.1
		12.17-year average				34.5	0.9	1.1	1.1
		1945		Cotton	228 lbs.	37.2	4.2	6.1	1.4
		1946		Oats	39 bu.	45.8	0.2	0.1	0.6
	Since 1944, crop rotation cotton, oats, alfalfa. Rows down slope or flat.	1947		Alfalfa	2 tons	27.2	0.2	0.4	1.7
		1948		Cotton	172 lbs.	19.0	1.1	1.3	1.2
		1949		Oats	79 bu.	32.3	0.1	0.0	0.2
		5-year average				32.3	1.2	1.6	1.4
	Crop rotation corn, oats (E), oats (E).	1950		Oats (E)		22.4	0.1	0.0	0.4
		1951		Corn	45 bu.	27.7	0.4	0.3	0.8
		2-year average				25.1	0.2	0.2	0.7
		1933		Cotton	(3)				
			Vetch	Cane	(3)	25.2	1.2	0.7	0.6
		1934		Cotton	176 lbs.				
			Vetch	Sudan	(3)	30.1	0.3	0.5	1.7
		1935		Cotton	164 lbs.				
			Vetch	Sudan	(3)	45.3	5.2	2.5	0.5
		1936		Cotton	160 lbs.				
			Vetch	Sudan	(3)	39.0	2.3	0.9	0.4
		1937		Cotton	327 lbs.				
17	Area 0.0505 acre, 17 by 129.5 feet. Land slope, 2 percent. Soil, Houston Black clay. Cropping practice, strip-cropped beginning at bottom of plot. 30 feet resistant crop, 99.5 feet cotton. Rows on contour, 1931-44.		Vetch	Sudan	4 tons	29.2	1.0	0.6	0.6
		1938		Cotton	292 lbs.				
			Oats	Oats	78 bu.	27.6	0.9	0.3	0.4
		1939		Cotton	266 lbs.				
				Cane	1 ton	24.4	0.4	0.2	0.5
		1940		Cotton	333 lbs.				
				Sudan	2 tons	39.9	0.6	0.4	0.6
		1941		Cotton	303 lbs.				
			Oats	Oats	23 bu.	43.4	1.3	0.4	0.3
		1942		Cotton	203 lbs.				
				Cane	4 tons	37.2	2.9	1.7	0.6
		1943		Cotton	478 lbs.				
				Sudan	1 ton	24.2	0.1	0.1	2.0
		1944 (½ year)		Cotton					
				Oats		32.8	5.0	2.5	0.5
		11½-year average				34.6	1.8	0.9	0.5
		1945		Oats (H)	42 bu.	37.9	4.1	1.2	0.3
		1946		Oats (H)	42 bu.	45.0	0.1	0.1	0.8
	Since 1944, crop rotation continuous oats (Hubam). Rows flat.	1947		Oats (H)	27 bu.	28.4	0.4	0.1	0.3
		1948		Oats (H)	5 bu.	19.6	0.4	0.1	0.2
		1949		Oats (H)	69 bu.	32.8	1.1	0.5	0.4
		5-year average				32.7	1.2	0.4	0.3

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches — —		— — — Tons — — —	
	Crop rotation corn, oats (E).	1950		Oats (E)		21.3	0.7	0.4	0.6
		1951		Corn	30 bu.	27.5	0.6	0.4	0.6
		2-year average				24.4	0.7	0.4	0.6
		1933	Grass	None	None	25.2	(1)	(2)	
		1934	do	do	do	30.1	(1)	(2)	
		1935	do	do	do	45.3	1.3	0.4	0.3
	Area 0.0286 acre, 9 by 138.35 feet.	1936	do	do	do	39.1	(1)	(2)	
	Land slope, 2 percent.	1937	do	do	do	29.2	(1)	(2)	
18	Soil, Houston Black clay.	1938	do	do	do	27.6	0.2	0.0	0.1
	Cropping practice, continuous	1939	do	do	do	24.4	(1)	(2)	
	Bermudagrass, clipped.	1940	do	do	do	39.9	(1)	(2)	
		1941	do	do	do	43.4	2.2	0.3	0.1
		1942	do	do	do	37.2	0.2	0.1	0.3
		1943	do	do	do	24.2	(1)	(2)	
		1944	do	do	do	50.2	1.3	0.1	0.1
		1945	do	do	do	37.9	1.6	0.2	0.1
		1946	do	do	do	45.0	0.3	0.2	0.6
		1947	do	do	do	28.4	(1)	(2)	
		1948	do	do	do	19.6	0.2	0.1	0.3
		1949	do	do	do	32.8	0.3	0.0	0.1
		5-year average				32.7	0.5	0.1	0.2
		1950	do	do	do	21.3	(1)	(2)	
		1951	do	do	do	27.5	(1)	(2)	
		2-year average				24.4	0	0	
		19-year average				33.1	0.4	0.1	0.2
		1933		Cotton	No rec.	25.2	1.5	2.8	1.9
		1934		Corn	22 bu.	30.1	2.6	7.4	2.8
		1935	Oats	Oats	42 bu.	45.3	1.1	0.8	0.7
	Area 0.0286 acre, 9 by 138.35 feet.	1936		Cotton	413 lbs.	39.0	6.2	17.2	2.8
	Land slope, 2 percent.	1937		Corn	37 bu.	29.2	0.8	1.1	1.3
19	Soil, Houston Black clay.	1938	Oats	Oats	71	27.6	0.1	0.1	0.6
	Cropping practice, 3-year rotation	1939		Cotton	230 lbs.	24.4	1.4	2.2	1.5
	cotton, corn, oats.	1940		Corn	34 bu.	39.9	2.9	3.7	1.3
	Rows down slope.	1941	Oats	Oats	46 bu.	43.4	0.9	0.4	0.4
		1942		Cotton	236 lbs.	37.2	4.8	12.7	2.6
		1943		Corn	28 bu.	24.2	1.0	1.5	1.5
		1944	Oats	Oats (½ yr.)		32.8	4.1	1.4	0.3
		11½-year average				34.6	2.4	4.4	1.9
		1945		Oats	24 bu.	37.9	2.9	0.9	0.3
	Crop rotation continuous oats.	1946		Oats	38	45.0	0.4	0.2	0.6
	Rows flat.	1947		Oats	25	28.4	0.1	0.1	0.4
		1948		Oats	41	19.6	1.0	0.7	0.7
		1949		Oats	45	32.8	1.0	0.5	0.5
		5-year average				32.7	1.1	0.5	0.4
	Crop rotation corn, oats (E), oats (E).	1950		Corn		21.3	0.7	0.4	0.6
		1951		Oats (E)		27.5	0.5	0.3	0.5
		2-year average				24.4	0.6	0.3	0.5
		1933		Corn	27 bu.	25.2	2.6	2.9	1.1
		1934	Oats	Oats	28 bu.	30.1	0.9	1.2	1.3
		1935		Cotton	735 lbs.	45.3	6.8	11.5	1.7
	Area 0.0286 acre, 9 by 138.35 feet.	1936		Corn	49 bu.	39.0	5.7	13.6	2.4
	Land slope, 2 percent.	1937	Oats	Oats	50	29.2	0.2	0.4	2.1
20	Soil, Houston Black clay.	1938		Cotton	289 lbs.	27.6	3.4	9.0	2.7
	Cropping practice, 3-year rotation	1939		Corn	38 bu.	24.4	1.0	1.1	1.1
	cotton, corn, oats.	1940	Oats	Oats	20	39.9	4.0	2.4	0.6
	Rows down slope.	1941		Cotton	301 lbs.	43.4	6.0	10.0	1.7
		1942		Corn	31 bu.	37.2	4.8	11.2	2.3
		1943	Oats	Oats	39	24.2	0.1	0.2	1.4
		1944	(½ year)	Cotton		32.8	10.0	24.8	2.5
		11½-year average				34.6	4.0	7.7	1.9
		1945		Corn	26 bu.	37.9	3.9	3.6	0.9
	Cropping rotation continuous corn with	1946		Corn	36	45.0	2.8	3.5	1.3
	Hubam clover winter green manure.	1947		Corn	26	28.4	0.9	0.6	0.7
	Rows down slope or flat.	1948		Corn	24	19.6	1.1	1.1	1.0
		1949		Corn	37	32.8	2.6	3.7	1.4
		5-year average				32.7	2.3	2.5	1.1
		1950		Corn		21.3	0.4	0.2	0.6
	Crop rotation corn, oats (E).	1951		Oats (E)		27.5	0.5	0.4	0.7
		1952		Corn	32 bu.				
		2-year average				24.4	0.5	0.3	0.6
		1933	Oats	Oats	16 bu.	25.2	1.7	2.2	1.3
		1934		Cotton	254 lbs.	30.1	3.9	12.3	3.1
		1935		Corn	43 bu.	45.3	9.1	17.0	1.9
	Area 0.0286 acre, 9 by 138.35 feet.	1936	Oats	Oats	40	39.0	2.0	1.1	0.6
	Land slope, 2 percent.	1937		Cotton	474 lbs.	29.2	0.3	0.4	1.2
21	Soil, Houston Black clay.	1938		Corn	49 bu.	27.6	2.5	6.4	2.5
	Cropping practice, 3-year rotation	1939	Oats	Oats	54	24.4	(1)	(2)	
	cotton, corn, oats.	1940		Cotton	234 lbs.	39.9	4.3	3.8	0.9
	Rows down slope.	1941		Corn	36 bu.	43.4	5.5	11.7	2.1
		1942		Oats	37	37.2	0.1	0.2	1.4
		1943		Cotton	378 lbs.	24.2	1.2	2.1	1.7
		1944	(½ year)	Corn		32.8	8.7	18.0	2.1
		11½-year average				34.6	3.4	6.5	1.9
		1945		Cotton	342 lbs.	37.9	4.9	7.6	1.5
	Since 1947, crop rotation continuous with	1946		Cotton	306	45.0	4.1	6.2	1.5
	Hubam clover for winter green manure.	1947		Cotton	237	28.4	2.6	5.4	2.1
	Rows flat.	1948		Cotton	157	19.6	2.1	3.0	1.4
		1949		Cotton	376	32.8	4.5	9.8	2.2
		5-year average				32.7	3.6	6.4	1.8

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	Inches		Tons	
	Crop rotation, corn, oats (E), oats (E).	1950		Oats (E)		21.3	0.4	0.2	0.6
		1951		Corn	44 bu.	27.5	0.8	0.4	0.5
		2-year average				24.4	0.6	0.3	0.5
		1933		Corn	26 bu.	25.2	2.9	5.1	1.8
		1934		do	19	30.1	3.1	6.1	2.0
		1935		do	33	45.3	6.2	12.4	2.0
	Area 0.0286 acre, 9 by 138.35 feet.	1936		do	39	39.0	6.5	18.9	3.0
	Land slope, 2 percent.	1937		do	35	29.2	0.5	0.9	1.8
22	Soil, Houston Black clay.	1938		do	34	27.6	2.6	7.4	2.9
	Cropping practice continuous corn.	1939		do	29	24.4	1.0	1.4	1.3
	Rows down slope.	1940		do	31	39.9	4.5	4.9	1.1
		1941		do	24	43.4	5.5	13.5	2.4
		1942		do	29	37.2	7.3	14.1	1.9
		1943		do	29	24.2	1.5	3.8	2.6
		1944		do	18	50.2	9.4	22.4	2.4
	Since 1947, rows flat.	1945		do	22	37.9	4.8	11.3	2.4
		1946		do	23	45.0	6.5	10.8	1.7
		1947		do	27	28.4	2.8	4.5	1.6
		1948		do	14	19.6	2.1	3.1	1.5
		1949		do	21	32.8	4.2	8.8	2.1
		5-year average			21 bu.	32.7	4.1	7.7	1.9
		8-year average			23	34.4		9.8	
		17-year average (1933 to 1949)				34.1	4.2	8.8	2.1
		1950		Oats (E)		21.3	0.7	0.4	0.6
	Crop rotation corn, oats (E), oats (E).	1951		Oats (E)		27.5	0.2	0.1	0.4
		1952		Corn	31 bu.				
		2-year average				24.4	0.5	0.3	0.6
	Area, 1.5 acres, 151 by 432 feet.	1939		Cotton	787 lbs.	22.8	0.7	0.9	1.2
	Land slope, 2.31 percent.	1940		Oats	23 bu.	40.5	4.4	3.0	0.7
P-1	Soil, 100% Houston Black clay.	1941		Corn	39	41.3	5.1	5.9	1.1
	Cropping practice 3-year rotation cotton, oats, corn.	1942		Cotton	494 lbs.	36.3	3.3	2.7	0.8
	Guide lines 108 feet apart.	1943		Oats	31 bu.	25.1	0.5	0.2	0.3
	Rows on contour.	1944		Corn	14	48.8	4.6	11.7	2.5
		6-year average				35.8	3.1	4.1	1.3
		1945		Oats	21 bu.	37.8	4.0	0.9	0.2
	Crop rotation oats, corn, Hubam.	1946		Corn	31	43.3	2.7	1.8	0.7
	Conventional plowing.	1947		Hubam	380 lbs.	26.3	0.7	0.2	0.3
		1948		Oats		19.8	1.0	1.5	1.5
		4-year average				31.8	2.1	1.1	0.5
	Crop rotation cotton, oats (clover).	1949		Cotton		33.1	2.2	4.0	1.9
	Residue turned under.	1950		Oats (C)		21.7	0.2	0.1	0.8
		1951		Cotton		26.6	0.8	2.2	2.6
		3-year average				27.1	1.1	2.1	2.0
		1939		Corn	35 bu.				
			Oats	Oats	42				
	Area 1.5 acres, 151 by 432 feet.			Cotton	612 lbs.	22.8	0.0	0.0	1.4
	Land slope, 2.31 percent.	1940		do	572				
P-2	Soil, 100% Houston Black clay.			Corn	34 bu.				
	Cropping practice 3-year rotation		Oats	Oats	19	40.5	3.7	1.2	0.3
	cotton, oats, corn.	1941		do	33				
	Strip-cropped 36-foot strips.			Cotton	554 lbs.				
	Guide lines 108 feet apart.			Corn	36 bu.	41.3	3.7	2.1	0.6
	Rows on contour.	1942		Cotton	642 lbs.				
				Corn	21 bu.				
				Oats	20	36.3	2.4	1.9	0.8
		1943		Cotton	412 lbs.				
				Corn	22 bu.				
				Oats	31	25.1	0.3	0.2	0.7
		1944		Cotton	256 lbs.				
				Corn	11 bu.				
				Oats	25	48.8	3.7	4.6	1.2
		6-year average				35.8	2.3	1.7	0.7
		1945		Corn	23 bu.	37.8	3.8	4.3	1.1
	Crop rotation oats, corn, Hubam.	1946		Hubam	355 lbs.	43.3	3.7	1.6	0.4
	Residue on surface.	1947		Oats	22 bu.	26.3	1.3	0.4	0.3
		1948		Corn		19.8	0.4	0.6	1.5
		4-year average				31.8	2.3	1.7	0.7
	Crop rotation cotton, oats (clover), oats	1949		Cotton		33.1	0.8	1.7	2.3
	(clover).	1950		Oats (C)		21.7	0.1	0.1	0.8
	Residue removed.	1951		Cotton		26.6	0.7	0.9	1.3
		3-year average				27.1	0.5	0.9	1.7
		1939	Oats	Oats	49 bu.				
				Cotton	804 lbs.				
				Corn	36 bu.	22.8	0.1	0.1	1.3
		1940		do	32				
	Area 1.5 acres, 151 by 432 feet.		Oats	Oats	40				
	Land slope, 2.78 percent.			Cotton	409 lbs.	40.5	3.3	1.5	0.4
P-3	Soil, 77% Houston Black clay, 23% Austin clay.	1941		do	427				
	Cropping practice, 3-year rotation			Corn	28 bu.				
	cotton, oats, corn.			Oats	57	41.3	4.0	1.6	0.4
	Strip-cropped, 36-foot strips.	1942		Cotton	522 lbs.				
	Guide lines 108 feet apart.			Corn	29 bu.				
	Rows on contour.			Oats	25	36.3	2.9	1.5	0.5
		1943		Cotton	502 lbs.				
				Corn	25 bu.				
				Oats	25	25.1	0.6	0.3	0.5
		1944		Cotton	272 lbs.				
				Corn	16 bu.				
				Oats	20	48.8	4.3	2.9	0.7
		6-year average				35.8	2.5	1.3	0.5

Table 17. **Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)**

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches — —		— — — Tons — — —	
		1945		Hubam	130 lbs.	37.8	4.5	2.4	0.5
	Crop rotation Hubam, oats, corn.	1946		Oats	28 bu.	43.3	1.2	0.1	0.1
	Residue on surface.	1947		Corn	3	26.3	1.5	1.0	0.7
		1948		Hubam		19.8	0.5	0.3	0.6
		4-year average				31.8	1.9	1.0	0.5
	Crop rotation cotton, oats (clover).	1949		Cotton		33.1	3.0	4.3	1.4
	Residue on top.	1950		Oats (C)		21.7	0.2	0.1	0.6
		1951		Cotton		26.6	1.3	2.5	1.9
		3-year average				27.1	1.5	2.3	1.5
	Area, 1.5 acres, 151 by 432 feet.	1939		Corn	29 bu.	22.8	0.7	2.5	3.7
	Land slope, 3.01 percent.	1940		Cotton	561 lbs.	40.5	4.6	13.6	3.0
P-4	Soil, 44% Houston Black clay, 56% Austin clay.	1941	Oats	Oats	43 bu.	41.3	4.4	4.6	1.1
	Cropping practice, 3-year rotation cotton,	1942		Corn	25	36.3	3.4	11.8	3.4
	oats, corn.	1943		Cotton	536 lbs.	25.1	0.7	2.4	3.5
	Guide lines 108 feet apart.	1944		Oats	28 bu.	48.8	3.7	2.2	0.6
	Rows on contour.	6-year average				35.8	2.9	6.2	2.1
		1945		Hubam	155 lbs.	37.8	4.5	5.9	1.3
	Crop rotation Hubam, oats, corn.	1946		Oats	22 bu.	43.3	1.3	0.5	0.4
	Conventional plowing.	1947		Corn	7 bu.	26.3	1.4	3.8	2.8
		1948		Hubam		19.8	0.6	0.7	1.2
		4-year average				31.8	1.9	2.7	1.4
	Crop rotation cotton, oats (clover),	1949		Oats (C)		33.1	0.2	0.1	0.6
	oats (clover).	1950		Cotton		21.7	0.5	0.6	1.4
	Residue removed.	1951		Oats (C)		26.6	0.4	0.2	0.4
		3-year average				27.1	0.3	0.3	0.9
		1939		Cotton	463 lbs.				
				Corn	24 bu.				
			Oats	Oats	30	22.8	0.1	0.1	0.5
		1940		do	31				
				Cotton	549 lbs.				
				Corn	25 bu.	40.5	4.4	4.1	0.9
	Area, 1.5 acres, 151 by 432 feet.	1941		do	24				
	Land slope, 3.01 percent.			Oats	33				
P-5	Soil, 56% Houston Black clay, 44% Austin clay.			Cotton	656 lbs.	41.3	3.5	3.4	1.0
	Cropping practice, 3-year rotation	1942		do	374				
	cotton, oats, corn.			Corn	19 bu.				
	Strip-cropped, 36-foot strips.			Oats	5	36.3	4.0	2.1	0.5
		1943		Cotton	288 lbs.				
				Corn	18 bu.				
				Oats	14	25.1	0.7	1.1	1.5
		1944		Cotton	182 lbs.				
				Corn	10 bu.				
				Oats	21 bu.	48.8	4.3	7.1	1.6
		6-year average				35.8	2.8	3.0	1.0
		1945		Oats	20 bu.	37.8	5.1	2.0	0.4
	Crop rotation oats, corn, Hubam.	1946		Corn	21	43.3	3.7	5.0	1.4
	Residue on surface.	1947		Hubam	347 lbs.	26.3	2.2	1.2	0.6
		1948		Oats		19.8	0.6	0.7	1.3
		4-year average				31.8	2.9	2.2	0.8
	Crop rotation cotton, oats (clover).	1949		Oats (C)		33.1	0.0	0.0	1.0
	Residue turned under.	1950		Cotton		21.7	0.2	0.3	1.2
		1951		Oats (C)		26.6	0.0	0.1	2.2
		3-year average				27.1	0.1	0.1	1.3
	Area, 1.5 acres, 151 by 432 feet.	1939	Oats	Oats	41 bu.	22.8	0.0	0.0	0.5
	Land slope, 3.01 percent.	1940		Corn	26	40.5	6.7	10.0	1.5
P-6	Soil, 90% Houston Black clay, 10% Austin clay.	1941		Cotton	470 lbs.	41.3	5.2	7.4	1.4
	Cropping practice, 3-year rotation	1942	Oats	Oats	8 bu.	36.3	3.9	1.4	0.4
	cotton, oats, corn.	1943		Corn	21	25.1	0.7	0.9	1.2
	Guide lines 108 feet apart.	1944		Cotton	271 lbs.	48.8	5.2	20.0	4.0
	Rows on contour.	6-year average				35.8	3.7	6.8	1.9
		1945		Corn	16 bu.	37.8	5.3	10.1	1.9
	Crop rotation corn, Hubam, oats.	1946		Hubam	267 lbs.	43.3	2.0	1.0	0.5
	Conventional plowing.	1947		Oats	27 bu.	26.3	1.4	0.8	0.6
		1948		Corn		19.8	0.2	2.7	14.3
		4-year average				31.8	2.2	3.7	1.7
	Crop rotation cotton, oats (clover).	1949		Oats (C)		33.1	0.0	0.0	0.9
	Residue on top.	1950		Cotton		21.7	0.2	0.1	0.6
		1951		Oats (C)		26.6	0.0	0.1	2.2
		3-year average				27.1	0.1	0.1	0.9
	Area, 1.5 acres, 151 by 432 feet.	1939		Oats	30 bu.	23.0	(1)	(2)	
	Land slope, 2.31 percent.	1940		Corn	40	40.6	0.8	0.7	1.0
O-1	Soil, 100% Houston Black clay.	1941		Cotton	948 lbs.	41.9	1.7	2.5	1.4
	Cropping practice, 3-year rotation	1942	Oats	Oats	7 bu.	36.4	1.2	0.5	0.4
	cotton, oats, corn.	1943		Corn	22 bu.	25.1	0.3	0.2	0.7
	Guide line 108 feet apart.	1944		Cotton	343 lbs.	49.4	3.3	8.8	2.7
	Rows on contour.	6-year average				36.0	1.2	2.1	1.7
		1945		Oats	29 bu.	38.1	3.3	0.8	0.2
	Crop rotation oats, corn, clover.	1946		Corn	33	44.5	3.4	2.8	0.8
	Residue on surface.	1947		Hubam	433 lbs.	27.4	0.6	0.7	1.0
	Rows on contour.	1948		Oats (C)		19.6	1.2	1.5	1.3
		4-year average				32.4	2.1	1.4	0.7
	Crop rotation cotton, oats (clover).	1949		Cotton		32.7	2.1	5.0	2.4
	Residue on top.	1950		Oats (C)		22.0	0.1	0.1	0.8
	Rows on contour.	1951		Cotton		27.1	1.3	4.6	3.4
		3-year average				27.3	1.2	3.2	2.7

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches — —		— — — Tons — — —	
	Area, 1.5 acres, 151 by 432 feet.	1939		Corn	33 bu.	23.0	0.0	0.0	0.6
	Land slope, 1.85 percent.	1940		Cotton	687 lbs.	40.6	1.6	0.7	0.4
O-2	Soil, 100% Houston Black clay.	1941	Oats	Oats	61 bu.	41.9	3.2	0.9	0.3
	Cropping practice, 3-year rotation	1942		Corn	33	36.4	1.8	1.6	0.9
	cotton, oats, corn.	1943		Cotton	737 lbs.	25.1	0.0	0.0	0.9
	Guide rows 108 feet apart.	1944	Oats	Oats	44 bu.	49.4	2.7	0.8	0.3
	Rows on contour.	6-year average				36.0	1.6	0.7	0.4
		1945		Hubam	123 lbs.	38.1	3.1	1.4	0.5
	Crop rotation Hubam, oats, corn.	1946		Oats	28 bu.	44.5	0.7	0.1	0.2
	Residue on surface.	1947		Corn	11	27.4	1.9	1.4	0.8
	Rows on contour.	1948		Hubam		19.6	0.6	0.5	0.7
		4-year average				32.4	1.6	0.9	0.5
	Crop rotation cotton, oats (clover), oats (c).	1949		Cotton		32.7	2.4	5.0	2.1
	Residue removed.	1950		Oats (C)		22.0	0.1	0.0	0.4
	Rows on contour.	1951		Cotton		27.1	0.9	1.8	2.1
		3-year average				27.7	1.1	2.3	2.0
		1939	Oats	Oats	28 bu.				
				Cotton	566 lbs.				
				Corn	35 bu.	23.0	0.1	0.1	1.5
		1940		do	35				
			Oats	Oats	21				
	Area, 1.5 acres, 151 by 432 feet.			Cotton	456 lbs.	40.6	1.1	0.3	0.2
	Land slope, 2.08 percent.	1941		do	621				
O-3	Soil, 100% Houston Black clay.			Corn	36 bu.				
	Cropping practice, 3-year rotation		Oats	Oats	57	41.9	2.1	0.6	0.3
	cotton, oats, corn.	1942		Cotton	624 lbs.				
	Strip-cropped 36-foot strips.			Corn	33 bu.				
	Guide lines 108 feet apart.		Oats	Oats	16	36.4	1.1	1.1	0.9
	Rows on contour.	1943		Cotton	480 lbs.				
				Corn	22 bu.				
			Oats	Oats	30	25.1	0.0	0.0	0.6
		1944		Cotton	412 lbs.				
				Corn	22 bu.				
			Oats	Oats	38	49.4	3.1	1.7	0.5
		6-year average				36.0	1.2	0.6	0.5
		1945		Oats	22 bu.	38.1	3.0	1.4	0.5
	Crop rotation corn, Hubam, oats (clover).	1946		Corn	34	44.5	2.1	2.1	1.0
	Conventional plowing.	1947		Hubam	553 lbs.	27.4	0.6	0.2	0.4
		1948		Oats		19.6	0.6	0.5	0.8
		4-year average				32.4	1.6	1.0	0.7
	Crop rotation cotton, oats (clover).	1949		Cotton		32.7	1.8	2.3	1.3
	Residue turned under.	1950		Oats (C)		22.0	0.1	0.0	0.4
		1951		Cotton		27.1	0.9	0.9	1.0
		3-year average				27.3	0.9	1.1	1.1
	Area, 1.5 acres, 151 by 432 feet.	1939		Cotton	795 lbs.	23.0	0.3	0.3	0.9
	Land slope, 2.08 percent.	1940	Oats	Oats	23 bu.	40.6	4.2	1.4	0.3
O-4	Soil, 100% Houston Black clay.	1941		Corn	40	41.9	3.5	3.0	0.9
	Cropping practice, 3-year rotation	1942		Cotton	619 lbs.	36.4	2.4	2.1	0.8
	cotton, oats, corn.	1943		Oats	31 bu.	25.1	0.5	0.1	0.2
	Guide lines 108 feet apart.	1944		Corn	19	49.4	4.2	5.7	1.3
	Rows on contour.	6-year average				36.0	2.5	2.1	0.8
		1945		Corn	26 bu.	38.1	3.5	2.2	0.6
	Crop rotation corn, Hubam, oats.	1946		Hubam	275 lbs.	44.5	1.9	0.6	0.3
	Conventional plowing.	1947		Oats (H)	39 bu.	27.4	1.3	0.6	0.5
		1948		Corn		19.6	0.2	0.2	1.1
		4-year average				32.4	1.7	0.9	0.5
	Crop rotation cotton, oats (clover).	1949		Oats (C)		32.7	0.0	0.0	0.0
	Residue on top.	1950		Cotton		22.0	0.1	0.1	0.1
		1951		Oats (C)		27.1	0.0	0.0	0.0
		3-year average				27.3	0.0	0.0	1.0
		1939		Cotton	558 lbs.				
				Corn	33 bu.				
			Oats	Oats	29	23.0	0.1	0.2	1.5
		1940		do	27				
				Cotton	542 lbs.				
	Area, 1.5 acres, 151 by 432 feet.			Corn	34 bu.	40.6	1.3	0.9	0.7
	Land slope, 2.31 percent.	1941		do	28				
O-5	Soil, 100% Houston Black clay.		Oats	Oats	63				
	Cropping practice, 3-year rotation			Cotton	629 lbs.	41.9	2.3	1.0	0.4
	cotton, oats, corn.	1942		do	804				
	Strip-cropped, 36-foot strips.			Corn	28 bu.				
	Guide lines 108 feet apart.		Oats	Oats	15	36.4	1.6	1.7	1.1
	Rows on contour.	1943		Cotton	521 lbs.				
				Corn	17 bu.				
			Oats	Oats	42	25.1	0.2	0.1	0.5
		1944		Cotton	266 lbs.				
				Corn	15 bu.				
			Oats	Oats	28	49.4	3.7	6.5	1.8
		6-year average				36.0	1.5	1.7	1.1
		1945		Corn	17 bu.	38.1	3.4	4.8	1.4
	Crop rotation corn, Hubam, oats (Hubam).	1946		Hubam	233 lbs.	44.5	4.4	3.1	0.7
	Residue on surface.	1947		Oats (H)	22 bu.	27.4	1.9	0.9	0.5
		1948		Corn		19.6	0.5	1.9	3.5
		4-year average				32.4	2.6	2.7	1.0
	Crop rotation cotton, oats (clover).	1949		Oats (C)		32.7	0.0	0.0	0.0
	Residue turned under.	1950		Cotton		22.0	0.1	0.1	0.8
		1951		Oats (C)		27.1	0.0	0.0	1.0
		3-year average				27.3	0.1	0.1	0.8

Table 17. **Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)**

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	Inches		Tons	
		1939		Cotton	596 lbs.				
				Corn	33 bu.				
				Oats	35	23.0	0.0	(8)	
		1940		do	28				
				Cotton	639 lbs.				
	Area, 1.5 acres, 151 by 432 feet.			Corn	37 bu.	40.6	3.5	0.8	0.2
	Land slope, 1.39 percent.	1941		do	34				
[illegible]-6	Soil, 100% Houston Black clay.			Oats	44				
	Cropping practice, 3-year rotation			Cotton	829 lbs.	41.9	3.9	1.2	0.3
	cotton, oats, corn.	1942		do	566				
	Strip-cropped, 36-foot strips.			Corn	23 bu.				
	Guide lines 108 feet apart.			Oats	22	36.4	2.1	0.9	0.5
	Rows on contour.	1943		Cotton	737 lbs.				
				Corn	27 bu.				
				Oats	22	25.1	0.0	0.0	1.2
		1944		Cotton	252 lbs.				
				Corn	10 bu.				
				Oats	27	49.4	3.9	3.3	0.8
		6-year average				36.0	2.2	1.0	0.5
		1945		Hubam	180 lbs.	38.1	4.2	1.6	0.4
	Crop rotation Hubam, oats, corn.	1946		Oats	35 bu.	44.5	0.5	0.1	0.1
	Conventional plowing.	1947		Corn	16	27.4	1.3	0.9	0.7
		1948		Hubam		19.6	0.1	0.1	0.7
		4-year average				32.4	1.6	0.7	0.4
	Crop rotation cotton, oats (clover), oats	1949		Oats (C)		32.7	0.0	0.0	
	(clover).	1950		Cotton		22.0	0.0	0.0	1.2
	Residue removed.	1951		Oats (C)		27.1	0.0	0.0	
		3-year average				27.3	0.0	0.0	1.3
		1931		Corn	15 bu.	24.7	0.3	0.1	0.3
		1932		Cotton	227 lbs.	33.1	1.0	1.4	1.4
		1933	Oats	Oats	6 bu.	25.3	2.2	1.8	0.8
Terrace C-5		1934		Cotton	139 lbs.	29.8	1.2	2.6	2.1
	Area, 1.044 acres.	1935		Corn	17 bu.	45.9	7.6	6.3	0.8
	Length, 850 feet.	1936		Cotton	321 lbs.	40.5	8.5	4.6	0.5
	Vertical interval, 3 feet.	1937	Oats	Oats	35 bu.	29.5	1.8	0.6	0.3
	Grade, 3 inches per 100 feet.	1938		Cotton	350 lbs.	28.9	3.5	1.9	0.5
	Land slope, 5.4 percent.	1939		Corn	20 bu.	22.2	0.1	0.0	0.3
	Soil, 40% Houston Black clay,	1940		Cotton	408 lbs.	40.9	7.8	3.1	0.4
	60% Austin clay.	1941	Oats	Oats	26 bu.	40.6	6.1	1.4	0.2
	Cropping practice cotton, corn, cotton, oats.	1942		Cotton	494 lbs.	35.9	4.1	2.1	0.5
		1943		Corn	17 bu.	25.3	1.0	0.6	0.7
		1944		Cotton	258 lbs.	47.9	11.2	10.9	1.0
		1945	Oats	Oats	20 bu.	37.8	7.2	1.1	0.1
		1946		Cotton	154 lbs.	42.5	6.0	2.4	0.4
		16-year average				34.4	4.3	2.5	0.6
		1947		Hubam		25.0	4.3	2.5	0.6
		1948				16.9	4.2	2.4	0.6
		2-year average				20.9	4.3	2.5	0.6
		1931		Corn	19 bu.	24.7	(4)	0.0	
		1932		Cotton	259 lbs.	33.2	1.5	0.7	0.0
		1933	Oats	Oats	6 bu.	25.3	2.3	1.9	0.8
		1934		Cotton	128 lbs.	29.7	1.4	2.9	2.1
Terrace C-6		1935		Corn	21 bu.	45.9	7.7	7.7	1.0
	Area, 1.473 acres.	1936		Cotton	383 lbs.	40.5	8.6	5.6	0.7
	Length, 844 feet.	1937	Oats	Oats	37 bu.	29.5	1.1	1.2	1.1
	Vertical interval, 4 feet.	1938		Cotton	274 lbs.	28.9	3.4	3.7	1.1
	Grade, 3 inches per 100 feet.	1939		Corn	27 bu.	22.2	0.1	0.0	0.3
	Land slope, 5.4 percent.	1940		Cotton	395 lbs.	40.9	7.1	3.5	0.5
	Soil, 30% Houston Black clay,	1941	Oats	Oats	35 bu.	40.6	4.5	1.0	0.2
	70% Austin clay.	1942		Cotton	339 lbs.	35.9	2.8	1.7	0.6
		1943		Corn	21 bu.	25.3	0.6	1.1	1.8
		1944		Cotton	237 lbs.	47.9	10.2	11.4	1.1
		1945	Oats	Oats	19 bu.	37.8	7.2	1.3	0.2
		1946		Cotton	154 lbs.	42.5	4.7	2.7	0.6
		16-year average				34.4	3.9	2.9	0.7
		1947		Hubam		25.0	3.7	2.0	0.5
		1948		Hubam		16.9	1.6	0.7	0.4
		2-year average				20.9	2.6	1.3	0.5
		1931		Corn	18 bu.	24.7	0.1	0.2	1.5
		1932		Cotton	468 lbs.	33.3	1.8	2.0	1.1
		1933	Oats	Oats	6 bu.	25.3	1.9	2.3	1.2
Terrace C-7		1934		Cotton	155 lbs.	29.7	1.4	3.0	2.2
	Area, 1.831 acres.	1935		Corn	21 bu.	46.0	9.7	11.5	1.2
	Length, 828 feet.	1936		Cotton	320 lbs.	40.6	9.1	10.0	1.1
	Vertical interval, 5 feet.	1937	Oats	Oats	42 bu.	29.5	0.7	1.4	2.1
	Grade, 3 inches per 100 feet.	1938		Cotton	323 lbs.	28.8	5.3	6.3	1.2
	Land slope, 5.4 percent.	1939		Corn	28 bu.	22.2	0.2	0.1	0.3
	Soil, 41% Houston Black clay,	1940		Cotton	381 lbs.	40.9	5.9	4.3	0.7
	59% Austin clay.	1941	Oats	Oats	38 bu.	40.6	4.1	1.3	0.3
	Cropping practice cotton, corn, cotton, oats.	1942		Cotton	399 lbs.	35.9	3.8	3.6	1.0
		1943		Corn	19 bu.	25.3	0.9	1.7	2.0
		1944		Cotton	279 lbs.	47.9	10.1	17.9	1.8
		1945	Oats	Oats	23 bu.	37.8	5.8	1.2	0.2
		1946		Cotton	154 lbs.	42.5	4.0	2.8	0.7
		16-year average				34.4	4.1	4.4	1.1
		1947		Hubam		25.0	3.2	2.2	0.7
		1948		Oats		16.9	0.9	0.2	0.2
		2-year average				20.9	2.1	1.2	0.6

Table 17. Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experim Station, Temple, Texas, 1931-51 (Continued)

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches — —		— — — Tons — —	
Terrace C-13		1932		Cotton	153 lbs.	33.6	2.1	1.0	0.5
	Area, 3.937 acres.	1933	Oats	Oats	6 bu.	25.5	2.3	1.9	0.8
	Length, 1,930 feet.	1934		Cotton	176 lbs.	29.6	2.6	2.5	1.0
	Vertical interval, 3.9 feet.	1935		Corn	18 bu.	46.4	9.1	6.5	0.7
	Grade, 0-3 inches per 100 feet, variable.	1936		Cotton	404 lbs.	40.8	8.8	2.4	0.3
	Land slope, 4.4 percent.	1937	Oats	Oats	34 bu.	29.2	1.6	0.5	0.3
	Soil, 51% Houston Black clay,	1938		Cotton	254 lbs.	28.3	3.0	1.8	0.6
	49% Austin clay.	1939		Corn	28 bu.	22.7	0.0	0.0	0.2
	Cropping practice cotton, corn, cotton, oats.	8-year average				32.0	3.7	2.1	0.7
		1940	Oats	Oats	22 bu.				
				Cotton	403 lbs.	42.3	6.5	1.1	0.2
		1941	Oats	Oats	11 bu.				
	Cropping practice cotton, corn rotated.			Corn	27	40.9	6.4	1.3	0.2
	Oat strip permanent.	1942	Oats	Oats	9				
				Cotton	589 lbs.	36.8	3.3	0.4	0.0
		1943	Oats	Oats	12 bu.				
				Corn	21	25.2	0.2	0.0	0.0
		1944	Oats	Oats	5 bu.				
				Cotton	295 lbs.	48.5	9.3	4.0	0.4
		5-year average				38.7	5.1	1.4	0.3
		1945		Corn	14 bu.	38.3	7.2	0.8	0.1
	Cropping practice corn, clover, cotton,	1946		Clover	267 lbs.	41.8	1.1	0.1	0.1
	oat-clover.	1947		Cotton	374	25.7	1.6	0.6	0.4
		1948		Oats-Clover		16.9	0.5	0.2	0.3
		4-year average				30.7	2.6	0.4	0.2
Terrace C-14		1932		Cotton	198 lbs.	33.6	2.0	1.5	0.7
	Area, 4.047 acres.	1933	Oats	Oats	9 bu.	25.5	2.5	2.1	0.8
	Length, 1,875 feet.	1934		Cotton	211 lbs.	29.6	0.7	0.6	0.8
	Vertical interval, 3.4 feet.	1935		Corn	19 bu.	46.4	11.3	9.8	0.9
	Grade, 3 inches per 100 feet.	1936		Cotton	232 lbs.	40.8	7.1	4.7	0.7
	Land slope, 4.1 percent.	1937	Oats	Oats	32 bu.	29.2	1.2	0.7	0.6
	Soil, 64% Houston Black clay,	1938		Cotton	270 lbs.	28.3	4.9	2.8	0.6
	36% Austin clay.	1939		Corn	29 bu.	22.7	0.1	0.0	0.1
	Cropping practice cotton, corn, cotton, oats.	8-year average				32.0	3.7	2.8	0.7
		1940		Cotton	282 lbs.	42.3	8.2	2.2	0.3
		1941		Corn	21 bu.	40.9	9.7	3.0	0.3
	Cropping practice cotton, corn.	1942		Cotton	410 lbs.	36.8	3.7	0.9	0.3
		1943		Corn	18 bu.	25.2	0.3	0.1	0.5
		1944		Cotton	242 lbs.	48.5	13.3	9.7	0.7
		5-year average				38.7	7.0	3.2	0.5
		1945		Cotton	413 lbs.	38.3	8.7	2.3	0.3
	Cropping practice cotton, oats, corn, clover.	1946	Oats	Oats	33 bu.	41.8	3.6	0.8	0.2
		1947		Corn		25.7	2.6	1.0	0.4
		1948		Clover		16.9	0.0	0.0	1.1
		4-year average				30.7	3.7	1.0	0.3
Terrace C-15		1932		Cotton	165 lbs.	33.6	1.4	0.8	0.6
	Area, 3.443 acres.	1933	Oats	Oats	9 bu.	25.5	2.0	1.5	0.8
	Length, 1,856 feet.	1934		Cotton	179 lbs.	29.6	1.9	1.9	1.0
	Vertical interval, 2.8 feet.	1935		Corn	23 bu.	46.4	10.0	7.6	0.8
	Grade, 4 inches per 100 feet.	1936		Cotton	298 lbs.	40.8	9.4	5.4	0.6
	Land slope, 3.6 percent.	1937	Oats	Oats	38 bu.	29.2	2.0	0.6	0.3
	Soil, 85% Houston Black clay,	1938		Cotton	362 lbs.	28.3	4.5	2.4	0.5
	15% Austin clay.	1939		Corn	35 bu.	22.7	0.1	0.0	0.1
	Cropping practice cotton, corn, cotton, oats.	8-year average				32.0	3.9	2.5	0.6
		1940		Cotton	359 lbs.	42.3	7.6	2.2	0.3
		1941		Corn	25 bu.	40.9	9.2	2.7	0.3
	Cropping practice cotton, corn.	1942		Cotton	567 lbs.	36.8	3.2	0.6	0.2
		1943		Corn	20 bu.	25.2	0.3	0.1	0.4
		1944		Cotton	285 lbs.	48.5	12.0	7.8	0.7
		5-year average				38.7	6.4	2.7	0.4
		1945		Cotton	413 lbs.	38.3	8.7	2.3	0.3
	Cropping practice cotton, oats, corn, clover.	1946		Oats	33 bu.	41.8	3.6	0.8	0.2
		1947		Corn		25.7	2.6	1.0	1.4
		1948		Clover		16.9	0.0	0.0	1.1
		4-year average				30.7	3.7	1.0	0.3
Terrace C-16		1932		Cotton	244 lbs.	33.7	1.6	0.2	0.1
	Area, 3.960 acres.	1933	Oats	Oats	12 bu.	25.5	2.0	1.6	0.8
	Length, 1,870 feet.	1934		Cotton	271 lbs.	29.5	1.7	1.7	1.0
	Vertical interval, 2.8 feet.	1935		Corn	26 bu.	46.5	8.7	6.7	0.8
	Grade, 5 inches per 100 feet.	1936		Cotton	188 lbs.	40.8	8.6	4.2	0.5
	Land slope, 3.1 percent.	1937	Oats	Oats	39 bu.	29.2	1.6	0.4	0.3
	Soil, 92% Houston Black clay,	1938		Cotton	355 lbs.	28.3	4.5	3.1	0.7
	8% Austin clay.	1939		Corn	31 bu.	22.7	0.2	0.1	0.5
	Cropping practice cotton, corn, cotton, oats.	8-year average				32.0	3.6	2.2	0.6
		1940	Oats	Oats	28 bu.				
				Cotton	383 lbs.	42.3	7.9	0.9	0.1
		1941	Oats	Oats	38 bu.				
				Corn	30	40.9	6.4	1.4	0.2
	Cropping practice cotton, corn rotated.	1942	Oats	Oats	22				
	Permanent oat strip.			Cotton	587 lbs.	36.8	2.5	0.2	0.1
		1943	Oats	Oats	22 bu.				
				Corn	18	25.2	0.3	0.1	0.2
		1944	Oats	Oats	14				
				Cotton	294 lbs.	48.5	8.7	2.9	0.3
		5-year average				38.7	5.2	1.1	0.2

Table 17. **Annual summary of rainfall, runoff and soil loss for all areas under measurement at the Blackland Experiment Station, Temple, Texas, 1931-51 (Continued)**

Plot or watershed	Plot or watershed characteristics and treatments	Year	Winter cover	Crop harvested	Yield of crop per acre	Rain-fall	Depth of runoff	Soil loss per acre	Soil loss per acre inch of runoff
					Bu. or lbs.	— — Inches — —		— — — Tons — — —	
		1945	Oats	Oats	21 bu.	38.3	6.2	0.6	0.1
		1946		Corn	31	41.8	2.2	0.4	0.2
	Cropping practice oats, corn, clover, cotton.	1947		Clover		25.7	2.4	0.6	0.2
		1948		Cotton		16.9	1.4	0.8	0.6
		4-year average				30.7	3.0	0.6	0.2
Terrace C-17		1932		Cotton	339 lbs.	33.8	1.5	1.6	1.1
	Area, 3.778 acres.	1933	Oats	Oats	12 bu.	25.3	1.5	1.0	0.7
	Length, 1,890 feet.	1934		Cotton	352 lbs.	29.6	1.7	1.2	0.7
	Vertical interval, 2.9 feet.	1935		Corn	30 bu.	46.2	11.9	6.9	0.6
	Grade, 0-5 inches per 100 feet, variable.	1936		Cotton	465 lbs.	40.8	6.7	4.2	0.6
	Land slope, 3.2 percent.	1937	Oats	Oats	54 bu.	29.3	1.2	0.3	0.3
	Soil, 96% Houston Black clay,	1938		Cotton	306 lbs.	28.5	3.9	2.4	0.6
	4% Austin clay.	1939		Corn	40 bu.	19.4	0.0	(8)	0.6
	Cropping practice cotton, corn, cotton, oats.	7.8-year average				32.4	3.6	2.3	0.6

Table 18. **Individual storm data for all storms causing runoff on Plot 3 (continuous corn) shown in comparison with Plot 6 (ungrazed Bermudagrass)**

Date of all rains causing runoff	Rain-fall	Intensities: 5-minute period	15-minute period	30-minute period	Condition of corn	Condition of soil	Water and soil loss: Plot 3 Depth of runoff	Plot 3 Soil loss per acre	Plot 6 Depth of runoff	Plot 6 Soil loss per acre
	Inches	— — — Inches per hr. — — —					Inches	Tons	Inches	Tons
1942										
Apr. 7-8	2.55	2.40	1.68	1.14	3"-4"	Wet, packed	0.532	1.35	0.042	0.01
Apr. 19-20	0.73	2.52	0.92	0.52	5"	Moist, crusted	0.063	0.13		
Apr. 23-25	2.23	2.76	1.52	0.96	5"-6"	Wet, packed	0.903	1.39		
Apr. 25	0.05	0.60			5"-6"	Wet, packed	0.009	0.01		
May 7-8	1.67	1.80	1.60	1.48	8"-10"	Loose cult.	0.054	0.06		
May 11	1.19	4.32	1.84	0.96	8"-10"	Wet	0.237	0.54		
May 18-19	3.16	3.24	2.64	2.24	12"-14"	Moist, packed	2.007	11.29	0.043	T
May 23	0.29	0.36	0.24	0.24	12"-14"	Moist, packed				
June 6	1.21	3.12	2.00	1.90	24"-36"	Wet	0.551	2.28	0.031	T
June 10-11	1.07	1.08	0.88	0.82	24"-36"	Wet	0.178	0.24	0.008	T
Aug. 16	1.57	6.00	4.28	2.70	Harvested	Moist	0.185	0.19	0.011	0.01
Aug. 19	0.62	3.24	2.16	1.22	Harvested	Wet, sl. packed	0.237	0.46	0.002	T
Aug. 30	0.65	2.64	1.60	0.86	Harvested	Wet	0.135	0.29		
Sept. 7-8	5.65	3.60	2.68	2.18	Harvested	Wet, packed	3.105	3.63	0.004	T
Sept. 8-9	0.52				Harvested	Wet, packed	0.160	0.10		
Sept. 20	0.47	1.68	0.80	0.58	Harvested	Moist	0.042	0.03		
Oct. 3-4	0.96	0.24	0.24	0.22	Harvested					
Total yearly	24.05						8.398	21.99	0.141	0.02
1943										
Mar. 19	0.55	3.48	2.04	1.10	Not up	Dry, loose, flat				
Mar. 24	2.38	3.84	2.68	2.32	Not up	Flat, moist	1.238	2.93		
Apr. 8	1.51	2.40	1.36	1.08	2"-3"	Moist, packed	0.263	0.35	0.001	T
May 10	0.44	2.16	1.08	0.56	4"-22"	Moist	0.026	0.03		
May 29-30	1.62	1.92	0.96	0.70	2'-5'	Dry, loose	0.107	0.06	0.002	T
July 10-11-12	3.29	3.60	2.88	1.80	6'	Dry, cracked	0.442	0.91	0.006	T
July 26	0.51	1.92	1.60	1.02	Ripening	Moist, flat	0.065	0.15	0.003	T
July 29	1.65	1.08	0.88	0.86	Ripening	Wet, flat	0.026	0.02	0.017	T
Oct. 12-13	1.15	1.32	1.24	1.22	Open	Moist, flat	0.073	0.04	0.010	T
1944										
Feb. 8	1.43	2.76	2.12	1.48	Open in beds	Wet	0.124	0.14	0.019	0.01
Feb. 13	0.78	1.68	1.24	0.88	Open in beds	Wet	0.141	0.20		
Feb. 25-26-28	2.09	4.08	1.96	0.96	Open in beds	Saturated	0.693	1.43	0.013	0.01
Mar. 16	1.42	3.60	2.12	1.30	Open in beds	Wet	0.309	0.61	0.006	T
Mar. 18-19	0.40	2.16	0.96	0.50	Open in beds	Wet	0.059	0.04	0.002	T
Mar. 21-22	1.21	1.80	1.68	1.08	Open in beds	Wet	0.446	0.86	0.013	T
Apr. 29-30	3.72	3.00	2.08	1.40	5"-7"	Dry	0.862	1.48	0.003	T
May 1-2	3.55	6.00	3.60	3.10	5"-7"	Wet	1.612	13.26	0.457	0.06
May 4	0.87	0.48	0.38	0.36	5"-7"	Wet	0.122	0.03	0.003	T
May 8-9	1.38	3.24	2.32	1.60	6"-9"	Wet	0.650	0.90	0.007	T
May 21-22	1.68	1.92	1.64	1.20	14"-16"	Moist	0.229	0.24	0.005	T
May 25	1.02	2.04	0.92	0.66	16"-18"	Wet	0.056	0.04		
May 27	1.02	5.28	3.04	1.72	2'	Saturated	0.491	0.82	0.001	T
May 29	0.92	3.12	1.56	0.90	2'	Saturated	0.414	0.52	0.001	T
June 5-6	2.75	2.88	2.80	2.30	3'	Wet, loose	1.041	2.52	0.004	T
June 7	0.68	5.52	2.60		3'-4'	Wet, packed	0.450	1.39		
June 11	0.28	1.68	1.00		3'-4'	Wet	0.010	0.02		
Sept. 5-6	1.73	2.40	1.64	1.08	Open, flat	Moist	0.039	0.05	0.008	T
Sept. 26-27	1.58	2.88	1.52	0.92	Open, flat	Sl. wet	0.140	0.18	0.010	T
Dec. 4-5	2.47	1.92	1.84	1.30	Open, cloddy	Wet	0.017	0.02		
Total yearly	30.98						7.905	24.75	0.552	0.08
1945										
Jan. 18-17	2.63	1.08	0.76	0.54	Open in beds	Loose, sl. wet	0.006	T	0.002	T
Feb. 11-12	2.97	2.04	1.52	1.12	Open in beds	Loose, sl. wet	0.758	0.76	0.002	T
Feb. 18-19-20-21	1.27	3.84	1.52	0.80	Open in beds	Wet, packed	0.136	0.22	0.002	T
Mar. 1-2-3	0.93	1.80	1.32	0.74	Open in beds	Saturated	0.245	0.24		
Mar. 3	0.21	1.32	0.48	0.28	Open in beds	Saturated	0.096	0.11		
Mar. 6	0.14	0.48	0.32	0.20	Open in beds	Saturated	0.009	0.01		
Mar. 14	0.42	1.32	0.96	0.68	Planted	Moist, loose	0.001	T		
Mar. 31-Apr. 1	1.39	1.44	0.92	0.92	3"-4"	Moist, flat	0.021	0.04		
Apr. 20-21	5.70	4.32	2.92	2.78	4"-6"	Moist, loose	1.251	2.81	0.704	0.04
May 15	0.85	5.40	2.76	1.42	12"-18"	Moist, loose	0.258	2.11	0.004	T
May 21	0.87	2.04	1.60	1.38	18"-22"	Moist, packed	0.233	0.28		
June 12	1.65	1.56	1.40	1.24	4'-5'	Moist	0.335	0.21		
June 17-18	1.51	3.12	2.16	1.32	5'-6'	Wet, packed	0.399	0.36		
Sept. 28-29-30	1.62	3.96	2.32	1.44	Harvested, cut	Dry, cracked	0.145	0.25		
Oct. 8-9-10	1.64	1.92	1.46	0.88	Open	Wet	0.225	0.08		
Total yearly	23.80						4.118	7.48	0.714	0.04

Table 18. Individual storm data for all storms causing runoff on Plot 3 (continuous corn) shown in comparison with Pl (ungrazed Bermudagrass) (Continued)

Date of all rains causing runoff	Rain-fall	Intensities: 5-minute period	Intensities: 15-minute period	Intensities: 30-minute period	Condition of corn	Condition of soil	Water and soil loss, Plot 3: Depth of runoff	Plot 3: Soil loss per acre	Plot 6: Depth of runoff	Plot 6: Soil loss per acre
	Inches	Inches per hr.	Inches per hr.	Inches per hr.			Inches	Tons	Inches	Tons
1946										
Jan. 4	1.06	5.04	2.80	1.56	Open in beds	Moist	0.183	0.15		
Jan. 7-8	0.72	0.60	0.44	0.32	Open in beds	Wet	0.118	0.01		
Jan. 10-11	0.65	0.36	0.28	0.24	Open in beds	Saturated	0.172	0.02		
Jan. 14-15	1.35	0.60	0.40	0.32	Open in beds	Saturated	0.331	0.02		
Feb. 9	0.98	3.00	1.12	0.66	Open in beds	Wet, packed	0.108	0.11		
Feb. 17-18	1.50	3.12	2.00	1.20	Open in beds	Wet, packed	0.299	0.43	0.009	T
Mar. 12-13	2.07	1.08	0.64	0.65	Planted	Moist, loose	0.017	0.12	0.019	0.01
Mar. 25	0.81	1.68	0.88	0.58	——	——	T	T	0.005	T
Mar. 26	0.33	1.08	0.56	0.36	Up	Moist, packed	0.004	T	0.003	T
Apr. 22-23	2.93	2.88	2.00	1.46	8"-10"	Moist, loose	0.155	0.19	0.015	T
Apr. 29-30	1.09	2.64	1.60	1.20	10"-12"	Moist, loose	0.182	1.27	0.003	T
May 3	0.42	2.16	1.08	0.62	10"-12"	Wet, packed	0.053	0.12	0.002	T
May 10	0.98	2.16	1.60	1.04	12"-18"	Moist, loose	0.046	0.12	0.004	T
May 12-13	1.16	1.20	0.56	0.48	2'-3'	Wet, packed	0.262	0.24	0.001	T
May 15	1.99	7.44	6.08	3.40	2'-3'	Saturated	1.368	6.03	0.096	0.02
May 15-16	0.92	2.28	1.60	1.54	2'-3'	Saturated	0.586	0.76	0.005	T
May 24-25	0.43	1.68	1.20	0.68	3'-4'	Saturated	0.007	0.01		
May 29	1.04	3.60	1.80	1.22	4'-5'	Moist, packed	0.318	1.07		
May 31	1.36	3.60	3.16	1.92	4'-5'	Wet	0.821	5.68	0.010	T
June 20	0.79	1.32	0.84	0.56	5'-6'	Moist	0.079	0.11		
Sept. 12-13-14	2.73	3.00	2.16	1.64	Open	Moist, cloddy	0.252	0.09	0.004	T
Nov. 1-2-3	1.88	3.36	2.56	1.88	Open	Loose	0.479	0.20	0.006	T
Nov. 5-6	0.35	1.08	0.60	0.32	Open	Wet	0.054	0.03		
Nov. 15-16	2.68	4.32	3.60	2.90	Open	Wet	1.421	2.78	0.001	T
Nov. 25-26	0.88	3.84	2.00	1.00	Open	Wet	0.346	0.44		
Dec. 9-10-11	2.60	2.28	1.08	0.74	Open	Wet	0.856	0.48	T	T
Total yearly	45.84						8.517	20.38	0.183	0.03
1947										
Jan. 16-17-18-19	2.57	0.48	0.40	0.32	Open, flat	Wet	0.260	0.02		
Mar. 12	0.93	1.68	1.12	0.88	Planted	Moist, loose	0.062	0.01	0.004	T
Mar. 18	1.40	0.96	0.64	0.52	Planted	Wet	0.120	0.04	0.003	T
Apr. 12-14	1.68	3.60	2.56	1.48	2"-3"	Moist, loose	0.425	0.30	0.011	T
Apr. 19	1.68	7.20	4.40	3.24	2"-3"	Wet, packed	1.322	4.87		
Apr. 24-25	0.73	1.44	0.88	0.50	6"-8"	Wet, packed	0.055	0.11		
May 8-9	1.25	1.20	0.76	0.50	8"-10"	Loose, dry	0.006	0.01		
May 17-18	1.48	6.00	4.08	2.46	14"-16"	Wet, packed	0.737	2.05	0.002	T
May 20	1.35	4.80	4.00	2.66	14"-16"	Wet, packed	1.062	4.28		
Total yearly	27.23						4.049	11.69	0.020	T
1948										
Apr. 12-13	1.27	2.04	1.20	1.20	3"-5"	Dry	0.107	0.06		
May 18	1.33	2.40	2.00	1.60	3"-4"	Moist, loose	0.615	0.73		
June 28	3.20	3.60	2.56	2.48	6"-7"	Dry, cracked	0.989	1.92	0.012	T
July 2-3	1.00	2.16	1.28	0.96	6"-7"	Wet, packed	0.526	0.33	0.009	T
Total yearly	18.98						2.237	3.04	0.021	T
1949										
Mar. 20-21	2.11	3.24	2.84	2.10	Planted	Dry, loose	0.650	0.85		
Apr. 9	0.51	3.00	1.64	0.98	2"-4"	Wet, packed	0.161	0.60		
Apr. 19-20	0.98	0.48	0.28	0.18	4"-6"	Wet, packed	0.099	0.04		
Apr. 24-25	2.61	4.56	3.24	2.12	4"-6"	Wet, packed	1.136	1.80		
Apr. 28	1.39	4.08	2.76	1.44	4"-6"	Saturated	0.874	1.78	0.002	T
June 14 a.m.	1.32	3.60	3.24	2.50	5'-6'	Dry, cracked	0.431	0.41		
June 14 p.m.	1.21	3.34	2.72	2.04	5'-6'	Wet	0.795	1.43		
June 22-23	1.72	3.96	3.05	2.52	5'-6'	Moist	1.018	2.84	0.005	T
June 24-25-26	0.73	1.08	0.60	0.32	5'-6'	Wet	0.072	0.06		
July 3	0.53	2.52	1.68	0.98	5'-6'	Moist	0.152	0.20		
July 31	1.23	3.00	1.76	1.26	Matured	Moist	0.205	0.18		
Oct. 21-22-24	4.15	3.12	2.00	2.00	Open	Dry, cracked	0.727	0.21		
Total yearly	32.26						6.320	10.39	0.007	T
1950										
Feb. 9-10-11-12	2.87	4.44	3.32	2.06	Open, flat	Saturated	0.351	0.26	0.002	T
Apr. 2	0.79	3.00	2.40	1.58		Dry, loose	0.109	0.11		
Apr. 13	1.16	1.08	0.76	0.58		Dry, loose	0.185	0.05		
Apr. 15-16-17	2.55	4.56	2.40	1.66		Wet	1.158	0.68	0.003	T
May 11	0.72	2.88	2.00	1.06	8"-12"	Moist	0.121	0.19		
May 13	1.14	4.80	3.84	2.08	8"-12"	Wet	0.644	0.77	0.006	T
Sept. 10	1.56	6.00	4.00	2.44	Open	Dry, cracked	0.493	0.33		
Sept. 16	0.66	1.80	1.08	0.60	Open	Moist	0.045	0.03		
Total yearly	22.41						3.106	2.42	0.011	T
1951										
Apr. 29	1.72	2.40	1.76	1.44	8"-10"	Dry	0.288	0.17		
May 3	0.93	5.28	3.60	1.86	12"-14"	Moist	0.498	0.66		
May 5-6	1.21	2.40	2.32	1.44	12"-14"	Wet, packed	0.493	0.91		
May 10	0.61	2.04	1.28	1.06	12"-14"	Wet, packed	0.216	0.49		
May 14-15	1.89	2.88	1.92	1.50	14"-18"	Wet	0.955	0.91		
May 22	0.80	4.56	2.48	1.38	2'-3'	Moist	0.010	0.02		
May 24-25	1.25	1.92	1.60	1.28	2'-3'	Wet	0.252	0.15		
June 11	1.16	3.12	1.44	1.16	5'-6'	Dry	0.209	0.18		
Sept. 12-13	3.74	4.20	3.60	3.30	Harvested	Dry	1.137	0.50		
Sept. 25	1.33	4.56	2.80	1.98	Harvested	Moist	0.350	0.17		
Total yearly	27.74						4.408	4.16		